The Impact of Practical Work Experience on Academic Achievement in Biology Among Senior Secondary School Students in Yenagoa Metropolis

ABSTRACT

The study investigated the impact of practical work experience on academic achievement in biology at the senior school level in Yenagoa Metropolis. Additionally, the moderating effect of gender on the dependent variable was examined. Two public secondary schools were randomly selected for this study, and one intact class was randomly selected from each school and randomly assigned to experimental and control groups. The sample size consisted of 219 students out of 256 students offering biology at the Senior Secondary one (SSI) level in the selected schools.

A pretest-posttest quasi-experimental design was adopted. The experimental group used a practical work experience strategy, while the control group was taught using a modified lecture strategy. The study used the Biology Achievement Test (BAT). Experts in biology education validated the BAT, and a reliability of 0.73 was obtained using Kuder-Richardson Formula 21. Two hypotheses and two research questions guided the study, and the hypotheses were tested at a 0.05 significance level.

Differences in mean scores were subjected to t-test statistics, which were significant in favor of the experimental group and were found to be gender-friendly. It was recommended that practical allowances should be paid to science teachers to motivate them to adopt practical work experience strategies in the teaching-learning process in schools.

Keywords: *Practical work, Experience, andAcademic Achievement*

1. INTRODUCTION

Science is the bedrock upon which the development of any nation is hinged, be it economic or technological. This is evident as scientific knowledge is applied in all areas of a nation's economy, including but not limited to communication, health, agriculture, construction, entertainment, education, transportation, food, and security. Science, thus, has been defined by different authors in various ways. According to Patrick (2017), *science* is defined as the "study of the structure, behavior of the physical, natural and social world, especially through observation and experimentation" (p. 70). Rahman and Yunus (2020) defined "*science* as rationally structured knowledge about nature, which embraces systematic methods of positive attitudes in its acquisition, teaching, learning, and application.For Nigeria to attain its national goals and objectives, there is a need for the teaching of science". Supporting this view, Gultepe (2016) opined that "the fundamental goal of science teaching in contemporary times is to educate students to conduct research, explore, investigate, make connections between everyday life with topics of science, use scientific methods to solve problems and see the world through the eyes of scientists". Similarly, Shimasaki (2015) identified "the following objectives of science education in Nigeria to prepare students to observe and explore the environment, explain simple natural phenomena, develop scientific attitudes including curiosity, critical reflection, and objectivity, apply the skill and knowledge gained through science to solve everyday problems in the environment and develop self-confidence and self-reliance through problem-solving activities in science".

"In order to equip its citizenry with knowledge and working of science, several science subjects have been incorporated into the school curriculum. One of the subjects that are imperative to achieve the objectives of science education in Nigeria is biology. Biology is an essential science subject and a requirement for further learning in a number of science-related professional courses such as pharmacy, medicine, microbiology, and agriculture. Today, biology pervades every field of study and plays a fundamental role in educational and technological advancement" (Mushimiyimana et al., 2022). "Hence, it is compulsory for arts and science students at the senior secondary school level. Despite the importance of science teaching, it has been observed that most secondary school students need more time to study biology due to perceived difficulty and low interest in biology" (Odutuyi, 2019). This low interest has been traced to students' poor achievement in biology in examinations. Darling-Hammond (2018) believes that "teachers' ineffectiveness in classroom interaction with the learners could be responsible for the observed poor performance of learners and the widely acclaimed fallen standard of education". "Poor academic performance of learners can be linked to poor teacher performance in terms of accomplishing the teaching task, negative attitude to work, and poor teaching habits, which have been attributed to poor motivation (Darling-Hammond, 2018). Many have blamed such performance in this subject on variables like student factors, language problems, and lack of practical work experience" (Ogunode et al., 2022).

Realizing this, Odukoya et al. (2018) recommend practical work, exploratory, and experimental teaching methods. In like manner, DeBoer (2019) insists that practical work experience is indispensable in science education since it is experimental. Patrick (2017) reported that it is only in practical work that students are assessed in the three domains of learning, namely, cognitive, psychomotor, and affective. Again, Babajide (2015) summarized "the significant objectives of practical work experience as developing skills, concepts, cognitive abilities, and understanding the nature of science. He added that skills such as manipulation, inquiry, investigation, organizational, and communicative skills can develop from practical work experiences. It also allows students to practice the correct use of apparatus, thus helping them be manipulative".

