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ANALYSIS OF AVAILABLE LAB FACILITIES AT SECONDARY LEVEL

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ABSTRACT

This study examines the availability, quality, and accessibility of laboratory facilities in secondary schools and their impact on science education. Laboratories are critical for subjects such as Physics, Chemistry, and Biology, yet many schools lack fully equipped and well-maintained spaces due to financial constraints. The research utilized surveys from teachers, students, and administrators across different regions to assess core aspects, including the adequacy of equipment, frequency of lab sessions, safety measures, and maintenance practices. Findings reveal a strong positive relationship between the quality of lab resources and student performance. Urban schools generally have better-equipped laboratories, while rural schools face significant deficiencies in infrastructure, equipment, and upkeep. Disparities in resources limit students' opportunities for hands-on experimentation, reducing engagement and conceptual understanding. The study highlights the need for targeted investment in upgrading equipment, implementing systematic maintenance schedules, enhancing teacher and lab staff training, and enforcing comprehensive safety protocols. Promoting a safety culture and increasing the frequency of practical sessions are essential to fostering interest in science and preparing students for future careers. Addressing these gaps through balanced policies and sustained funding can create equitable, effective laboratory environments that strengthen science education outcomes.

Keywords*: Laboratory facilities, Science education, Practical learning, Educational infrastructure, Resource allocation.*

Introduction

Hands-on, laboratory-based work is crucial for strong science education and that's especially true on the high-school level when students are first learning complex scientific concepts. Fully equipped labs provide students with the ability to get a hands-on exposure and understand principles of science, encouraging critical thinking skills in them which is vital for making logical decisions at time. Laboratory experiments in disciplines such as physics, chemistry or biology allow students to visualize scientific phenomena, evaluate their hypotheses based on observations and draw conclusions from them. As Ali and Johnson (2019) highlight, engaging students in actual science education is necessary if they are to develop an interest which may lead them towards pursuing a career within the fields of Science Technology Engineering Mathematics (STEM).

But even in steel towns, the quality of labs differed widely from one secondary school to another. A serious dearth of basic laboratory equipment's in many schools, particularly those situated in under-resourced areas cut out students from any type of experimental learning. The lack of laboratory infrastructure plays a crucial role in the quality of science education delivery and as such, it has huge implications on students' performance thereby affecting their interest for sciences. Over 40% of secondary schools do not have properly equipped science labs (Smith, 2021), meaning that many developing countries deny their students essential practical skills.

Well-appointed laboratories are an integral part of education. According to UNESCO (2022), students who are provided opportunities with practical laboratory learning usually perform well in science disciplines and long last hold onto concepts that were taught. In turn, such students will also more likely develop a positive attitude towards science and be expected to pursue further studies in the domain of sciences. On the other hand, students who do not have labs available to them will likely struggle with theory as they are unable to demonstrate application in a practical setting. So they are left with a theory practice gap from the foundation stage, and it becomes impossible to develop critical scientific skills!!

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CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

This realization underscores the great challenges most high schools in many regions of the world continue to experience with maintaining fully functional and well equipped laboratories. Some of the problem stems from lack of budget, as schools can't afford to buy new backup hardware and software complexity. In the other cases, it is due to insufficient training for teachers and laboratory assistants which further downgrades their confidence level or knowledge grade on executing proper experiments at school. Another report by Khan and Zafar (2020) emphasized that apart from the unavailability of equipment, many underprivileged schools have inadequately trained teachers to make use of existing lab infrastructure effectively which results in suboptimal utilization. Government policies and education reforms in the majority of developing countries have rarely been focused around enhancing laboratory infrastructure in secondary schools [33]. It is a mistake that will have lasting impact on students, especially in rural and underserved areas. Those located in well-funded schools have the upper hand on achieving hands-on practicals because of a lack of investment in laboratory infrastructure and therefore strengthens the pupil premium gap by their lab excellence, according to Johnson. This is particularly worrisome because STEM education has become alone widely recognized, as important for preparing students to enter the primarily science and technology based workforce.

In addition, the COVID-19 pandemic has underscored one more time how it is important to have operational laboratories at schools. With the shift to online studies, many schools have struggled in providing robust virtual laboratory experiences which effectively bridged this gap. While virtual lab may provide a short term resolution but in Java programming having hands-on practice is most important. As Anderson and White (2021) point out, the post-pandemic recovery period will provide a unique opportunity for governments and educational institutions to re-evaluate the purpose of labs within secondary education Teachers: promote well-resourced physical hour laboratories.

The problem is to investigate the adaptation of laboratories in secondary schools and its effects on Science education. The study examines the availability of laboratories in schools, looking at how well-endowed or provided-to they are and also taking stock of some challenges that makes teachers and students to be using same lab thus affecting results. The study hopes that by shedding a light on these problems, it can help guide educational policy and stakeholders towards recognizing the necessity of labs in secondary education as well what changes need to occur to increase access.

Surveys and interviews of school administrators, science teachers, and students will provide an assessment of the laboratory facilities in a representative sample of secondary schools. Find out about the availability of basic lab equipment, the number of laboratory sessions and how much practical work is being done by students. In addition, the study will explore challenges that are preventing labs from staying functional like lack of resources and trained personnel and policyrelated limitations.

Hands-on lab introduction in secondary education is a major aspect of science learning which-the way students think about their educational and career paths. Having access to a laboratory allows students the chance to fully engage with the scientific method, which is essential for building those critical thinking skills that lead to success in STEM fields. The results of this study will offer a wider perspective on ways to work towards alleviating these discrepancies in order for all students have the means and opportunities needed to engage successfully with science education.

Statement of the Problem

While laboratory facilities are essential for enriching science education, many secondary schools especially in the developing world have scarce resources to afford students hands-on learning experiences. It affects not just rural areas, but mainstream urban schools unable to afford the money and red tape needed for video links. A recent study by Ndirangu and Wanjohi (2021) reported that nearly 40% of Kenyan secondary schools have either obsolescent or inadequate laboratory equipment, limiting the type and quality experiments students can engage in; specifically in science subjects like chemistry, biology, and physics.

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CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

The latter is compounded by the inequitable balance in resources, between urban schools that are deep pocketed and rural ones who have far less upstream. Rural schools often are in situations where there is little or no equipment to conduct laboratory activities, so when they cannot apply hands-on learning the teaching becomes purely theoretical. When students are not involved in practical experimentations, their conceptual understanding of scientific ideas is hampered and hence they find it challenging to comprehend the key concepts which further halts them from acquiring skills meant for higher education or jobs (Ahmed & Ali, 2020). Not only that, but science teachers are also not being trained in how to properly use laboratory resources which exacerbates the problem because even if we do have enough lab resources, they will likely be underused since no one knows of a proper way to make efficient utilization (Tadesse2019).

