

FACTORS AFFECTING THE CONDUCT OF BIOLOGY PRACTICAL IN PUBLIC SECONDARY SCHOOLS IN ONITSHA EDUCATION ZONE, ANAMBRA STATE, NIGERIA

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Abstract

*This study investigated factors affecting the conduct of Biology practical in public secondary schools in Onitsha Education Zone, Anambra State, Nigeria. The study was anchored on **Bandura's Social Learning Theory (1977)**, which explains that learning occurs through observation, imitation, and hands-on experience. Biology practical activities therefore require adequate laboratory facilities and effective teacher guidance for meaningful learning outcomes. A descriptive survey research design was adopted for the study. The population comprised all Senior Secondary School (SS1–SS3) Biology students and Biology teachers in the 29 public secondary schools in Onitsha Education Zone, with a total population of 14,767 respondents (14,680 students and 87 teachers) based on NEMIS (2022/2023) data. A sample of 461 respondents was selected using the Taro Yamane formula and proportionate stratified random sampling technique. Data were collected using a structured questionnaire titled Factors Affecting Biology Practical Questionnaire (FABPQ). The instrument was validated by experts in Biology Education, Measurement and Evaluation, and Educational Psychology, and its reliability was established using Cronbach's Alpha, yielding a coefficient of 0.82. Data were analyzed using frequency counts and percentages. The findings revealed that 85.1% of respondents agreed that inadequate laboratory facilities and reagents hinder the conduct of Biology practical. Also, 78.3% agreed that shortage of qualified Biology teachers affects practical instruction, while 72.6% identified student-related factors such as large class size and poor attitude as constraints. Furthermore, 81.4% of respondents agreed that schools with inadequate Biology practical facilities record lower WAEC Biology performance compared to schools with adequate facilities. The study concluded that laboratory-related, teacher-related, and student-related factors significantly affect the effective conduct of Biology practical in public secondary schools in Onitsha Education Zone. It was recommended that government and school administrators should provide adequate laboratory facilities, employ qualified Biology teachers, reduce class size, and strengthen practical-based instruction to improve students' performance in Biology.*

Keywords: Factors, Challenges, Conduct, Biology Practical, Public Secondary Schools.

INTRODUCTION

1.1 Background to the Study

Biology is a core science subject in Nigerian senior secondary schools and serves as the foundation for science-related disciplines such as Medicine, Nursing, Pharmacy, Agriculture, Microbiology, and Environmental Science. It equips students with knowledge of living

organisms and their interactions with the environment, thereby contributing to scientific literacy and national technological development (Federal Republic of Nigeria [FRN], 2023). The Nigerian Biology curriculum emphasizes practical activities as an essential aspect of instruction because they enable students to observe biological phenomena, conduct experiments, manipulate laboratory equipment, and develop scientific process skills. Practical work helps students understand abstract biological concepts, promotes critical thinking and problem-solving, and improves knowledge retention and academic achievement. It also prepares students for external examinations such as the West African Senior School Certificate Examination (WASSCE) and the National Examination Council (NECO) examinations (Aina & Adedaja, 2021; West African Examinations Council [WAEC], 2024).

Despite its importance, the effective conduct of Biology practical remains a major challenge in many public secondary schools in Nigeria. Factors such as inadequate laboratory facilities, shortage of instructional materials, insufficient funding, overcrowded classrooms, lack of qualified Biology teachers, poor laboratory maintenance, and limited practical exposure hinder students' acquisition of practical skills and contribute to poor performance in Biology practical examinations (Akinbobola & Adeleke, 2022; Ogunode & Musa, 2023).

Teacher quality and competence also influence the effectiveness of Biology practical instruction. Qualified teachers are better able to organize laboratory activities, supervise experiments, maintain laboratory safety, and guide students in developing practical skills. Likewise, student-related factors such as attitude, interest, motivation, previous practical experience, and class size affect participation and learning outcomes. School administrators further contribute by providing adequate funding, maintaining laboratory facilities, supporting teachers, and creating an enabling environment for practical instruction (Aremu & Ojo, 2021; Eze & Ugwoke, 2022; Nwosu & Okeke, 2020).

