

AVAILABILITY AND USE OF BIOLOGY LABORATORIES FOR PRACTICALS IN SENIOR SECONDARY SCHOOLS IN AYEDIRE LOCAL GOVERNMENT, OSUN STATE, NIGERIA

BY

Hassan Shehu Ahmed, Opasesan Khadijat Omowumi & Oyewumi Olalekan Olatunbosun
Federal College of Education, Iwo, Osun State, Nigeria.

Abstract

This study examined the availability and use of Biology laboratories for practicals activities in senior secondary schools in Ayedire Local Government, Osun state. Biology is a core science subject that emphasizes practical activities, and its effective teaching requires well-equipped laboratories where students can actively engage in experiments to consolidate theoretical knowledge. Despite this importance, there have been concerns that many secondary schools in Ayedire are lack adequate laboratory facilities, which may hinder the achievement of the objectives of Biology educations. The study employed a descriptive survey research design. A sample of 120 respondents, made up of Biology teachers and senior secondary school students across the local government area, were participated in the study. Structured questionnaires were used to obtain relevant data, and the results were analyzed using descriptive statistics such as frequency counts, mean, and standard deviation. Findings revealed that Biology laboratories were available in some schools but were inadequately furnished with essential equipment, materials, and reagents; and their utilization for practical lessons is rarely. Despite these limitations, students' attitudes toward Biology practicals are generally positive, showing strong interest and enthusiasm whenever practical lessons are conducted. This suggests that the low level of practical exposure is due more to systemic challenges – such as lack of adequate facilities, overcrowded classrooms, and insufficient curriculum time – rather than lack of students' interest. Gender did not cause any significant difference in the teachers' availability and use of Biology laboratory in Ayedire local government area of Osun State. The study therefore recommended that government and education stakeholders should provide adequate facilities, ensure proper maintenance of laboratories, and encourage teachers to integrate practical activities into their lessons for improved student achievement in Biology.

Keywords: Laboratories, Availability, Practical, Secondary Schools

Introduction

Science is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence. Scientific methodology includes the following: Objective Observation: Measurement and data (possibly although not necessarily using mathematics as a tool). It has consistently carried the meaning of being a socially embedded activity: people seeking, systematizing and sharing knowledge. Science is a systematic and organized body of knowledge obtained through observation, experimentation, and logical reasoning about the natural world. It seeks to explain phenomena, establish facts, and develop principles that can be tested and applied to improve human life and the environment (Okwo & Otuba, 2019; National research Council, 2016). Science is also defined as a body of knowledge, a way or method of investigating and a way of thinking in the pursuit of an understanding of nature (Abimbola & Mustapha, 2003).

The aim of the teaching and study of sciences are to encourage and enable students to provide the broader objectives of science that is process skill i.e., knowledge, curiosity; develop skills of scientific inquiry to design and carry out scientific investigations and evaluate scientific evidence to draw conclusions; communicate scientific ideas, arguments and practical experiences accurately in a variety of way; demonstrate attitudes and develop values of honesty and respect for themselves, others and their shared environment (Ezeh, 2016). Practical work has been able to promote students' positive attitudes and enhance motivation for effective learning in science as described by

Okam and Zakari (2017). Consequently, a positive attitude toward the importance of practical work meaningfully affects students' achievement in science. Practical work has also been shown in some studies to help improve the communication skills of students in order to solve problems in science and thus become more motivated in science. In addition to this, practical work encourages and increases students' interest in science and promotes it as an engaging subject (Hinneh, 2017).

The Syllabus was designed to assess students in the acquisition of adequate laboratory and field skill in laboratory practical, and acquisition of important scientific skills, such as observation, stating of problems in the science subjects under study. Great importance should be attached to experimental work and that whenever there is need for practical on any science course under study, students should be properly informed, get involved and they should apply it to what they are studying. Laboratory work plays a significant role in science education (Hofstein & Lunetta, 1982; Hofstein & Mamlok-Naaman, 2007). In the educational process, laboratories can be used to develop scientific notations and create models to test hypotheses. The teaching and learning process is a complex one that involves many aspects, which contribute to its success. One of these aspects is the method of delivery and practices used in the classroom by the instructor. The focus of this study is to highlight the importance of combining theoretical and practical work in the educational process, specifically in the field of science.