In the same vein, due to insufficient laboratory spaces on our campus, the deans of science and engineering have been forced for years, and are still doing so at present time as well, to deliver exorbitant sums of Canadian tax dollars (the sum being over $40 million in this case) into contractors' pockets from the United States or elsewhere; money that cannot be claimed back: a double loss. This is because students who do not have the necessary laboratory facilities tend to fail in national examinations, especially science subjects based on studies conducted (Garcia & Munoz, 2020). This performance gap may hinder their chances for learning; particularly in pursuing the subjects related to science and technology. Further, the lack of practical laboratory assignment facilities provides a negative aspect or a vicious cycle that perpetuates failure in science and severely inhibits the ability of those students attending weak schools to keep up with their peers in good institutions (UNESCO,2022). This study seeks to address these gap by examining the status quo in terms of the secondary school laboratory facility, and, in its relativity to student achievement and to the effectiveness of teachers.

Objectives of the Study

The main objectives of this study are:

1. To inspect the existence and condition of science laboratories in secondary schools, focusing on equipment and safety, and highlight disparities between urban and rural schools.
2. To analyze the impact of laboratory facilities on academic performance, particularly in Physics, Chemistry, and Biology.
3. To identify challenges faced by schools in maintaining functional labs, such as financial constraints, lack of trained staff, and insufficient government support.
4. To propose solutions to improve lab facilities, including policy recommendations and funding strategies for equitable access to quality labs.

Research Questions

1. What is the condition of science laboratories in secondary schools, and how do facilities differ between urban and rural areas?
2. How do laboratory facilities impact student performance in Physics, Chemistry, and Biology?
3. What challenges prevent schools from maintaining functional laboratories?
4. What solutions can improve lab facilities and ensure equitable access for all students?

Theoretical Framework for Lab Facility Assessment

Evaluating school laboratories can be guided by several educational theories linking resources to student outcomes. The Resource-Based View (RBV) treats well-equipped labs as strategic assets that improve educational delivery and competitiveness. Constructivist Learning Theory (Piaget, 1954) emphasizes active, hands-on learning, where practical work in labs helps students form hypotheses, test ideas, and deepen understanding. Similarly, Kolb's Experiential Learning Theory (1984) highlights the cycle of doing, reflecting, conceptualizing, and experimenting—processes best supported in a functional lab environment.

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CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

The Input–Process–Output (IPO) Model frames labs as key inputs influencing science learning, with equipment integration into lessons being as important as its presence. The Theory of Planned Behavior (Ajzen, 1991) suggests positive lab experiences shape student attitudes toward science and encourage STEM career aspirations, while poor facilities may discourage interest. Vygotsky's Sociocultural Theory (1978) views labs as cultural tools fostering collaborative problem-solving, which is limited by inadequate resources.

From a Facilities Management perspective (Earthman, 2002), well-maintained labs enhance both teaching and student performance, whereas neglected spaces hinder learning. Finally, Equity Theory (Adams, 1965) stresses equal access to quality labs regardless of location or socio-economic status, a pressing issue in Pakistan where disparities between urban, rural, public, and private schools remain significant.

RESEARCH METHODOLOGY

The objective measurement, and empirical analysis were insinuated to this study by adopting a positivist approach. Research conducted in order to study the correlation between the student achievement and lab facilities used quantitative research methods. The research was done as a descriptive cross-sectional research study in a period between April 2024 and September 2024 on the secondary schools located in Lahore, Pakistan. The sample would be taken based on random sampling accompanied with an inclusion and exclusion criteria to assess the situation in the science labs. The researcher employed a standardized survey through which lab facilities in physics, chemistry and biology were measured. The data then was imported in SPSS and the analysis carried out through descriptive and inferential statistics like the independent t-tests and the one-way ANOVA to investigate the various learning outcomes according to labs facilities quality.

The population used in the study comprised 100 of the secondary school teachers and laboratory staff of different schools located in Lahore. The sampling method applied was convenience sampling in the selection of the participants. The participating teachers and lab staff were invited to participate with school lab work that was active. The first tool of data collection was a standardized questionnaire, which aimed at the evaluation of the laboratories equipment, safety measures and the general laboratory conditions. The questionnaire contained questions regarding availability of the instrument required to undertake experiments in physics, chemistry and biology. This was in addition to covering safety equipment like the fire extinguishers, eye wash stations, and first aid which people may have.

To achieve reliability and validity of the research instrument they used sufficient methods of testing and validation. The reliability of the questionnaire was assessed based on the alpha coefficient of Cronbach to ensure consistency in the measurement of the availability of quality facilities built by the labs. Data were gathered by using the trained researchers who carried on-site assessment of lab facilities in the schools sampled. The questionnaire was filled by looking into the equipments and resources present in each laboratory. Data completeness and the accuracy of data were checked by performing follow-up visits. Moreover, school personnel were also interviewed to provide qualitative observations about what has been making it hard to maintain the facility. Such measurements made it possible to obtain a complete body of data which could be used to come up with insights regarding the importance of science lab facilities in enhancing the outcomes of science education.