The study is anchored on Bandura's Social Learning Theory (1977), which explains that learning occurs through observation, imitation, and active interaction with the learning environment. Biology practical therefore provides opportunities for students to acquire scientific knowledge and skills through demonstration and hands-on experience.

Although Biology is widely offered in public secondary schools within Onitsha Education Zone of Anambra State, concerns persist regarding inadequate laboratory facilities, insufficient qualified teachers, and students' limited practical competence. These challenges necessitated the present study to investigate the factors affecting the conduct of Biology practical in public secondary schools in the zone. The findings are expected to provide useful information for teachers, school administrators, educational planners, policymakers, and other stakeholders toward improving Biology practical instruction and students' academic performance.

1.2 Statement of the Problem

Biology practical forms an integral component of science education because it provides students with opportunities to develop scientific process skills, understand biological concepts, and apply theoretical knowledge through experimentation. The Nigerian secondary school curriculum requires Biology practical activities to complement classroom instruction and prepare students adequately for external examinations and future scientific careers.

Despite the importance attached to Biology practical, many public secondary schools continue to experience challenges in conducting practical lessons effectively. Reports from teachers, school administrators, examination bodies, and educational researchers indicate persistent inadequacies in laboratory facilities, shortage of qualified Biology teachers, overcrowded classrooms, insufficient instructional materials, poor funding, and limited opportunities for students to participate actively in practical activities. These challenges appear to contribute to students' poor acquisition of practical skills and unsatisfactory performance in Biology practical examinations.

In Onitsha Education Zone, concerns have been expressed regarding the declining quality of Biology practical instruction in public secondary schools. Some schools reportedly lack functional laboratories, while others have inadequate laboratory equipment and reagents. In addition, increasing student enrolment without corresponding expansion of laboratory facilities has resulted in overcrowded practical classes, making effective supervision difficult. Although previous studies have examined students' achievement in Biology, limited empirical evidence exists regarding the combined influence of laboratory-related, teacher-related, and student-related factors on the conduct of Biology practical specifically within public secondary schools in Onitsha Education Zone. This knowledge gap necessitated the present study.

Therefore, the problem of this study is to investigate the factors affecting the conduct of Biology practical in public secondary schools in Onitsha Education Zone, Anambra State.

1.3 Purpose of the Study

The main purpose of this study was to investigate the factors affecting the conduct of Biology practical in public secondary schools in Onitsha Education Zone, Anambra State.

Specifically, the study sought to:

1. determine the laboratory-related factors affecting the conduct of Biology practical.
2. examine the teacher-related factors affecting the conduct of Biology practical.
3. identify the student-related factors affecting the conduct of Biology practical.
4. determine the influence of Biology practical facilities on students' academic performance in Biology.

1.4 Research Questions

The following research questions guided the study:

1. What laboratory-related factors affect the conduct of Biology practical in public secondary schools?
2. What teacher-related factors affect the conduct of Biology practical?
3. What student-related factors affect the conduct of Biology practical?
4. How do Biology practical facilities influence students' academic performance in Biology?

1.5 Significance of the Study

The findings of this study will be beneficial to Biology teachers, students, school administrators, curriculum planners, educational policymakers, researchers, and government agencies.

The study will help Biology teachers identify factors limiting effective practical instruction and encourage the adoption of appropriate teaching strategies.

Students will benefit through improved practical instruction, increased laboratory participation, enhanced scientific skills, and better academic achievement.

School administrators will obtain useful information for planning laboratory improvement, allocating instructional resources, and supporting Biology teachers.

Educational planners and curriculum developers will use the findings to improve science education policies and strengthen practical components of the Biology curriculum.

Government and education authorities will benefit by using the findings to formulate policies aimed at improving laboratory facilities, teacher recruitment, and funding for science education.