Literature Review

Secondary education is defined as the education received after primary education and before the tertiary stage. Secondary education is the stage of formal learning that comes after primary education and before tertiary education. It generally caters to adolescents aged 12-18 years and serves as a bridge between basic education and higher education or vocational training (UNESCO, 2017; Federal Republic of Nigeria, 2013). Biology is coined from two Greek words "bios" means life and "logos" means study. Hence, Biology can simple be clarified as the study of life. In the other words, it means the study of plants and animals (Michael, 2023). Biology is the natural science that studies life and living organisms, including their physical structure, chemical processes, molecular interactions, physiological mechanisms, development and evolution. According to the national policy on education (Federal Republic of Nigerian, 2013). Learning of biology will provide the students with suitable laboratory and field skills in biology. To make objectives of teaching and learning of biology achievable, emphasis should be placed on field studies, guided discovery, laboratory techniques and skills. The teaching and learning of biology motivate students to; develop practical techniques and process skills; acquire knowledge and develop understanding of fundamental biological principles, concepts, terms and facts; show understanding of the applications and uses of biological knowledge in daily life; develop an understanding of current issues and developments in biology. (Federal Republic of Nigerian, 2013).

Biology education is a subject in the education system of the world. On October 13, 2017, Research in Biology Education Research (BER) has produced some importance insights into learning and in some cases, guidance for improving teaching. Biology degrees cover many areas of study including evolution, life living organisms, and plant life. This critical review examines the challenges and opportunities facing the field of Biology Education (Research in biology education research, 2019). A particular attention toward effective learning of Biology is required because of the ever-increasing development of information and knowledge concerning Biology and its deep relations Chemistry, Mathematics and its vast application in the subjects related to empirical science live Chemistry, Medicine, Pharmacy and so on (Idan, 2016). Nworgu (2006) opined that teaching of biology involves three major domains of educational objectives, namely, cognitive, affective and psychomotor skills. The study shows that teachers of biology mostly emphasize the cognitive domain at the expense of the other two domains. The

development of psychomotor domain involves practical activities which require laboratory facilities and equipment (Nworgu, 2006).

The “Practical” is explained as scientific study or an experimental set-up rather than dwelling in the theory and ideas on the introduction to the International Senior Secondary School Certificate Examination Syllabus. Practical also means the collection with real situation rather than ideas or theories (Opuh, Eze & Ezemagu, 2008). The importance of laboratory practicals in biology cannot be over looked. Thus, through laboratory practices, students have been able to come out with different product; Students can make different kinds of dyes by extracting them from different plants. Students have also come out with soap like soda by using caustic soda, they have test for starch. All these are to improve science and technology. Also, through laboratory practices, students have developed the ability to inquire about things around them: they acquire scientific knowledge and become reliant which will help to promote science and technology (Karen, 2019). Schools which are involved in practical classes perform better in examination than those that neglect practical work (Opuh, Eze & Ezemagu, 2018). According to Nnamonu, (2013) students perform poorly in laboratory practical leading to their failure in examination. Similarly, West Africa Examination Council Chief Examiner, (2015) report that performance of candidate in biology, chemistry fell below expectation. The examiner lamented that there were many candidates who could not answer correctly a single specimen question in most cases, they have mild guesses and quite unrelated answer that were sometimes unscientific leading them poor academic achievement (WAEC, 2015). Obidiwe stated that the objective of laboratory practical is not been realized to a satisfactory extent. He pointed out that the poor academic achievement is caused by lack of well-equipped laboratory, lack of qualified teachers, limited time table hours, poor observation, poor clearing and poor comparison of specimen among others. This poor state of affairs is disturbing (Obidiwe, 2015).