Against this background, the researcher thought it wise to investigate the impact of practical work experience on students' academic achievement at the senior school level in Yenagoa Metropolis, Bayelsa State. This is necessary because students in this area are not immune to poor achievement in the aforementioned subject.

1.1. Research Questions

The following research questions will guide this study:

- How does practical work experience impact SS1 students' biology mean achievement scores?
- What impact has gender had on SSI students' achievement in biology when taught with practical work experience?

1.2. Null Hypothesis

As shown below, two null hypotheses were posted and tested as $p < 0.05$ significance level on a 2-tailed test.

- Ho1: There is no significant difference in the mean achievement score of SS1 students taught with practical work experience and their counterparts taught with a modified lecture method.
- Ho2: There is no significant effect of gender on the mean achievement score of SS1 students taught with biology practical work experience.

2. Literature Review

2.1 Conceptual Review

2.1.2 Importance of Practical Work Experience

Science has made the world a global community or village. Science pervades all aspects of our lives. No nation would be regarded as developed without science. Its value to nation-building and development cannot be swept under the carpet. Science's contributions are evident in all our lives, including food, clothing, shelter, transportation, agriculture, health, and technology, as agreed with Usman and Saminu (2017).

Adegboye et al. (2018) defined *science* as studying the structure and behavior of the physical, natural, and social worlds, primarily through observation and experimentation. From this definition, it is safe to conclude that science learning involves observations, experimentation, and practical work in the laboratory. Pember and Achor (2017) refer to practical work as an activity carried out by a particular student or a group of students to make personal observations of processes, products, or events.

Science is experimental, so any science course must include practical work. It is where one learns why science insists on precise measurement, accurate observation, and clarity in communication. Practical work can bridge the gap between abstract ideas and realities. It can create a learning environment that encourages students to question, fostering critical thinking. Students are often encouraged to work in small groups, leading to social interactions and peer teaching. Purwandari (2015) asserts that practical work includes experimental, fieldwork, and laboratory work.
Science educators and teachers agree that practical work is indispensable to understanding science (Hamidu et al., 2014; Falemu et al., 2021; Abdussemiu, 2022). The primary purpose of practical work is to provide students with conceptual and theoretical knowledge to help them learn scientific concepts and understand the nature of science through scientific methods.

"Practical work experience also allows students to experience science using scientific research procedures. In order to achieve meaningful learning, scientific theories and their application methods should be experienced by students. Moreover, practical work should encourage the development of analytical and critical thinking skills and interest in science" (Xhomara, 2022). Practical activities provide opportunities for students to produce new knowledge through scientific investigations. Seery et al (2019) and Agustian & Seery (2017) stated that the general importance of practical work may be:

- Supporting or strengthening theoretical knowledge.
- Experiencing the pleasure of discovery and development of their psychomotor skills.
- Teaching how scientific knowledge may be used in daily life.
- Increasing creative thinking skills.
- Gaining scientific working methods and higher-order thinking skills.
- Developing communication skills.
- Developing manual dexterity by using tools and equipment.
- Allowing students to apply skills instead of memorizing (McGuire et al., 2015).

2.1.3 Students' Academic Achievement in Biology

Students' achievement in Biology at the Senior Secondary School Certificate Examination (SSCE) level has been unsatisfactory. Scholars have attributed various reasons to this problem. Waseka and Simatwa (2016) concluded that "the availability of textbooks, practical apparatus, and other learning resources contributes significantly to students' performance in Biology examinations. They added that students with a positive attitude towards the subject perform better than those with a negative attitude. Those with a positive attitude are motivated to work hard, which is reflected in the good marks they scored on the examination". Odikpo and Ejide (2021) researched "the influence of parents' education and occupation on students' academic achievement; they concluded that parents' education and occupation positively influence children's academic achievement". Femi (2012) concluded that "parents' educational qualifications and students' health status are significant factors affecting their academic performance". According to Akinsanya et al. (2014), "parents' education significantly influences students' academic achievement because a child from an educated family has more opportunities to study hard due to access to the internet, newspapers, and television. They can also receive extra lessons at home. Students raised in illiterate families need more access to these resources".