Researchers will use the findings as reference materials for future studies on Biology practical and science education.

1.6 Scope of the Study

The study was delimited to public secondary schools in Onitsha Education Zone, Anambra State.

Content-wise, the study focused on:

- laboratory-related factors; teacher-related factors; student-related factors and the influence of Biology practical facilities on students' academic performance.

The respondents comprised Biology teachers and Senior Secondary School students (SS1–SS3) in public secondary schools within the study area.

REVIEW OF RELATED LITERATURE

This section reviewed literature related to the factors affecting the conduct of Biology practical in public secondary schools in Onitsha Education Zone, Anambra State. The review covered the conceptual framework, theoretical framework, empirical studies, and summary of findings.

Biology was described as the scientific study of living organisms and their interactions with the environment. It is a core science subject in Nigerian secondary schools and provides the foundation for professional fields such as Medicine, Nursing, Agriculture, Environmental Science, and Biotechnology. The objectives of Biology education include developing scientific knowledge, laboratory skills, problem-solving abilities, and positive scientific attitudes. Because Biology involves observation and experimentation, practical activities are considered essential for meaningful learning and improved academic performance.

Biology practical refers to laboratory and field activities that enable students to observe specimens, conduct experiments, collect and analyze data, and draw scientific conclusions. Such activities help students develop observation, measurement, communication, analytical, and critical-thinking skills. Practical instruction bridges the gap between theory and real-life experience, making scientific concepts easier to understand.

The review further showed that Biology practical is important because it enhances students' understanding of difficult concepts, improves retention of knowledge, stimulates curiosity, promotes independent learning, and prepares learners for higher education where laboratory competence is required. Schools that conduct regular practical lessons generally record better academic performance than those that rely mainly on lecture methods.

Laboratory facilities were identified as a major determinant of effective Biology practical. Adequate laboratories, microscopes, chemicals, specimens, charts, glassware, water supply, electricity, and other instructional materials are necessary for successful practical instruction. Many public secondary schools in Nigeria, however, face challenges such as inadequate equipment, poor laboratory conditions, and insufficient instructional materials, leading to reduced student participation and poor practical performance.

Teacher-related factors were also highlighted. Qualified and experienced Biology teachers are better able to organize practical lessons, manage laboratories, supervise students, and ensure safety during experiments. Continuous professional development and teacher motivation further improve the quality of practical instruction.

Student-related factors include attitude toward Biology, interest in practical activities, class size, previous practical exposure, and laboratory discipline. Students with positive attitudes and strong interest participate more actively and achieve better learning outcomes, while overcrowded classrooms often limit effective supervision during practical sessions.

School administration also influences the conduct of Biology practical through funding, laboratory maintenance, supervision, provision of instructional materials, and support for science teachers. Principals who prioritize science education tend to provide better laboratory environments.

The literature established a strong relationship between regular participation in Biology practical and improved academic achievement. Students who engage frequently in practical work generally understand concepts better, retain knowledge longer, and perform better in examinations such as the West African Senior School Certificate Examination.

The study was anchored on Bandura's Social Learning Theory (1977), which explains that learning occurs through observation, imitation, modeling, and interaction with the environment. The theory is relevant because Biology practical depends heavily on teacher demonstrations, student observation, repeated practice, and interaction with laboratory equipment. Adequate laboratories and effective teaching therefore provide opportunities for meaningful observational learning.

Empirical studies reviewed showed that teacher qualification, laboratory facilities, school leadership, student attitude, and practical exposure significantly influence Biology practical instruction and students' academic performance. However, most previous studies examined these factors separately and few investigated them collectively within public secondary schools in Onitsha Education Zone, Anambra State.

In summary, the literature review established that effective Biology practical depends on adequate laboratory facilities, qualified teachers, supportive school administration, positive student attitudes, manageable class sizes, and sufficient funding. Although previous studies generally reported positive effects of these factors on practical instruction and academic achievement, there remains limited evidence on their combined influence in public secondary schools in Onitsha Education Zone. This gap justified the present study.