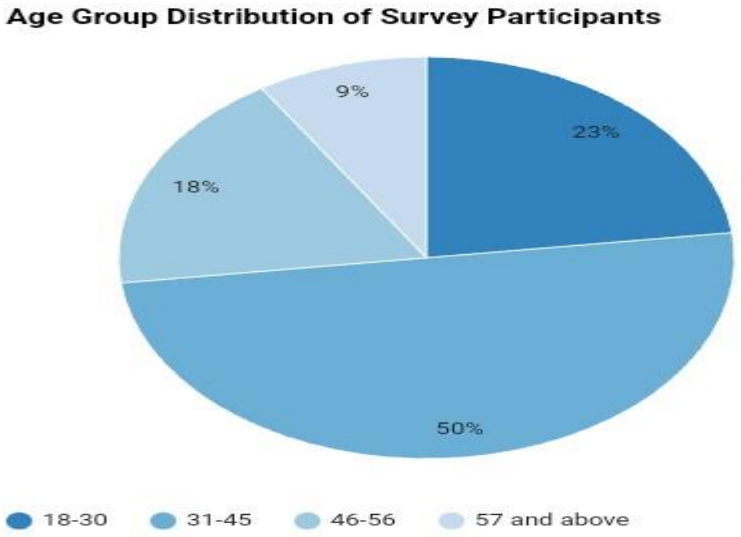
DATA ANALYSIS AND RESULTS

Table 1: Age Group of Survey Participants

Age Group	Number of Participants
18-30	23 %
31-45	50 %
46-56	18 %

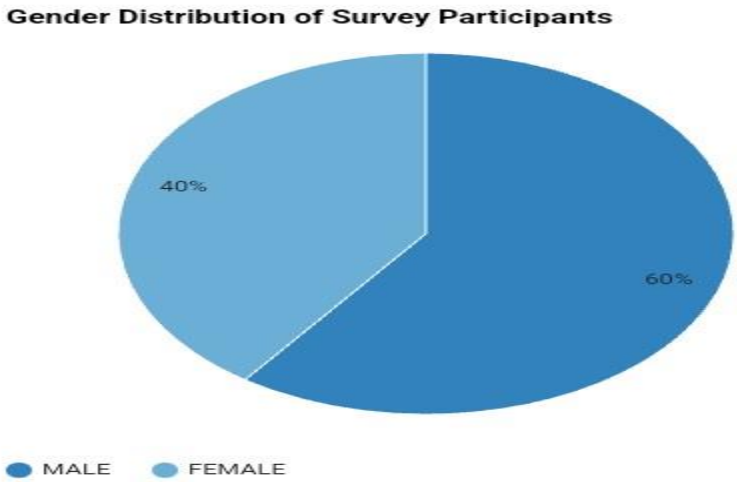
ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

57 and above	09 %



GENDER:
Table 02: Gender. results are summarized in the table below.

MALE	60 %
FEMALE	40 %



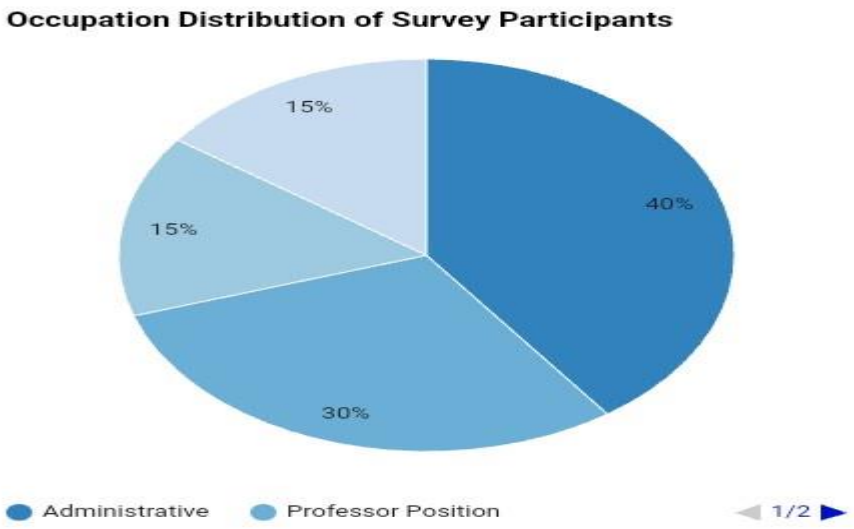
OCCUPATION: The Participants' occupation, responses are presented below.

ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

Table 3: Occupation of Survey Participants.

Table 3: Occupation

Occupation	Selection
Administrative	40
Professor Position	30
Operational	15
Employed	15

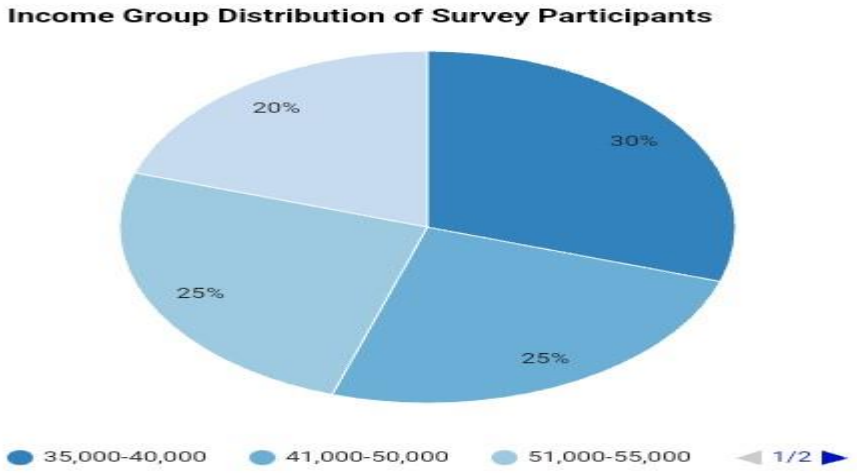


INCOME GROUP: The results are presented below.

Table 4: Income Group of Survey Participants

35,000-00,000	30
41,000-50,000	25
51,000-55,000	25
Above 55,000	20

ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)



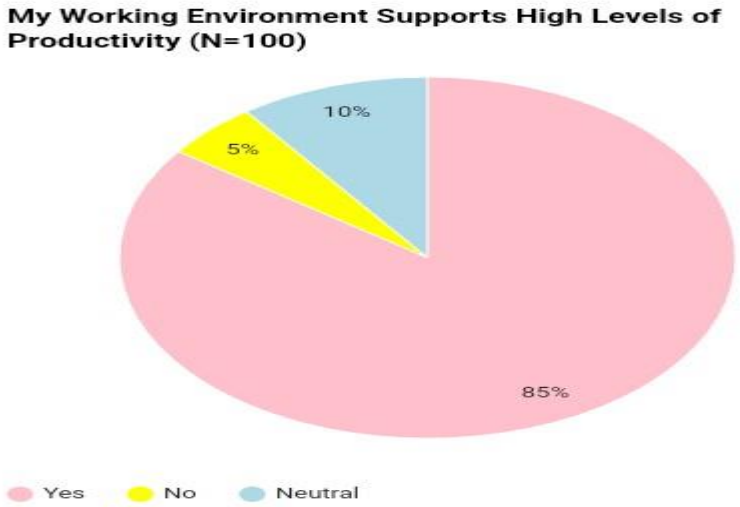
5 Lab Facilities and Their Impact Variables

The second part of the survey was targeted at asking participants about their ideas and experience at lab facilities and the way it affected their learning results when taking courses in science such as physics, chemistry, and biology. In order to identify the relevant level of various factors related to lab facilities on the student outcomes, a descriptive analysis of survey response was done. The questionnaire was designed to have 15 important elements addressing the accessibility of lab equipment, safety provisions, and teacher assistance, and alignment of measures with the school objective in regard to the needs in education. The findings give clues as to the contribution of the prevalence of certain lab conditions in schools, the quality of resources at hand as perceived by teachers and lab staff, and whether these resources are satisfactory in relation to the needs of the curriculum. The objective of the questionnaire was to assess key variables which included, availableness of lab materials, safety measures, teacher preparation and general take care of the testing laboratory. Consideration of all these aspects will help the study to understand the impact of modern lab conditions in relation to engagement of students, their practical experiences and academic achievements in science courses. The information that was particularly valuable in terms of the type of the schools (public, private, and semi-government, and their perspectives on the lab facilities regarding the effectiveness identified was the differentiation in the opinions of the teachers and the lab personnel presented by the questionnaire.