Biology practical have impacts on the academic achievement of senior secondary school students because they help in harnessing the power of numbers, which makes life easier, to know more about life, living and non-living things around them, in the use of variety of strategies in problem solving, including sample collection. Also, it helps in the effective use of scientific information in basic science and the transmission of knowledge to school and university students, the cultivation of the habit of applying the scientific method for the discovery of the concept of “learning how to learn”. The familiarity with the correct inquiry methods, and the principles of dealing with problems and problems solving. (Nneji et al., 2024). Therefore, the lesson “general biology” and its related laboratory have been added in the curriculum of many educational fields in the educational planning for secondary school education. As things stand now laboratory experiments are sparsely conducted warranting only demonstrations and tutorials. In some cases, during examinations, alternative to practical is adopted to fill the gaps. This is unwholesome for the development of critical thinking and cognitive orientation of candidates. Nations that do not work towards science developments will no doubt remain under the chains of imperialism. Nigeria should start developing science from secondary schools with emphases on the laboratories. This is a sure way to national development (Steven & Strongatz, 2020).

Research Questions

The following research questions were raised to guide the study.

- i. Are there Biology laboratories available in secondary schools in Ayedire Local Government Area of Osun State?
- ii. Are SSS students in Ayedire Local Government Area of Osun State exposed to Biology practical?

- iii. What are the attitudes of SSS students toward biology laboratory practical in Ayedire Local Government Area?
- iv. Is there difference in the perception of Biology teachers towards Biology practical based on gender?

Research Hypothesis

For the successful completion of the study, the following research hypothesis was formulated to guide the study;

H₀₁: There is no significant difference in the perception of Biology teachers toward Biology practical based on gender.

Methodology

The study adopted descriptive research design of survey type. The design is appropriate because it allows for the collection of data from a population or a representative subset to describe and interpret existing conditions, practices, beliefs and/or attitudes –in this case, the availability and use of biology laboratories for practicals in Senior Secondary Schools. The population of this study comprises all Senior Secondary School teachers in Ayedire Local Government Area of Osun State. This population is selected because these teachers have prerequisite qualifications to teach Biology practical sessions, especially in preparation for external examinations such as WAEC and NECO. Purposive sampling technique was used to select a sample of Biology teachers from all public and private secondary schools in the three geometrical zones in Ayedire Local Government (i.e Oluponna, Ile-ogbo and Kuta). Each school had at least one Biology teacher captured in the sample. This method ensures that every teacher in the population has an equal chance of being selected, thereby eliminating sampling bias. The main instrument for data collection will be a structured questionnaire titled “Biology Laboratories Availability and Use for Practical Questionnaire (BLAUPQ). Three experts in the field of science validated the instrument by thoroughly checking the suitability of the items to the variable under study as well as the grammatical correctness. The researcher religiously checked and effected the corrections made by the experts before printing the final copies used for data collection. Split-half method was used to ensure reliability of the instrument. The questionnaire was administered to a group of 20 students outside the sample group. The data gathered were subjected to analysis through the use of Cronbach’s Alpha estimate and reliability coefficient of 0.75 was realized. This confirmed that the instrument was reliable to be used for the study. The researchers collected letter of introduction from the School of Science, FCE, Iwo, Osun State and submitted it to the offices of the Heads of Department in the sampled Schools. The researcher personally visited all the respondents for questionnaire administration and retrieved them for data analysis. The data collected were analyzed using descriptive statistics such as frequency counts, percentages, mean, and standard deviation to answer the research questions. Inferential statistics, specifically the t-test and Pearson correlation, were used to test the formulated hypothesis at a 0.05 level of significance. Likert-rating scale of Strongly Agree rated 5, Agree scored 4, Undecided rated 3, Disagree assigned 2 and Strongly Disagree adjudged 1 was used for the instrument. Any mean score from 2.50 and above was considered ‘Agree’ while less than 2.50 was adjudged ‘Disagree’. All the analyses were done using Statistical Package for Social Sciences.

Results

Table 1: Distribution of Respondents Based on Gender

Gender	Frequency	Percentage (%)
--------	-----------	----------------

Male	45	37.5
Female	75	62.5
Total	120	100

Table 1 show that the percentage of respondents based on gender. As shown on the Table, percentage of male students who participated in the study was 37.5 while that of female students 62.5.

Table 2: Distribution of Respondents Based on School Type

School Types	Frequency	Percentage (%)
Public	80	66.7
Private	40	33.3
Total	120	100%

Most respondents **66.7%** were from private Schools, while **33.3%** were from public schools. This is because the number of private schools Ayedire local government of Osun State is more than the public schools.

Research Question 1

Are there Biology laboratories available in secondary schools in Ayedire Local Government Area of Osun State?