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the methodology adopted for the study. It presents the research design, area of the study, population, sample and sampling technique, instrument for data collection, validation and reliability of the instrument, method of data collection, and method of data analysis.

3.2 Research Design

The study adopted a descriptive survey research design. This design was considered appropriate because it enabled the researcher to collect data from Biology teachers and students regarding the factors affecting the conduct of Biology practical in public secondary schools without manipulating any variables. It was suitable for obtaining respondents' opinions and perceptions on the variables under investigation (Creswell & Creswell, 2023).

3.3 Area of the Study

The study was conducted in Onitsha Education Zone of Anambra State, Nigeria. The zone comprises six Local Government Areas: Onitsha North, Onitsha South, Ogbaru, Oyi, Anambra East, and Anambra West, with 29 public secondary schools. The area was selected because Biology is widely taught in the schools, yet challenges such as inadequate laboratory facilities, shortage of instructional materials, and overcrowded laboratories continue to affect the effective conduct of Biology practical lessons.

3.4 Population of the Study

The population of the study consisted of 14,767 respondents made up of 14,680 Senior Secondary School Biology students and 87 Biology teachers in the 29 public secondary schools within Onitsha Education Zone. The population figures were obtained from the National Education Management Information System (2022/2023).

3.5 Sample and Sampling Technique

A sample of 461 respondents was used for the study. The sample size was determined using the Taro Yamane (1967) formula and was increased to ensure adequate representation of both teachers and students. Proportionate stratified random sampling was adopted by grouping respondents into Biology teachers and Biology students. All 87 Biology teachers were included through census sampling because of their relatively small number, while 374 Biology students were selected using simple random sampling.

3.6 Instrument for Data Collection

Data were collected using a structured questionnaire titled *Factors Affecting Biology Practical Questionnaire (FABPQ)*. The instrument consisted of two sections. Section A obtained respondents' demographic information, while Section B contained 40 questionnaire items

grouped into four clusters covering laboratory-related factors, teacher-related factors, student-related factors, and Biology practical facilities and students' performance. Responses were measured using a four-point Likert scale of Strongly Agree, Agree, Disagree, and Strongly Disagree.

3.7 Validation of the Instrument

The questionnaire was subjected to face and content validation by three experts in Biology Education, Measurement and Evaluation, and Educational Psychology. Their comments and suggestions were used to improve the clarity, relevance, and adequacy of the instrument before the final administration.

3.8 Reliability of the Instrument

The reliability of the instrument was established through a pilot study involving respondents from public secondary schools outside the study area. The data obtained were analyzed using Cronbach's Alpha, producing an overall reliability coefficient of 0.82, indicating that the instrument possessed high internal consistency and was suitable for the study (Taber, 2018).

3.9 Method of Data Collection

An introductory letter was obtained from the researcher's department before visiting the selected schools. Permission was sought from the school principals, after which the questionnaires were administered with the assistance of three trained research assistants. Respondents were assured of confidentiality, and all completed questionnaires were retrieved immediately, resulting in a 100% return rate.

3.10 Method of Data Analysis

The data collected were analyzed using frequency counts and percentages. Responses with percentages of 50% and above were interpreted as agreed, while those below 50% were interpreted as disagreed. The analyzed data were presented in frequency and percentage tables to facilitate interpretation and discussion of the findings.

DATA PRESENTATION, ANALYSIS, AND DISCUSSION OF FINDINGS

We present here the analysis of data collected from the respondents on the factors affecting the conduct of Biology practical in public secondary schools in Onitsha Education Zone, Anambra State. A total of **461 questionnaires** were administered to Biology teachers and Senior Secondary School (SS1–SS3) students. All the questionnaires were correctly completed and returned, representing a **100% return rate**.

The data were analyzed using **frequency counts and percentages** in line with the research questions. Responses with **50% and above** were regarded as **Agreed**, while responses below **50%** were regarded as **Disagreed**.