The falling academic standards and the influencing factors include the parent's economic status. Given the country's current economic situation, many poor parents send their children to do petty household work before school. These children often need clarification about how to help their families and manage their academic work. Poverty has a significant effect on children's academic work as they lack sufficient resources and funds to sponsor their education, including good schooling, housing facilities, medical care, and social welfare services. However, in his study, Obeta(2014) says that "parents' socio-economic and educational background is not a significant factor in students' performance". Ogbugo-Ololube (2016), in their "research on the impact of students' parental background on academic achievement in secondary schools, revealed that family structure, parents' occupation, and educational level of parents did not have a significant influence on students' achievement in Biology". Lebata and Awelani (2014) concluded in their study that "the possible factors responsible for poor performance in Biology include lack of financial support, lack of equipped libraries, lack of laboratories and Biology textbooks, teaching methods, and assessment in Biology". Owino et al. (2014) attached "the problem to an inadequate supply of teaching and learning resources, such as chemicals, charts, apparatus, models, local specimens, laboratories, textbooks, and libraries, which lead to poor performance in Biology".
Biology must be taught using hands-on and different learning materials to improve students' achievement and arouse their interest. This will enable them to acquire the cognitive competence and proficiency needed to pass the subject.

2.2 Relevance of These Concepts to the Field of Study

2.2.1 Importance of Practical Work Experience in Science Teaching

Practical work has taken center stage at all levels of school science since the early introduction of activity-oriented science curricula. A survey of practical work carried out by Palmer et al (2017) found that most secondary school teachers indicated that about 40% to 80% of class time was spent on practical activities. Research studies carried out on the role of practical work (Ihejiamaizu & Ochui, 2016; Savery, 2015; Musah & Umar, 2017) agreed that "practical work is, and probably will be, an essential activity in school science. However, there were wide variations in the importance of the role and purpose of practical work carried out in classrooms".

Grooms and Sampson (2015), on the other hand, stressed that "science laboratories should provide opportunities for concrete experiences and ways to help students confront their misconceptions and develop skills in logical thinking and organization". Osborne (2015) classified "the reasons given by teachers for engaging in practical work into five major categories: to motivate learners by stimulating interest and enjoyment, to teach laboratory skills, to enhance the learning of scientific knowledge, to give insights into scientific methods, and to develop certain scientific attitudes".
Practical work is one perspective that could lead to student engagement and active participation in the learning process and, hence, to authentic knowledge construction. Dawud (2020) observed that "the practical teaching method involves a two-way approach carried out by one or more persons through exercise and experimental approaches, both valuable in science teaching". Eliyahu et al (2021) and Dawud (2020) observed that the use of practical work in science teaching has the following benefits:

- Practical teaching makes students learn about the nature of science and technology, fostering knowledge of human enterprise in science and enhancing the aesthetic and intellectual understanding of the child.
- Learning scientific inquiry skills that can be transferred to other spheres of problem-solving (i.e., acquisition of problem-solving skills).
- Students learn to appreciate and emulate the scientist's role through acquiring manipulative skills.
- Development of interests, attitudes, and values. When students are given the chance for personal experience by handling real things, a field experience has the best potential for stimulating a lifelong interest in science.

2.2.2 Challenges of Teaching Science in the Laboratory

The Science Teachers Association of Nigeria (STAN) has made definite demands on the teaching of science. This means that there are some demands made of the teacher if he or she is to teach effectively, and also some demands made of the students to benefit maximally from the program. The teacher must be able to modify their teaching method if such an approach needs to be fixed and ensure that laboratories are well equipped. Students must be actively involved in learning and able to apply their knowledge to new situations.