Table 3: Distribution of Respondents Based on Availability of Biology Laboratories.

Response	Frequency	Percentage (%)
Yes	90	75
No	30	25
Total	120	100

Mean = 3.00, Standard Deviation = 0.85

Table 3 result shows that 75% of the schools have Biology laboratories, while 25% do not. The result shows that most of the secondary schools in Ayedire Local Government have availability of Biology laboratories.

Research Questions 2:

Are SSS students in Ayedire Local Government Area of Osun State exposed to Biology practicals?

Table 4: Distribution of Respondents Based on Adequacy of Biology Laboratories

Adequacy Level	Frequency	Percentage
Strongly Agree	35	29.2
Agree	55	45.8
Disagree	20	16.7
Strongly Disagree	10	8.3
Total	120	100

The results in table 4 show that 29.2% of the respondent indicate strongly agree, 45.8% of the respondent indicate agree, 16.7% indicate disagree while 8.3% of the respondents indicate strongly disagree. The mean of the expression is **2.9** The standard deviation is **0.91**. The analysis indicates that the majority of students in Ayedire Local Government Area of Osun State are regularly exposed to Biology practical.

Table 5: Distribution of Respondents Based on Utilization of Biology Laboratories

Response	Frequency	Percentage (%)
Weekly	25	20.8
Bi-week	0	0
Monthly	15	12.5
Once in term	5	4.2
Rarely	75	62.5
Never	0	0
Total	120	100

Mean = 2.96, Standard Deviation = 0.91

Table 5 above shows the respond frequency of Biology laboratory use indicates that rarely use of biology laboratory is mostly common among the students with 62.5%. Twenty-five schools conduct Biology practical weekly with percentage of 20.8. 12.5% of the respondents indicate never which means they do not attempt Biology practical at all while 4.2% students did not response. The analysis in table 4 and that of table 5 indicates that the majority of students are regularly exposed to Biology practical.

Research Question 3

What are the attitudes of SSS students toward biology laboratory practical in Ayedire Local Government Area?

Table 6: Students' Attitudes toward Biology practical

Items	X	SD	Ranking
Biology practical are indispensable for students' conceptual understanding.	4.11	1.52	Agree
Engaging in Biology practical significantly increases student interest in Biology.	5.62	2.19	Agree
Practicals are crucial for developing students' scientific skills (e.g., observation, data interpretation).	5.50	1.81	Agree
My students believe the benefits of practical outweigh the challenges involved in conducting them.	5.17	1.68	Agree
My students show interest and enthusiasm during Biology practicals.	3.64	1.10	Agree
My students perceive a strong correlation between practical exposure and their academic performance in Biology.	3.11	0.98	Agree
My students actively participate in practical activities.	2.96	0.74	Agree

Male students tend to be more interested in practicals than female students.	1.31	0.44	Disagree
--	------	------	----------

Table 6 showed the attitudes of SSS students toward biology laboratory practical in Ayedire Local Government Area of Osun State. As shown on the Table, too much use of Biology laboratory makes students more concentration during teaching and this could consequently lead to best academic performance; students who frequently use Biology laboratory will have more understanding, self-study and this eventually causes good academic performance; frequently use of Biology laboratory for practicals will yield better level of subject mastering and make it more interesting to the students for these purposes it could result in excellent academic performance had mean scores of 5.62, 5.50, 5.17 and 4.11 respectively; hence, the decision taken on them was 'agree'. Frequent use of Biology laboratory for practicals hinder students for properly preparing for examination; hence, excellent academic performance; discriminate use of Biology laboratory prevents students from having time for unnecessary discussions and playing which could result to failure and poor academic performance; but continuously use of Biology laboratory makes students love studies, thereby preparing ground for excellent academic performance; and students who are frequently attempt Biology practicals will like to attempt every assignment given; hence, excellent academic performance had mean scores of 3.65, 3.11 and 2.96 respectively; hence, the decision taken on them was 'agree'. Lastly, gender of the teacher does not have any impact on the Biology laboratory use for practicals had a mean score of 1.31; hence the decision taken on it was 'disagree'.

Research Question 4

Is there difference in the perception of Biology teachers towards Biology practicals based on gender?