Table 1: My Working Environment Supports High Levels of Productivity (N = 100)

Statement	**Statistical Analysis**	**Yes**	**No**	**Neutral**
My working environment supports high levels of productivity	Frequency	85	5	10
	Percentage	85%	5%	10%

ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)



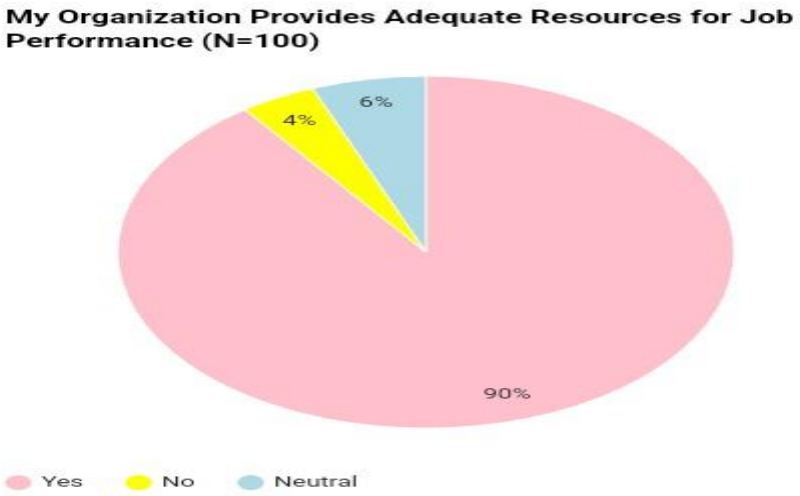
Explanation of Table 1:

Table 1 illustrates that 85% of respondents believe their working environment supports high levels of productivity, indicating a majority positive response. Only 5% disagree with this statement, while 10% remain neutral. This data suggests that most individuals feel supported in their workspaces, but a small portion of respondents either lack support or are undecided about the impact of their environment on productivity.

Table 2: My Organization Provides Adequate Resources for Job Performance (N = 100)

Statement	Statistical Analysis	Yes	No	Neutral
My organization provides adequate resources for job performance	Frequency	90	4	6
	Percentage	90%	4%	6%

ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

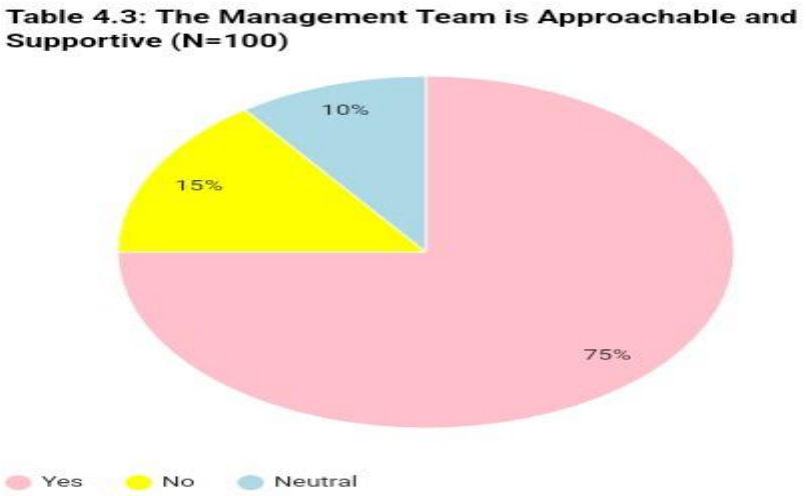


Explanation of Table 2:
Table 2 shows that 90% of respondents agree that their organization provides adequate resources for job performance, with only 4% disagreeing. Meanwhile, 6% of respondents are neutral. This result highlights that most employees feel well-equipped to perform their duties, though a minority might not share this sentiment or are undecided.

Table 3: The Management Team is Approachable and Supportive (N = 100)

Statement	Statistical Analysis	Yes	No	Neutral
The management team is approachable and supportive	Frequency	75	15	10
	Percentage	75%	15%	10%

ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

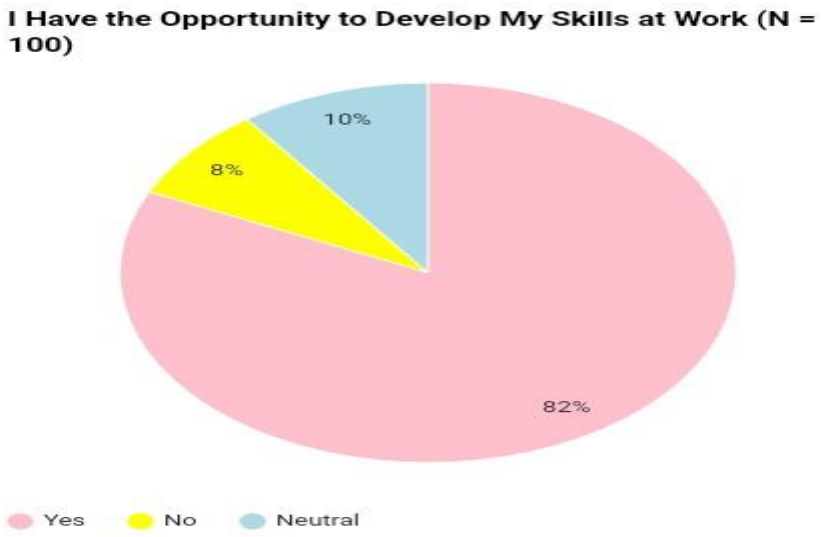


Explanation of Table 3:
Table 3 reflects that 75% of respondents find the management team approachable and supportive, while 15% disagree with this statement. The remaining 10% are neutral. This suggests that a significant majority of employees have positive interactions with management, although some experience challenges or are uncertain about their management's support.