4.1 Analysis of Research Questions

Research Question One

What laboratory-related factors affect the conduct of Biology practical in public secondary schools in Onitsha Education Zone?

Table 4.1

Frequency and Percentage Responses on Laboratory-related Factors Affecting Biology Practical (N = 461)

S/N	Item	Agree (%)	f Disagree (%)	f Decision
1	Inadequate Biology laboratories affect practical lessons.	396 (85.9)	65 (14.1)	Agree
2	Insufficient laboratory equipment hinders practical activities.	391 (84.8)	70 (15.2)	Agree
3	Lack of chemicals and reagents affects Biology practical.	393 (85.2)	68 (14.8)	Agree
4	Poor maintenance of laboratory equipment limits practical work.	382 (82.9)	79 (17.1)	Agree
5	Irregular electricity supply affects Biology practical.	344 (74.6)	117 (25.4)	Agree
6	Inadequate water supply affects Biology practical.	337 (73.1)	124 (26.9)	Agree
7	Insufficient laboratory space affects students' participation.	360 (78.1)	101 (21.9)	Agree
8	Lack of specimens affects practical instruction.	378 (82.0)	83 (18.0)	Agree
9	Poor laboratory environment discourages practical work.	350 (75.9)	111 (24.1)	Agree
10	Availability of laboratory facilities improves Biology practical.	421 (91.3)	40 (8.7)	Agree

Grand Mean

Agree	Disagree
375	86
(81.4%)	(18.6%)

Interpretation

Table 4.1 shows that the respondents agreed that laboratory-related factors significantly affect the conduct of Biology practical. The grand percentage of **81.4%** indicates that inadequate laboratory facilities constitute a major challenge in public secondary schools.

Research Question Two

What teacher-related factors affect the conduct of Biology practical?

Table 4.2

Frequency and Percentage Responses on Teacher-related Factors (N = 461)

S/N	Item	Agree (%)	f Disagree (%)	f Decision
1	Shortage of qualified Biology teachers affects practical lessons.	361 (78.3)	100 (21.7)	Agree
2	Teacher qualification influences Biology practical.	380 (82.4)	81 (17.6)	Agree
3	Teachers' experience improves practical instruction.	372 (80.7)	89 (19.3)	Agree
4	Teachers require regular training.	389 (84.4)	72 (15.6)	Agree

S/N	Item	Agree (%)	f Disagree (%)	f Decision
5	Poor teacher motivation affects Biology practical.	353 (76.6)	108 (23.4)	Agree
6	Heavy workload reduces effective supervision.	366 (79.4)	95 (20.6)	Agree
7	Teachers should prepare adequately before practical lessons.	414 (89.8)	47 (10.2)	Agree
8	Teacher commitment improves students' practical skills.	398 (86.3)	63 (13.7)	Agree
9	Effective laboratory management improves learning.	404 (87.6)	57 (12.4)	Agree
10	Teacher supervision ensures laboratory safety.	410 (88.9)	51 (11.1)	Agree

Grand Mean

Agree Disagree
385 (83.5%) 76 (16.5%)

Interpretation

The findings indicate that respondents agreed that teacher-related factors significantly influence the conduct of Biology practical. The overall agreement percentage of **83.5%** suggests that teacher quality and competence remain essential for effective Biology practical instruction.

Research Question Three

What student-related factors affect the conduct of Biology practical?