Emeka et al. (2021) state that Nigeria's problem has been one of implementation. Winthrop et al. (2016) highlight the ongoing scientific and technological developments worldwide. Nigeria must actively embrace this technological evolution to avoid being left behind, which would have dire consequences. Despite governmental efforts to promote science education and numerous research initiatives, Nigeria's challenges persist in teaching and learning sciences. These challenges include insufficient laboratories, a shortage of qualified science teachers, unclear institutional objectives in science teaching, inadequate textbooks, low learner interest, poorly equipped laboratories, large class sizes, and lack of teacher incentives.

2.3 Empirical Evidence

2.3.1 Studies on Practical Work Experience on Students' Biology Achievement

Ali et al. (2014) investigated “the level of students' academic achievement in Biology, finding it very poor. Their study aimed to identify students' academic achievements in Biology. The sample comprised one hundred respondents selected using a simple random sampling technique from five randomly selected secondary schools. Data were collected using questionnaires, documentary analysis of SSCE results over five years, observations, and interviews. The study highlighted the disappointing declining performance of secondary school students in the Kano district. However, Ali and Gasim suggested that if the government, NGOs, parents, teachers, students, and other involved bodies properly implement their recommendations, the level of students' academic achievement in Biology could reach its maximum standard”.

Ezechi (2019) conducted “a study to investigate the effect of improvised instructional materials on senior secondary school students' achievement in biology. The study adopted a quasi-experimental design, specifically, the pre-test and post-test non-equivalent group design. One hundred SS1

students were randomly drawn from public secondary schools in the Enugu State as the study sample. The instrument validated for data collection was the Biology Achievement Test (BAT). Five research questions were analyzed using mean, standard deviation, and ANOVA. The results revealed that students using improved instructional materials performed better than those taught using conventional materials".

Ihejiamaizu and Ochui (2016) studied "the utilization of Biology laboratory equipment and students' academic performance in senior secondary schools in Cross River State, Nigeria. An ex post facto research design was adopted, and a sample of four hundred and ninety Biology students was used. The instruments for data collection included a checklist on utilizing Biology laboratory equipment and the Biology Achievement Test. The hypothesis was tested at the 0.05 level of significance. The analysis revealed that utilizing Biology laboratory equipment significantly influenced students' academic performance in Biology".

2.3.2 Gender Studies on Practical Work Experience and Achievement

Some empirical research has been conducted on gender issues relevant to the present study. Maduabum (as cited in Shodeinde, 2015) studied the relative effectiveness of expository and guided discovery methods on students' performance in Biology. The study involved 42 male and 40 female SS1 students in a non-randomized pre-test and post-test control group design. The analysis showed no significant difference in the performance of male and female students exposed to the expository and guided discovery methods.
In another study, Iloputaife (as cited in Shodeinde, 2015) investigated the effect and analogy of conceptual changes in instructional models on integrated science among 186 JSS2 students (86 males and 100 females). The study revealed a significant difference in the performance of male and female integrated science students, attributed to the constructivist and conceptual instructional model used.

2.3.3 Distinction from Earlier Research

Previous studies, such as those by Maduabum and Iloputaife, have explored the impact of different instructional methods on academic achievement and have considered gender differences. However, these studies focused on something other than practical work experience. Maduabum's study compared expository and guided discovery methods without examining hands-on, practical activities (Shodeinde, 2015). Iloputaife's research on conceptual instructional models highlighted significant gender differences but did not investigate how practical work experiences influence these outcomes (Shodeinde, 2015).

This study distinguishes itself by focusing explicitly on the impact of practical work experience on academic achievement in biology. It assesses the effectiveness of practical work compared to modified lecture methods and examines whether this approach affects male and female students differently. By doing so, this research addresses a gap in the literature, providing new insights into how practical work experiences can be leveraged to improve educational outcomes in biology and ensuring that these benefits are equally accessible to all students, regardless of gender.

3.0 MATERIALS AND METHODOLOGY

3.1 Materials

3.1.1 Population of the Study: This study's target population comprised 200 SS1 students in two selected secondary schools in the Yenagoa metropolis of Bayelsa State.