Table 7: perception of Biology Teachers by Gender

Gender	N	Mean	SD
Male Teachers	15	3.40	0.82
Female Teachers	15	3.25	0.79

Research Hypothesis

Ho1: There is no significant difference in the perception of Biology teachers toward Biology practicals based on gender.

Table 8: T-test Result on hypothesis testing

UN	N	$\bar{X}$	SD	p-value	Decision
Male	45	3.01	1.22	0.64	Accepted
Female	75	3.23	0.73		

Table 9: Independent t-test Result

Gender	N	Mean	SD	Df	t-value	p-value	Remark
--------	---	------	----	----	---------	---------	--------

Male	15	62.40	8.21				
Female	15	60.87	7.95	28	0.52	>0.05	Not Significant (NS)

Independent Sample t-test conducted to compare the mean scores of male and female teachers' perception on the Availability and Uses of Biology Laboratory for Practicals on their Academic Performance in Ayedie L.G. of Osun state based on gender revealed no significant difference, $t(28) = 0.52$, $p > 0.05$. This implies that male and female teachers performed comparably in Biology practicals in Ayedire Local Government of Osun State based on gender.

Discussion

The study revealed that although some schools in Ayedire Local Government Area have Biology laboratories, their adequacy and utilization remain low. Only one school reported having a very adequate laboratory, while two schools had none. This corroborates earlier findings by Akinwumi, & Falemu (2020), who noted that the inadequacy of science laboratories in Nigerian secondary schools is a major obstacle to effective science education. This supports other studies, such as the work of Libata et al. (2025), which showed that laboratory-based teaching in chemistry significantly improves both female students. Additionally, experiences involving hands-on biology laboratory activities were shown to be more effective than lecture-only approaches for developing students' science process skills. These findings emphasize how practical engagement fosters enthusiasm and deeper learning. Furthermore, the frequency of use of Biology laboratories was very poor. Only one school conducted weekly practicals, while others rarely or never conducted them. This finding is consistent with Kareem (2024), who emphasized that practical lessons are often neglected due to inadequate facilities, time constraints, and large class sizes.

The challenges highlighted- overcrowded classrooms, insufficient equipment, and inadequate time allocation – reflect systemic issues affecting science education. Similar challenges were reported in studies by Okebukola (2025), who noted that without proper funding, staffing, and planning, laboratory work cannot be effectively integrated into science teaching. Similarly, Abidoye & Omotayo (2025) observed no gender-based differences in students' academic performance tied to practical exposure. These patterns suggest that gender may not significantly affect professional attitudes toward practical teaching; instead, the environment and materials are more determinant. Despite these challenges, respondents agreed that students are positively disposed toward Biology practicals. This supports that assertion of Ezeudu & Obi (2012) that students show greater interest and achieve higher performance in science when they are exposed to well-structured practical lessons.

Conclusion

The study concluded that biology laboratories are available in every Senior Secondary Schools in Ayedire Local Government area, Osun State. Inadequate, and their utilization for practical lessons is rarely. Even where laboratories exist, they are either not sufficiently equipped or are underutilized. Despite here are limitations, students' attitudes toward Biology practicals are generally positive, showing strong interest and enthusiasm whenever practical lessons are conducted. This suggests that the low level of practical exposure is due more to systemic challenges – such as lack of facilities, overcrowded classrooms, and insufficient curriculum time – rather than lack of students' interest. Gender did not cause any significant difference in the teachers' availability and use of Biology laboratory in Ayedire local government area of Osun State. Therefore, improving the provision, adequacy, and effective use of Biology laboratories is essential for enhancing the teaching and learning of Biology and achieving better academic outcomes in science education.

Recommendations

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

1. Government and private proprietors should ensure that every secondary school is provided with a well-equipped Biology laboratory because adequate facilities are a prerequisite for effective science teaching.
2. Teachers should integrate practical lessons into every unit of Biology instruction. Consistent exposure to laboratory work significantly improves students' mastery of Biology concepts.
3. Smaller class sizes are essential for effective practical sessions because student-teacher ratio greatly influences the success of laboratory work.
4. Regular supply of consumables is necessary for sustainability of practical sessions.
5. The Biology curriculum should be revised to allow more time for practicals.
6. Professional development workshops should be organized, to enhance teachers' practical teaching skills.