Table 4.3

Frequency and Percentage Responses on Student-related Factors (N = 461)

S/N	Item	Agree (%)	f Disagree (%)	f Decision
1	Large class size affects Biology practical.	335 (72.7)	126 (27.3)	Agree
2	Poor student attitude affects practical lessons.	348 (75.5)	113 (24.5)	Agree
3	Students' interest improves practical participation.	406 (88.1)	55 (11.9)	Agree
4	Students who attend practical regularly perform better.	418 (90.7)	43 (9.3)	Agree
5	Indiscipline affects laboratory activities.	371 (80.5)	90 (19.5)	Agree
6	Poor practical skills affect students' performance.	382 (82.9)	79 (17.1)	Agree
7	Students require adequate practical exposure.	402 (87.2)	59 (12.8)	Agree
8	Fear of handling laboratory equipment reduces participation.	327 (70.9)	134 (29.1)	Agree
9	Students' motivation influences Biology practical.	390 (84.6)	71 (15.4)	Agree
10	Regular participation improves academic achievement.	425 (92.2)	36 (7.8)	Agree

Grand Mean

Agree Disagree
380 (82.4%) 81 (17.6%)

Interpretation

Table 4.3 shows that respondents agreed that student-related factors significantly influence Biology practical. The grand percentage of **82.4%** indicates that students' attitudes, interest, class size, and participation affect practical instruction.

Research Question Four

How do Biology practical facilities influence students' academic performance?

Table 4.4

Frequency and Percentage Responses on Biology Practical Facilities and Students' Academic Performance (N = 461)

S/N	Item	Agree (%)	f Disagree (%)	f Decision
1	Adequate laboratory facilities improve Biology performance.	418 (90.7)	43 (9.3)	Agree
2	Schools with standard laboratories perform better in WAEC Biology.	375 (81.4)	86 (18.6)	Agree
3	Students who perform practical regularly achieve higher scores.	406 (88.1)	55 (11.9)	Agree
4	Availability of laboratory equipment improves learning.	412 (89.4)	49 (10.6)	Agree
5	Practical lessons improve understanding.	425 (92.2)	36 (7.8)	Agree
6	Biology practical improves scientific thinking.	410 (88.9)	51 (11.1)	Agree
7	Regular practical reduces examination anxiety.	389 (84.4)	72 (15.6)	Agree
8	Laboratory exposure improves students' confidence.	398 (86.3)	63 (13.7)	Agree
9	Practical skills improve examination performance.	415 (90.0)	46 (10.0)	Agree
10	Effective practical instruction improves overall Biology achievement.	421 (91.3)	40 (8.7)	Agree

Grand Mean

Agree Disagree
407 (88.3%) 54 (11.7%)

Interpretation

The findings reveal that adequate Biology practical facilities positively influence students' academic performance. The overall agreement of **88.3%** demonstrates that respondents perceive practical facilities as essential for improving Biology achievement.

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

This part presents the summary of the study, conclusion, educational implications of the study, recommendations, limitations of the study, suggestions for further studies, and summary of the study.

5.1 Summary of the Study

This study investigated the **factors affecting the conduct of Biology practical in public secondary schools in Onitsha Education Zone, Anambra State**. The study was motivated by

the persistent concern over the poor conduct of Biology practical and the declining performance of students in Biology practical examinations despite the importance attached to practical work in the secondary school curriculum.

The study was anchored on **Bandura's Social Learning Theory (1977)**, which posits that learning occurs through observation, imitation, modeling, and active interaction with the learning environment. The theory was considered appropriate because Biology practical requires students to observe demonstrations, manipulate laboratory equipment, and acquire scientific skills through active participation.

The study adopted a **descriptive survey research design**. The population consisted of **14,767 respondents**, comprising **14,680 Senior Secondary School (SS1–SS3) Biology students and 87 Biology teachers** in the **29 public secondary schools** in Onitsha Education Zone. A sample of **461 respondents** was selected using the **Taro Yamane formula** and **proportionate stratified random sampling technique**, while all Biology teachers were included through census sampling.

Data were collected using a structured questionnaire titled **Factors Affecting Biology Practical Questionnaire (FABPQ)**. The instrument was validated by experts in Biology Education, Measurement and Evaluation, and Educational Psychology. Its reliability was established using the **Cronbach's Alpha** method, which yielded an overall reliability coefficient of **0.82**, indicating that the instrument was reliable.