3.1.2 Sample and Sampling Techniques: This study's sample size included 40 students from two intact classes designated for the treatment and control groups. A simple random sampling technique was employed to select two schools, which were then assigned to the control and experimental groups.

3.1.3 Administration of Instrument for Data Collection:
Letter: The researcher obtained a letter of introduction from the Department of Science Education, Niger Delta University, addressed to the head teachers of the selected schools, requesting permission to use their facilities, teachers, and students for the study.
Training of Teachers: The researcher visited the participating teachers in their respective schools to train them to adhere strictly to the instructional and experimental procedures. Two teachers and research assistants were trained for the experimental group and instructed to use the instructional guide on biology practical work. Teachers for the control group were shown how to guide their students accordingly. The first week was dedicated to training the participating teachers in the selected schools.

3.1.4 Instrumentation: Data for the study were collected using a researcher-constructed instrument called the "Biology Achievement Test (BAT)." The BAT consisted of 20 objective test items designed to measure the effect of the instruction during the experiment. The BAT questions were constructed based on the SS1 biology curriculum topic "Food Test." The BAT assessed students' achievements in biology.

3.1.5 Validity of the Instrument: The Biology Achievement Test (BAT) was subjected to face and content validation by the supervisor and three experts (one in test construction, one in the English language, and one in biology education). These experts scrutinized the instrument for appropriateness and adequacy. Their comments, criticisms, suggestions, and recommendations were incorporated to modify the items and produce the final instrument.

3.1.6 Reliability of the Instrument: To establish the reliability index of the Biology Achievement Test (BAT), a test-retest method was employed.

3.2 Methodology

3.2.1 Pretest: The pretest was administered to the experimental and control groups in their respective schools. The BAT was administered to both groups from the two schools. One group formed the control group, and the other was the experimental group. The students were given 20 test items to answer, and their responses were marked and recorded.

3.2.2 Treatment: Both groups received classroom teaching for two weeks. Both groups received the same content treatment; however, the experimental group was taught using practical work experience, while the control group was taught without practical work experience.

3.2.3 Posttest: The posttest was administered after the treatment period of two weeks. Objective test items were given to students in both the experimental and control groups. The same questions

were provided to both groups to reduce bias. The class subject teacher assisted in administering the posttest and returned the answers to the researcher, who then marked and recorded the scores.

3.2.4 Research Design: This study adopted the quasi-experimental design, specifically the non-equivalent control group design. This design was chosen because the experiment was conducted in intact classes to avoid disrupting normal class schedules; thus, students were not randomly assigned to treatment or control groups.

Table 1: Diagram illustrating the non-equivalent control group.

Group	**Pretest**	**Treatment**	**Post-test**
E	T1	X	T2
C	T1	-	T2

3.2.5 Method of Data Analysis: Mean and standard deviation were used to answer the research questions, while the T-test was employed to test the hypotheses at a 0.05 significance level.

4.0 RESULTS

4.1 Analysis of Demographic (Personal) Variables

This section covers the gender of the respondents.

4.1.1 Gender distribution of respondents:

Table 2 shows the gender distribution of students that participated in the treatments administered to the control group and experimental group. The total number of students in both groups are 219. consisting of 109 male students and 110 female students representing 49.8% and 50.2% respectively of the total number of students.

Table 2 a. Gender distribution of students that participated in the treatments administered to the control group and experimental group

Gender	**Frequency**	**%**
Male	109	49.8
Female	110	50.2
Total	219	100

Source: Field survey, 2018

4.1.2 Gender distribution of students in control group:

Table 2 indicates the gender distribution of students in the control group. The total number of students in the control group is 111, comprising 53 male students and 58 female students, representing 47.7% and 52.3% of the total number of students in the control group, respectively.

Table 2b. Gender distribution of student's in the control group

Gender	Frequency	%
Male	53	47.7
Female	58	52.3
Total	111	100

Source: Field survey, 2018

4.1.3 Gender distribution of students in experimental group:

Table 3 clearly shows the gender distribution of students in the experimental group. The total number of students in the experimental group is 108, 56 of whom are male and 52 female, making up 51.9% and 48.1%, respectively.