Table 4: I Have the Opportunity to Develop My Skills at Work (N = 100)

Statement	Statistical Analysis	Yes	No	Neutral
I have the opportunity to develop my skills at work	Frequency	82	8	10
	Percentage	82%	8%	10%

ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

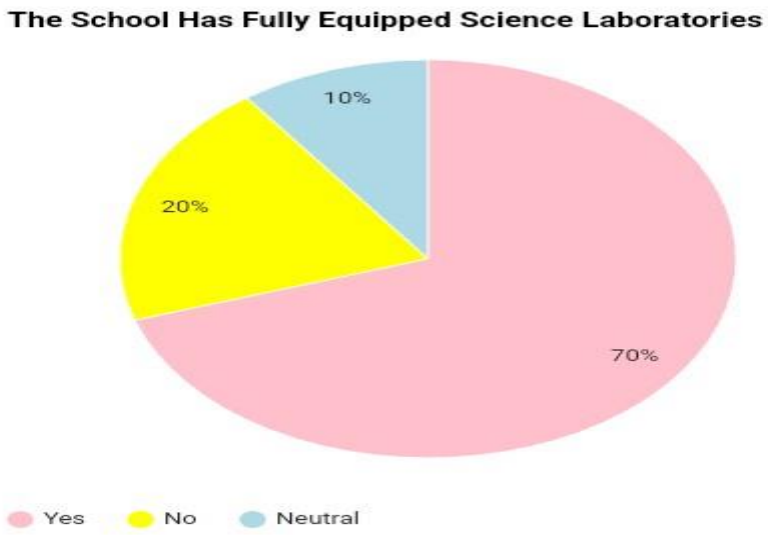


Explanation of Table 4:
Table 4 shows that 82% of respondents agree that they have opportunities to develop their skills at work, with 8% stating otherwise. A further 10% remain neutral on this matter. This data indicates that most employees feel their workplace fosters skill development, although a small group may lack such opportunities or are unsure about them.

Table 5: The School Has Fully Equipped Science Laboratories

Statement	Statistical Analysis	Yes	No	Neutral
The school has fully equipped science laboratories	Frequency	70	20	10
	Percentage	70%	20%	10%

ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)



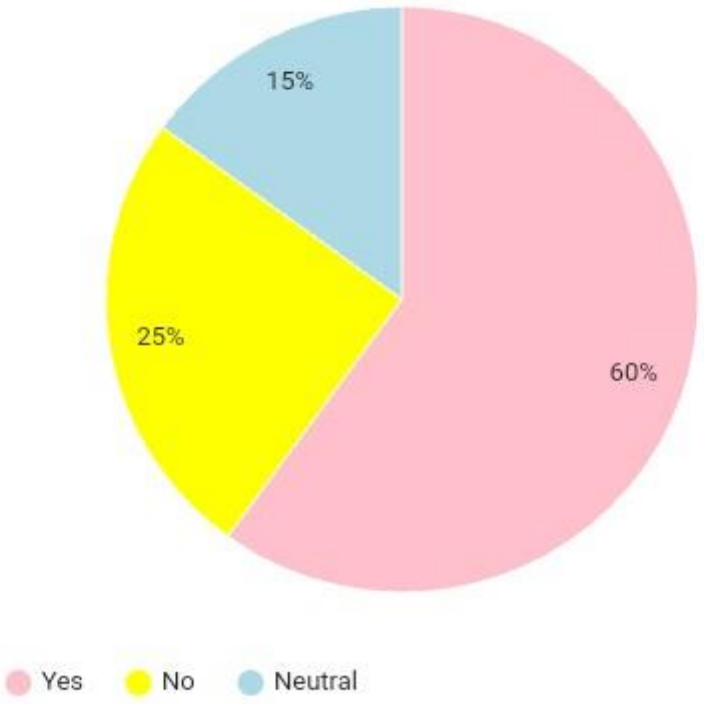
Explanation of Table 5:
Table 5 indicates that 70% of respondents agree their school has fully equipped science laboratories, 20% disagree, and 10% are neutral. This data suggests that while the majority of schools are well-equipped, a notable portion may struggle with resource availability in their labs.

Table 6: The Available Lab Equipment is in Good Working Condition

Statement	Statistical Analysis	Yes	No	Neutral
The available lab equipment is in good working condition	Frequency	60	25	15
	Percentage	60%	25%	15%

ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR

Table 4.6: Available Lab Equipment Condition

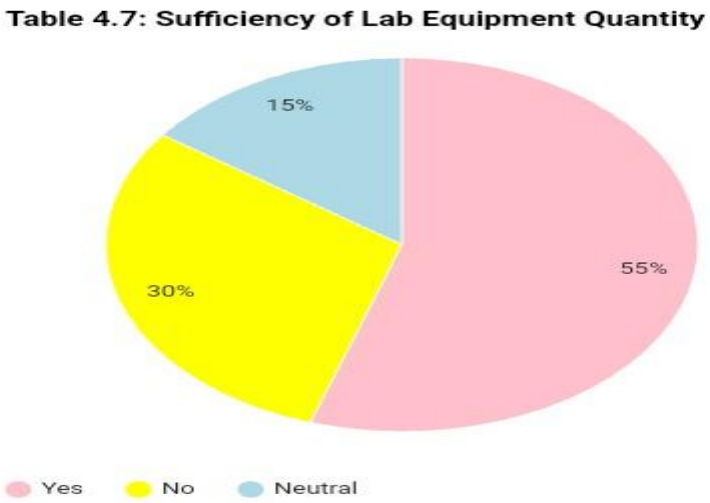


Explanation of Table 6:
In Table 6, 60% of respondents report that lab equipment is in good working condition, while 25% disagree, and 15% are neutral. This suggests that maintenance of lab equipment could be an issue in some schools, affecting the quality of practical sessions.

Table 7: There is Sufficient Quantity of Lab Equipment for All Students

Statement	Statistical Analysis	Yes	No	Neutral
There is sufficient quantity of lab equipment for all students	Frequency	55	30	15
	Percentage	55%	30%	15%

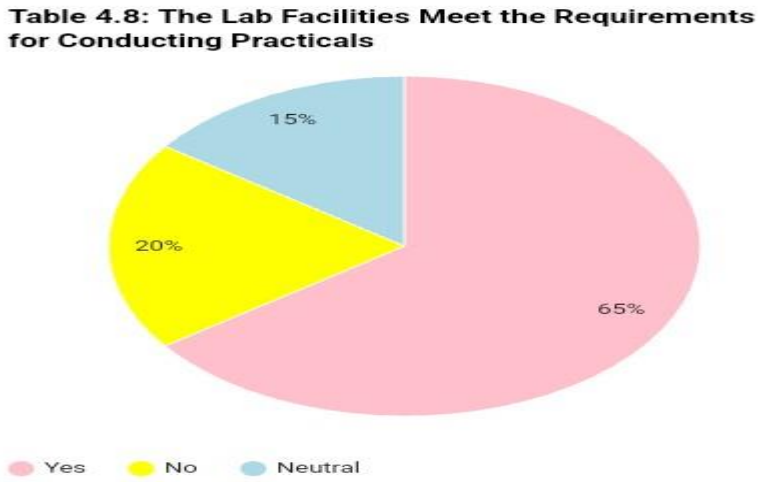
ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)



Explanation of Table 7:
Table 7 reflects that 55% of respondents believe there is sufficient lab equipment for all students, while 30% disagree, and 15% are neutral. This highlights the potential need for better resource distribution or investment in additional equipment.