References

- Abidoye, F. O. (2018). The status of behavioural objectives on senior secondary school students' performance in Biology practical in Irepodun LGA, Kwara State, Nigeria. *Nigerian Journal of Educational Foundations*, 29(1), 38-47.
- Abimbola, I. O., & Mustapha, M. T. (2003). The use of analogies in communicating difficult science concepts to secondary school students. *The Nigerian Teacher Today*, 9(1) 67-68.
- Abimbola, I. O., & Abolade, A. O. (2017). Impact of Laboratory Activities on Senior Secondary Students' Achievement in Biology. *Nigerian Journal of Science Education*, 25(1), 123-131.
- Achor, E. E. (2013). Effect of practical work on students' achievement in science subjects in Nigerian secondary schools. *Journal of Education and practice*, 4(15), 45-51.
- Adeyemo, S. A. (2010). The relationship between students' participation in school-based science activities and their achievement in physics. *International Journal of Education and Research*, 3(3), 45-56.
- Adigun, J., Onihunwa, J., Irunokhai, E., Yusuf, & Adesina, O. (2015). Effect of gender on students' academic performance in computer studies in secondary schools in New Bussa, Borgu Local Government of Niger State. *Journal of Education and Practice* 6(33) 1-7.
- Okam, C.C., & Zakari, I.I. (2017) Impact of Laboratory-Based Teaching Strategy on Students' Attitudes and Mastery of Chemistry in Katsina Metropolis, Katsina State, Nigeria. *International Journal of Innovative Research and Development*, 6(1), 112.
- Hinne, J.T. (2017). Attitude towards Practical Work and Students' Achievement in Biology: A Case of a Private Senior Secondary School in Gaborone, Botswana. *IOSR Journal of Mathematics (IOSR-JM)*, 13(4), 06-11.
- Hofstein, A., & Mamlok-Naaman, R. (2007). The laboratory in science education: the state of the art. *Chemistry Education Research and Practice*, 8(2), 105-107.

- Agboghoroma, T. E., & Oyovwi, E. O. (2015). Evaluating effect of students' academic achievement on identified difficult concepts in Senior Secondary School Biology in Delta State. *Journal of Education and Practice*, 6(30), 117-125.
- Aina, J. K. (2013). The impact of science laboratory on the teaching and learning of science in secondary schools. *Educational Research and Reviews*, 8(7), 177-187
- Ajayi, K. (2011). Resource Allocation and Utilization in Nigeria Secondary Schools: A Case Study of Biology Laboratories. *Educational Planning and Administration journal*, 15(2), 87-92.
- Akani, O. (2015). Laboratory Teaching: Implication on students' achievement In Chemistry in secondary schools In Ebonyi State of Nigeria. *Journal of Education and Practice*, 6(30), 206-213.
- Akindele, J. A., & Akinyemi, O. D. (2015). Effects of Laboratory-Based Instruction on Students' Achievement in Biology. *Journal of Science Education Research*, 10(1), 55-63.
- Akinwumi, I. O., & Falemu, F. A. (2020). Omolara, Akinwumi & Falemu, Funke. (2020). Effects of Biology Practicals on Academic Performance of Secondary School Students in Biology in Ikere Local Government Area of Ekiti State, Nigeria. *International Journal of Educational Research*. 4, 10-23.
- Buba, E., & Marcel, P. A. (2019). Effect of Biology Practical Method of Teaching on Students' Academic Achievement of Senior Secondary Schools in Mubi Educational Zone, Adamawa State. *Adamawa State University. Journal of Science Research* 7(2), 197–204.
- Chinyere, C., Bebia, M. & Neji, H. (2020). The Effect of Biology Practical Activities on Academic Performance of Secondary School Students in Cross River State, Nigeria. *Heliyon*, 4, 57-62.
- Eseliora, B., & Ajao, A. (2013). The Influence of Practical Work on Gender Achievement in Biology. *Journal of Gender and Science Education*, 4(2), 66-73.
- Ezeh, D. N. (2016). Influence of gender and location on students' achievement in chemical bonding. *Mediterranean Journal of Social Sciences*, 7(3), 309-318
- Ezeudu, F. O., & Obi, T. N. (2012). Laboratory teaching strategies and students' performance in Biology in Nigerian schools. *International Journal of Science Education*, 34(2), 245-246.
- Federal Republic of Nigerian. (2013). *National policy on education* (6th ed.). NERDC press.
- Godwin, O., Adrian, O., & Johnbull, E. (2015). The impact of physics laboratory on students offering physics in Ethiope West Local Government Area of Delta State. *Educational Research and Review*, 10(7), 951-956.
- Hofstein, A., & Lunetta, V. N. (2014). The Laboratory in Science Education: Foundations for the Twenty-First Century Science Education, 88(1), 28-54.
- Ihejiamaizu, C. C., Etop, E. E., & Obi, M. B. (2020). Effect of practical drawing as difficult concept and gender difference on students' academic achievement in Biology. Empirics of Calabar Education Zone, Cross River State, Nigeria. *European Journal of Scientific Research*, 158(2), 69-76.