Table 3. Gender distribution of students in the experimental group

Gender	Frequency	%
Male	56	51.9
Female	52	48.1
Total	108	100

Source: Field survey, 2018

4.2 Analysis of Research Questions

4.2.1 Research Question 1:

How does practical work experience impact SSI students' biology mean achievement scores?

Table 4: The mean and standard deviations of achievement scores of students taught with practical work experience and those taught with modified lecture method experience.

Group	Pre-test X	Pre-test SD	Post-test X	Post-test SD	Mean gain
Experimental	4.25	1.59	10.72	4.38	6.47
Control	4.80	1.8	9.6	2.2	4.8
Difference in mean	0.55		1.12		

Source: Field survey, 2018

Analysis of data obtained in Table 4 above shows the pre-test mean achievement scores of students not exposed to practical work experience, being those in the control group, is 4.80, with a standard deviation of 1.8. This indicates a mean gain of 4.8, while the post-test achievement score of students not exposed to practical work experience is 9.6, with a standard deviation of 2.2. Similarly, the pre-test mean achievement score of the experimental group is 4.25, with a standard deviation of 1.59. At the same time, the post-test mean and standard deviation are 10.72 and 4.38, respectively.

Thus, from the above analysis, it can be deduced that the modified lecture experience does not impact students' achievement, whereas practical work experience enhances their achievement. There was a mean gain of 4.8 after the post-test for the control and 6.47 after the post-test for the experimental groups, respectively. The mean difference between the experimental and control groups was 1.12 in favor of the experimental group.

4.2.2 Research Question 2:

What impact has gender had on SSI students' achievement in biology when taught with practical work experience?

Table 5: The mean and standard deviation of males and females of the experimental group.

Group	Post-test (Experimental Group) X	SD
Male	10.71	3.18
Female	10.73	5.39
Difference in mean	0.02	

Source: Field survey, 2018

Table 5 shows that the mean and standard deviation scores of male students in the experimental group were 10.71 and 3.18, respectively, while those of females were 10.73 and 5.39. The difference in the mean achievement score of male and female students was negligible (0.02), so no gender difference was recorded.

4.3 Test of Research Hypotheses

4.3.1 Hypothesis (Ho1)

There is no significant difference in the mean achievement score of SS1 students taught with biology practical and their counterpart taught with modified lecture method experience.

Table 6: Summary of T-test analysis of the Post-Test scores of the experimental and control groups.

Groups	N	Mean	SD	Df	t-cal	t-crit	Test	P
Experimental	108	10.72	4.38	217	2.38	1.97	Two-tailed	0.05
Control	111	9.6	2.2					

Source: Field survey, 2018

Table 6 presents the means for the experimental and control groups as 10.72 and 9.6, respectively. The standard deviations were 4.38 for the experimental group and 2.2 for the control group. The calculated t-value is 2.38, which exceeds the critical t-value of 1.97 at 217 degrees of freedom with a 0.05 significance level. Consequently, the null hypothesis (HO1) is rejected, indicating a significant difference in post-test achievement in biology between students taught with practical work experience and those taught with the modified lecture method.4.3.2 Hypothesis (Ho2)

There is no significant~~ce~~ effect of gender on the mean achievement score of SS1 students taught biology with practical work experience.

Table 7: Summary of the t-test analysis of the experimental group's post-test scores for male and female students.

Groups	N	Mean	SD	Df	t-cal	t-crit	Test	P
Male	56	10.71	3.18	106	-0.02	1.98	Two-tailed	0.05
Female	52	10.73	5.39					

Source: Field survey, 2018

Table 7 presents the calculated means of 10.71 for male students and 10.73 for female students. The standard deviations are 3.18 for males and 5.39 for females. The t-calculated value is (-0.02), lower than the t-critical value of (1.98) at 106 degrees of freedom with a 0.05 significance level. This analysis leads to accepting the null hypothesis (HO2), indicating that gender does not significantly affect the mean achievement score of SSI students taught with practical work experience.