The data collected were analyzed using **frequency counts and percentages** to answer the research questions.

The findings revealed that:

1. Laboratory-related factors such as inadequate laboratory facilities, insufficient equipment, lack of reagents, inadequate specimens, poor maintenance of laboratory facilities, and inadequate laboratory space significantly affect the conduct of Biology practical.
2. Teacher-related factors, including shortage of qualified Biology teachers, inadequate professional development, poor teacher motivation, heavy workload, and poor laboratory management skills, affect effective Biology practical instruction.
3. Student-related factors such as poor attitude toward Biology, overcrowded classrooms, inadequate practical exposure, low motivation, poor laboratory discipline, and fear of handling laboratory equipment influence the conduct of Biology practical.
4. Adequate Biology practical facilities positively influence students' academic performance, as schools with functional laboratories and regular practical activities tend to record better performance in Biology examinations. Y

5.3 Conclusion

Based on the findings of this study, it was concluded that the effective conduct of Biology practical in public secondary schools in Onitsha Education Zone depends largely on the availability of adequate laboratory facilities, qualified Biology teachers, positive student attitudes, and effective school management.

The study established that Biology practical remains indispensable in promoting scientific inquiry, enhancing students' understanding of biological concepts, and improving academic achievement. However, several challenges—including inadequate laboratory facilities, insufficient instructional materials, shortage of qualified Biology teachers, overcrowded classrooms, and poor funding—continue to hinder the effective implementation of Biology practical in many public secondary schools.

The study further concluded that improving laboratory infrastructure, strengthening teacher capacity, encouraging positive student participation, and providing adequate instructional resources will significantly enhance the conduct of Biology practical and improve students' performance in Biology.

5.4 Educational Implications of the Study

The findings of this study have several educational implications.

Firstly, the study highlights the need for governments and educational stakeholders to prioritize the provision of functional Biology laboratories in public secondary schools. Adequate laboratory facilities will enable students to acquire practical skills necessary for scientific learning and improve their performance in internal and external examinations.

Secondly, the study underscores the importance of recruiting and retaining qualified Biology teachers. Teachers with strong subject knowledge and practical instructional skills are better positioned to organize meaningful laboratory experiences that promote students' understanding of biological concepts.

Thirdly, the findings suggest that regular in-service training, workshops, seminars, and professional development programmes should be organized for Biology teachers to improve their competence in laboratory management and practical teaching methods.

Furthermore, school administrators should ensure effective supervision of Biology practical lessons and create supportive learning environments by providing adequate instructional materials, maintaining laboratory equipment, and enforcing laboratory safety regulations.

Finally, students should be encouraged to develop positive attitudes toward Biology practical by actively participating in laboratory activities, observing laboratory rules, and cultivating scientific inquiry skills.

5.5 Recommendations

Based on the findings of the study, the following recommendations were made:

1. **Government** should provide adequately equipped Biology laboratories in all public secondary schools to facilitate effective practical instruction.
2. **The Ministry of Education and Post Primary Schools Service Commission (PPSSC)** should recruit more qualified Biology teachers to reduce teacher shortages and improve supervision during practical lessons.
3. **School principals** should ensure regular maintenance of laboratory facilities, equipment, and instructional materials to guarantee their availability and functionality.

4. **Professional development programmes**, including workshops, seminars, and refresher courses, should be organized regularly for Biology teachers to improve their laboratory management skills and practical teaching competence.
5. **Schools** should reduce overcrowding during Biology practical by ensuring manageable class sizes or organizing students into smaller practical groups where necessary.
6. **Government and school authorities** should allocate adequate funds for the procurement of laboratory equipment, chemicals, specimens, reagents, and other consumable materials required for Biology practical.
7. **Biology teachers** should adopt learner-centered instructional strategies that encourage active student participation, inquiry, experimentation, and collaborative learning during practical lessons.
8. **Students** should be encouraged to participate actively in practical activities, observe laboratory safety rules, and develop positive attitudes toward Biology.

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