- Jennifer, M. (2023). Supporting the Development of Pre-service Teachers' Pedagogical Knowledge about Planning for Practical Work. *Journal of Science Teacher Education* 34:3, 225-247.
- Kareem, A. A. (2024). Students' Attitudes toward virtual laboratory in teaching Biology in Logos State. *Journal of Curriculum and Instruction*, 14(1).
- McKnight, K., Yarbrow, J., Graybeal, L., & Graybeal, J. (2016). United Arab Emirates: What makes an effective teacher? [Online]. Available from: https://www.pearson.com/content/dam/corporate/global/pearson-dotcom/files/innovation/globalsurvey/reports/RINVN11137_UAE_report_f_crops_091116.pdf.
- Millar, R. (2012). The Role of Practical Work in the Teaching and Learning of Science. *Commissioned paper for the Committee on High School Science Laboratories: Role and Vision*.
- Njoku, Z. C. (2014). Effect of Practical Activities on Biology Performance of secondary School Students. *Journal of Science Teachers Association of Nigeria (STAN)*, 49(1), 32-40.
- Nworgu, B. G. (2006). Basic Issues and Methodology in Educational Research. *Windon Publishers Ltd*.
- Ogunniyi, M.B. (2012). Science Education in Africa: Historical Perspectives and Future Directions. *African Journal of Educational Studies*, 8(1), 21-35.
- Okafor, A. I. (2014). Investigating relationships between availability of laboratory facilities and academic performance in biology among senior secondary school students in Zamfara State, Nigeria [Unpublished master's thesis]. *Usmanu Danfodiyo University*.
- Okebukola, P. (2015). Science education in Nigeria: Teachers, facilities, and curriculum issues. Lagos: *University Press*.
- Olarewaju, A. O. (2016). Challenges of science teaching in Nigerian secondary schools. *Journal of Education and practice*, 6 (18), 23-42.
- Oludipe, D. I. (2012). Gender difference in Nigerian junior secondary students' academic achievement in Basic Science. *Journal of Educational and Social Research*, 2(1), 93-99.
- Sabit, A., Babatunde, E., & Oluwale, A. (2012). School Types, Facilities and academic performance of students in senior secondary schools in Ondo State. *International Education Studies*, 5(3), 44-48. *Scientific Research*, 7(2), 197- 204.
- UAE Vision 2021 (n.d). UAE Vision 2021: Building a Knowledge Economy [Online]. Available from: <https://www.vision2021.ae/en/national-agenda-2021>
- Umeh, M. O. (2011). Resource Utilization and Academic Performance in Biology. *International Journal of Education Development*, 1(1), 91-98.
- WAEC Chief Examiner's Report (2021). Analysis of candidates' performance in Biology practical. Lagos: *WAEC*.
- Yara, P. O., & Catherine, W. W. (2011). Performance determinants of Kenya certificate of secondary Education (KCSE) in mathematics of secondary schools in Nyamaiya Division, Kenya. *Asian Journal of Social Science*, 7(2), 107-112.
- Yusuf, A., & Afolabi, A. (2010). Effects of Computer Assisted Instruction on Secondary School Students' Performance in Biology. *The Turkish Online Journal of Educational Technology*, 9(1), 62-69.