5.0 DISCUSSION

This study compares the biology achievement of students taught using practical work experience with those taught using a modified lecture method. It also examines gender differences in the biology achievement of male and female students taught with practical work experience. The results indicate that practical work experience significantly increases students' achievement in biology, as reflected in the experimental group's higher mean scores than the control group (see Table 6). Students taught with practical work experience improved biology achievement more than those taught with the modified lecture method. These findings align with Patrick (2017), who asserts that science education is inherently practical. Similarly, Odukoya et al. (2018) reported that only practical work in science simultaneously engages students' cognitive, psychomotor, and affective domains.

Table 7 shows that male and female biology students with practical work experience have post-test mean scores of 10.71 and 10.73, respectively. While female students have a slightly higher mean score than male students, the t-test statistics indicate that this difference is insignificant. This suggests that female students performed as well as their male counterparts, indicating that practical work experience is gender-inclusive. These findings agree with Maduabum in Shodeinde (2015). However, Iloputaife in Shodeinde (2015) argues that there is a significant difference in the performance of male and female students in integrated science.

These findings highlight that practical work experience has a high potential for improving students' grades in science. It enhances students' creative thinking, scientific methods, and psychomotor skills. Practical work experiences generally positively affect students' academic achievement and can be adapted for students with special needs. This approach supports and strengthens theoretical knowledge, promising students significant academic and social benefits.

6.0 CONCLUSION

Practical work experience is an effective educational strategy for enhancing students' achievement in biology. Adopting this approach will help students understand biology better and alleviate their fear of the subject. Additionally, practical work experience fosters students' communication and creative thinking skills.

While the modified lecture method remains effective, it should be partially discarded but combined with other teaching methods. The findings indicate that practical work experience significantly improves students' achievement in biology compared to the modified lecture method. Furthermore, there is no significant gender difference in students' achievement when taught with practical work.

Therefore, to maximize students' achievement in biology, it is crucial to supplement the practical work experience with the modified lecture method. This combined approach will provide a more comprehensive and practical biology education.

6.1 Educational Implications of the Study

This study investigated the impact of practical work experience on academic achievement in biology at the senior school level. The findings, which indicated significantly higher mean scores for academic achievement among students in the experimental group than those in the control group, imply that science teachers should expose students to practical work following theory classes to ensure sustained improvement in academic achievement.

Another vital finding of this study was the absence of significant differences in high mean scores between male and female biology students with practical work experience. This suggests that the practical work experience teaching strategy is gender-friendly and that teachers should be fully encouraged to utilize it in teaching-learning.

An important implication of this study is that any science instruction based solely on theory should be seriously discouraged. School laboratories need to be equipped with modern instruments, apparatus, chemicals, and other necessary materials to facilitate practical work in schools.
In conclusion, the implications highlighted are meaningful and relevant to education, underscoring the importance of this study.

7.0 RECOMMENDATION

Based on the study's findings, the following recommendations are proposed:

1. Science teachers should be encouraged to conduct practical sessions at least once a week in all primary and secondary school classes.
2. The Ministries of Education (both Federal and State), in collaboration with educational institutions, should organize seminars and workshops to familiarize biology teachers and other science educators with the application of practical work experience.
3. Teachers should strive to make teaching learner-centered by promoting student cooperation and teamwork. This approach will enhance achievement in science subjects, including biology.
4. Practical allowances should be provided to science teachers to motivate them to adopt practical work experience strategies in the teaching-learning process.

7.1 Limitations of the Study

The researcher encountered several limitations while conducting this study. These limitations were unavoidable. One significant issue was the unwillingness of some students to participate in group work, which made administering treatment to the experimental group challenging.

Time constraints also limited the study, as the available time was insufficient for the research.
The large class size (overpopulated) led to noise and lack of attention from students in both the control and experimental groups. For practical work and teaching to be more effective, the class size should ideally be limited to 40-50 students.

Additionally, the time block allotted for administering treatment to the experimental group needed to be increased, and the typical forty-minute lesson period allocated for teaching students in secondary schools proved inadequate for effectively administering the treatment to the experimental group.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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Details of the AI usage are given below:

1.

2.

3.

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