Table 8: The Lab Facilities Meet the Requirements for Conducting Practicals

Statement	Statistical Analysis	Yes	No	Neutral
The lab facilities meet the requirements for conducting practicals	Frequency	65	20	15
	Percentage	65%	20%	15%



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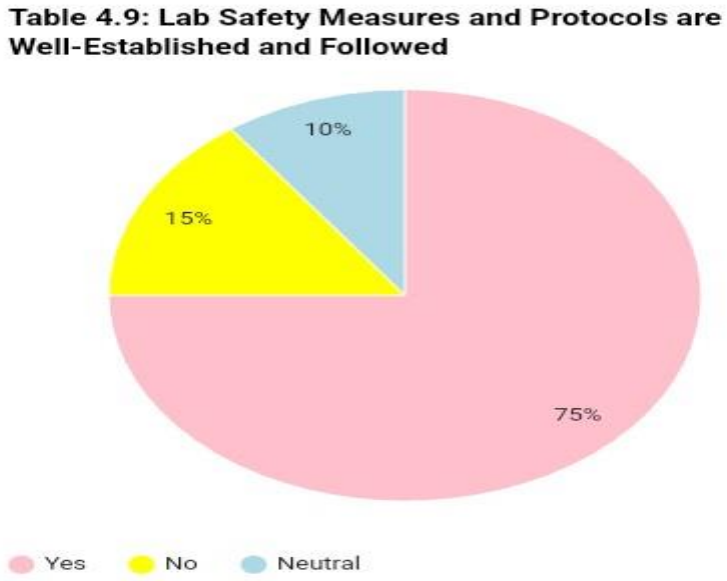
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

Explanation of Table 8:
Table 8 shows that 65% of respondents agree that their lab facilities meet the requirements for conducting practicals, with 20% disagreeing, and 15% neutral. This indicates that most labs are adequate for practical sessions, but some may need improvements to meet all requirements.

Table 9: Lab Safety Measures and Protocols are Well-Established and Followed

Statement	Statistical Analysis	Yes	No	Neutral
Lab safety measures and protocols are well-established and followed	Frequency	75	15	10
	Percentage	75%	15%	10%



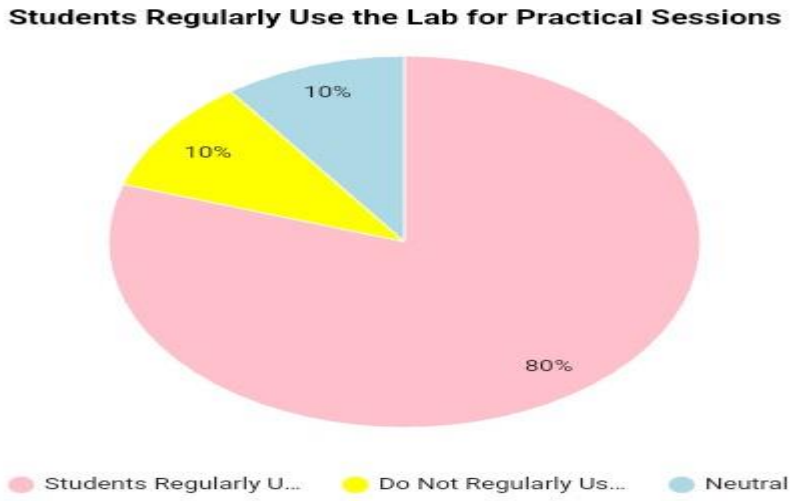
Explanation of Table 9:
Table 9 reveals that 75% of respondents feel lab safety measures are well-established and followed, 15% disagree, and 10% remain neutral. The results suggest that while most schools prioritize safety, there may be gaps in some institutions that need attention.

Table 10: Students Regularly Use the Lab for Practical Sessions

Statement	Statistical Analysis	Yes	No	Neutral

ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

Students regularly use the lab for practical sessions	Frequency	80	10	10
	Percentage	80%	10%	10%

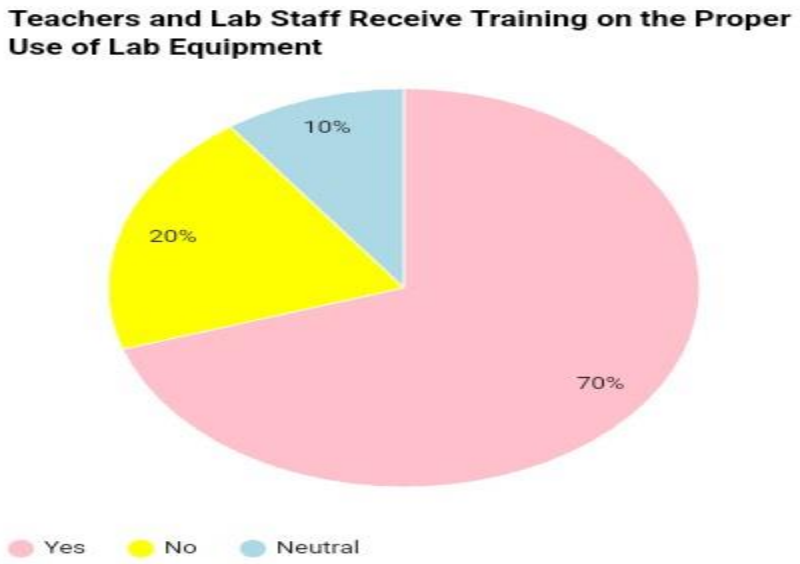


Explanation of Table 10:
Table 10 shows that 80% of respondents report regular use of labs for practical sessions, while 10% do not, and 10% are neutral. This data indicates strong usage of lab facilities, although a minority of schools may not be utilizing labs to their full potential.

Table 11: Teachers and Lab Staff Receive Training on the Proper Use of Lab Equipment

Statement	Statistical Analysis	Yes	No	Neutral
Teachers and lab staff receive training on the proper use of lab equipment	Frequency	70	20	10
	Percentage	70%	20%	10%

ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)



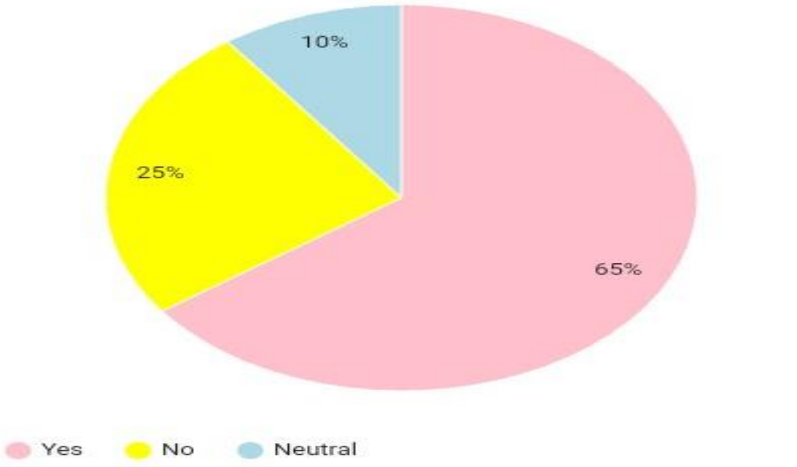
Explanation of Table 11:
Table 11 reflects that 70% of respondents agree teachers and lab staff are properly trained in lab equipment usage, with 20% disagreeing and 10% neutral. This suggests that while training is common, it may not be universally implemented across all schools.

Table 12: The Lab Equipment is Well-Maintained and Regularly Inspected

Statement	Statistical Analysis	Yes	No	Neutral
The lab equipment is well-maintained and regularly inspected	Frequency	65	25	10
	Percentage	65%	25%	10%

ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

Table 4.12: The Lab Equipment is Well-Maintained and Regularly Inspected



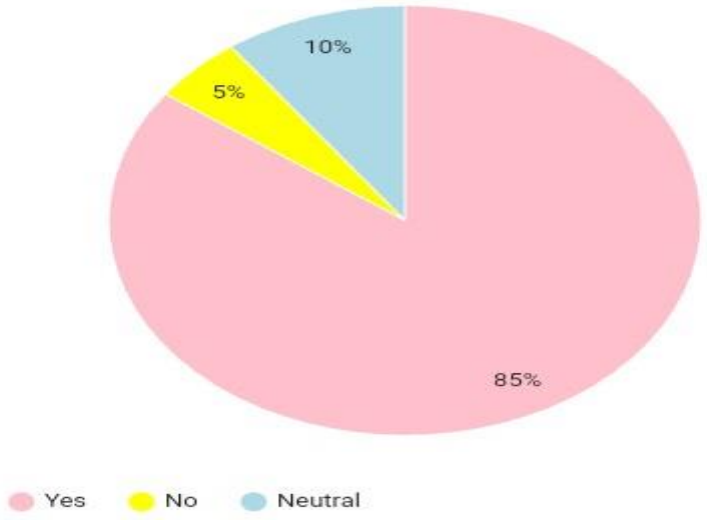
Explanation of Table 12:
Table 12 indicates that 65% of respondents believe lab equipment is well-maintained and regularly inspected, 25% disagree, and 10% are neutral. This points to a need for better maintenance protocols in some schools.

Table 13: The Condition of the Lab Affects Student Performance in Science Subjects

Statement	Statistical Analysis	Yes	No	Neutral
The condition of the lab affects student performance in science subjects	Frequency	85	5	10
	Percentage	85%	5%	10%

ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR

Table 4.13: The Condition of the Lab Affects Student Performance in Science Subjects



Explanation of Table 13:
Table 13 shows that 85% of respondents agree that the condition of the lab affects student performance in science subjects, with 5% disagreeing and 10% neutral. This data highlights the critical role of lab facilities in science education.

Table 14: The Lack of Lab Resources is a Challenge to Conducting Effective Practicals

Statement	Statistical Analysis	Yes	No	Neutral
The lack of lab resources is a challenge to conducting effective practicals	Frequency	75	15	10
	Percentage	75%	15%	10%

ISSN E: 3006-1466
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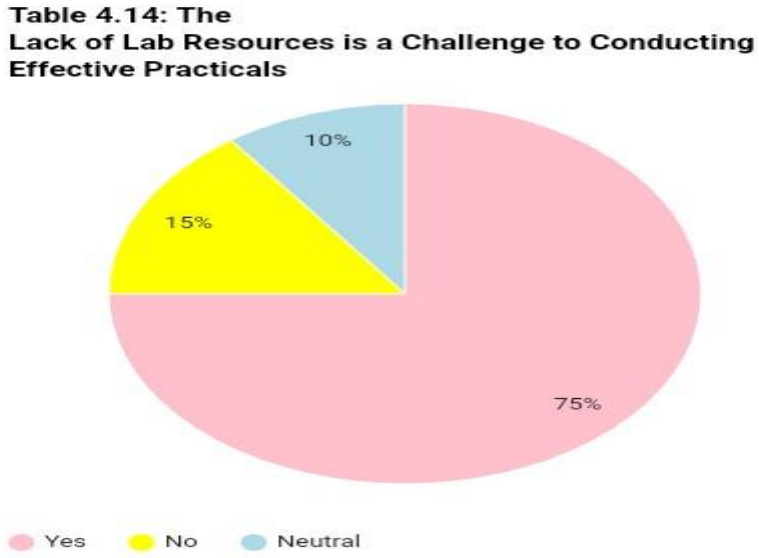
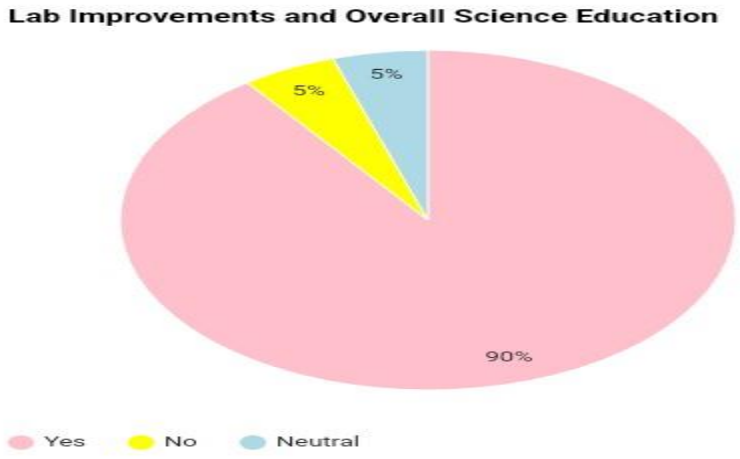
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)



Explanation of Table 14:
Table 14 reveals that 75% of respondents consider a lack of lab resources a significant challenge to conducting practicals, while 15% disagree and 10% are neutral. This shows that resource shortages remain a problem in some schools.

Table 15: Lab Improvements Would Enhance the Overall Science Education in the School

Statement	Statistical Analysis	Yes	No	Neutral
Lab improvements would enhance the overall science education in the school	Frequency	90	5	5
	Percentage	90%	5%	5%



ISSN E: 3006-1466
ISSN P: 3006-1458
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

Explanation of Table 15:
Table 15 reflects that 90% of respondents believe that lab improvements would enhance science education in their school, with only 5% disagreeing and another 5% neutral. This highlights a strong consensus on the importance of upgrading lab facilities to improve educational outcomes.

Discussion
The findings of this study clearly highlight the central role that science laboratory facilities play in The observations of this research clearly demonstrate the focal point that science laboratory facilities have in promoting academic performance of students especially in the fields of Physics, Chemistry and Biology at secondary school level. The outcomes invariably find that access to fully equipped, properly maintained laboratories with adequate safety systems has a strong correlation to increased student interest/interest, knowledge, and performance in the sciences. Such results correlate with the findings of earlier studies that indicate that practical laboratory experiences are sufficiently able to fill in the vacuum between theoretical knowledge and real-life applications, hence helping to cement learning outcomes (Hofstein & Lunetta, 2004; Abrahams & Millar, 2008).
The proportion of students who said that their schools are equipped with fully equipped laboratories was high (70%), Table 5, and eight out of every ten students said that they use labs regularly to have practical sessions (Table 10). This implies that practicing of science is highly valued by most schools. Nevertheless, there is a significant number of institutions that lack full facilities and/or do not make full use of facilities provided. This discrepancy reflects inequality in access to quality science education, especially in urban and rural or poorer schools-an aspect that the demography analysis confirms the existence of resource constraints in low income regions. Laboratory equipment included in the condition and maintenance came out as vital concerns. Although most respondents, 60 percent, agreed that there are proper equipment in good working conditions (Table 6), 25 percent denied it and 15 percent were neutral indicating inconsistency in maintenance standards. It is vital that the equipment is serviced and inspected on a regular basis, as equipment is likely to degrade over time thus compromising the quality and safety in the practical sessions.
This is consistent with the previous research findings (Onasanya & Omosewo, 2011) that emphasizes routine maintenance as a key aspect in sustaining functionality of a lab. The second strength is safety protocols, where 75 percent of the participants have stated that safety protocols are strong, and complied with (Table 9). Nevertheless, the discrepancy of the remaining 25 percent (15% and 10% of disagree and neutral, respectively) implies that safety is not always followed. It is initially important to enact regular application of safety rules especially in educational institutions that have less qualified staff or impoverished facilities. The quality of the trained personnel is also mentioned, whereby 70% of the respondents indicated that the training of the teachers and lab staff in using the equipments is adequate (Table 11). However, disagreement indicates that professional gaps still exist and is observed by 20% of the attendants.
The staff members are also essential in bringing efficiency in laboratory training as well as creation of a safety and innovation culture. Among the most striking results is the high level of believing in the relationship between the influence of lab facilities and the performance of students in studying science-85 percent of the respondents answered that the conditions of lab influence student performance in science (Table 13). Also, 90 percent reported that they feel that building up laboratory facilities would help in teaching science in their respective schools (Table 15). These answers reveal how science educators and lab personnel agree on the direct educational values of making the investments in laboratory infrastructure. The challenges detected, e.g., inadequate quantity of equipment at the disposal of the members of staff (Table 7) and insufficiency of resources (Table 14), can be related to the literature on financial constraints and insufficient funding by the

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CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
CJSSR
CONTEMPORARY JOURNAL OF SOCIAL SCIENCE REVIEW
Vol.03 No.03 (2025)

government as well as unfair distribution of (financial) resources that continues to hinder sound science teaching in various developing countries (UNESCO, 2016). To overcome these challenges, interventions are needed to include higher budgetary allocations to lab resources, association with the private sector groups, and involvement of the communities in the process of resource mobilization. Of great importance, the study confirms that the activities that occur in the laboratory are not supplementary tasks but they are central in attainment of curriculum goals in science teaching.

Practical work improves problem-solving capacity, promotes the thinking process and enhances the understanding of concepts - attributes that are essential in equipping students to be higher education and STEM professionals. In summary, the findings of the present study show convincing evidence in favor of the thesis that properly equipped and maintained, supervised, and actively used laboratories are also the key to the attainment of better results in science education in the secondary school level education process. The results are relevant to the study purpose since they confirm inequality between schools, highlight the major issues within this inequality, and prove the necessity to implement systematic changes in laboratory, teacher training, and resources management aspects. Resolving such problems will not only positively impact the performance of students but also create a more scientific culture at secondary educational institutions.

Conclusions

The study confirms that well-equipped and properly maintained laboratory facilities are crucial for enhancing science education in secondary schools. A strong positive link was found between the quality of lab resources and students' performance, highlighting the need for significant investment in laboratory infrastructure. Disparities in resources among schools indicate the necessity for balanced policies to ensure equal access to practical learning opportunities. Regular upgrades, inspections, and maintenance schedules should be implemented, supported by adequate funding. Teacher and lab staff training must be prioritized to improve practical teaching skills, ensure safety compliance, and introduce innovative instructional methods. Promoting a culture of safety through clear policies, drills, and ongoing awareness is essential for protecting both students and staff. Increasing the frequency of practical sessions not only strengthens conceptual understanding but also boosts students' interest in science and motivates them toward scientific careers. Enhancing laboratories should be considered a strategic educational goal, as it develops critical thinking, problem-solving abilities, and scientific literacy. Addressing resource allocation, maintenance, training, and safety can create balanced, productive learning environments that lead to better academic outcomes and prepare students to meet future scientific and societal challenges effectively.

Recommendations

1. Upgrade and maintain laboratory equipment through regular check-ups, repairs, and replacements.
2. Form partnerships with local businesses or schools for access to newer resources.
3. Increase the quantity of lab tools and materials so every student can actively participate in practical sessions.
4. Implement professional development programs for teachers and lab staff on equipment use, safety rules, and innovative teaching methods.
5. Introduce and enforce comprehensive lab safety policies, with regular safety drills and assessments.
6. Maximize governmental funding for laboratory improvements by lobbying education authorities.
7. Seek grants and local sponsorships to support lab upgrades.
8. Develop a feedback system for students and teachers to share opinions on lab facilities.
9. Conduct periodic surveys or focus group discussions to identify needs and challenges.
10. Continuously improve facilities to align with advancements in science education.

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Vol.03 No.03 (2025)

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