

## EFFECT OF INSTRUCTIONAL MATERIALS AND SCHOOL LOCATION ON STUDENTS' ACADEMIC PERFORMANCE IN BIOLOGY IN AKWA IBOM STATE, NIGERIA

<sup>1</sup>Caroline Gordian Edet, <sup>2</sup>Iniobong Fred Akpan, <sup>3</sup>Nkoyo Asuquo Thomas,

Department of Science Education, Akwa Ibom State University

Ikot Akpaden, Mkpatt Enin, Akwa Ibom State, Nigeria

<sup>1</sup>Carolyn.gordian@gmail.com, <sup>2</sup>Iniobongakpan@aksu.edu.ng,

<sup>3</sup>Nkoyothomas@aksu.edu.ng



### Abstract

*The study examined the effect of instructional materials and school location on students' academic performance in Biology in Akwa Ibom State, Nigeria. Three research questions and three null hypotheses were formulated for the study. The study utilized a quasi-experimental research design, employing a pre-test, post-test nonequivalent control group design with two experimental groups and one control group. Conducted in six co-educational public schools in Uruan Local Government Area, the sample comprised 264 participants. SS1 Biology students in intact classes, randomly assigned to experimental and control groups based on school location. Experimental group 1 was taught using Microscope, experimental group 2 with Microbes Instructional Kit, while the control group received lesson with no instructional material. Data were collected using a researcher-made instrument; Microorganisms Unit Test (MUT), with a reliability coefficient of 0.87. Data collected were analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA) at a significant level of 0.05. Results indicated that students taught with Microscope or Microbes Instructional Kit outperformed those without instructional material, and school location significantly influenced student performance. However, there was no significant interaction effect between school location and instructional material. In conclusion, both Microscope and Microbes Instructional Kit were effective in enhancing students' understanding of Microorganisms in Biology, regardless of school location.*



**Keywords:** Instructional Materials, Microscope, School Location, Students, Academic Performance, Biology

### Introduction

Biology as a subject taught in secondary schools, offers students an extensive exploration of living organisms, ranging from microscopic cells to entire ecosystems. It encompasses a wide array of concepts, including molecular Biology, ecology, genetics, and more, laying the groundwork for comprehending life's complexities on Earth (Udosen, Ogbonna, Jerzy, Iwuji, & Ozurumba-Dwight, 2024). The discipline of Biology holds significant global importance, influencing fields such as medicine, biotechnology, and environmental science (Kulak & Newton, 2015). Through the study of Biology, students inquire into the structures of organisms, the dynamics of ecosystems, genetics, and their practical applications in various domains. A good grasp of Biology is essential for students, empowering them to contribute to environmental sustainability, engage in scientific research, and make informed decisions across different sectors (Neji & Ntibi, 2019). However, the abstract nature and intricate relationships within Biology often pose challenges for both teaching and learning (Cimer, 2012). In secondary school education, Biology holds a foundational role, offering students a comprehensive grasp of

biological concepts and their practical applications. Despite the vital role Biology plays in Nigeria's education system, student performance in the subject remains consistently poor, posing a significant concern for education stakeholders.

An analysis of West African Senior School Certificate Examination (WASSCE) results for Biology in Nigeria, particularly in Akwa Ibom State, shows alarming trends from 2017 to 2020 with no instances of a 50% pass rate (WAEC Chief Examiners Report, 2020). For instance, in 2017 a raw mean score of 30 with a standard deviation of 9.00 was recorded. In 2018, this score slightly increased to 31, accompanied by a standard deviation of 11.92. The following year, 2019, maintained a similar raw mean score of 31 but with a standard deviation of 9.41. In 2020, the performance remained the same compared to the previous year. However, in 2021, the Chief Examiner reported a slight improvement in candidates' performance compared to 2020. Notably, none of the five years' WASSCE results showcased an excellent percentage pass, particularly in Biology questions pertaining to Microorganisms (WAEC, 2021). Subsequent reports from the Biology Chief Examiner for 2022 and 2023 also reflected concerning trends. In 2022, there was a continuation of the challenging performance landscape observed in previous years. Likewise, in 2023, the data indicated persistent struggles among candidates in achieving satisfactory results in Biology examinations administered by the WAEC.

These findings highlight the urgent need for targeted interventions to address the underlying factors contributing to students' struggles in Biology and improve overall academic outcomes. Research indicates that low performance in Biology can be attributed to various factors such as ineffective teaching strategies and instructional materials, school location and the use of outdated teaching methods among others (Adebajo & Omoniyi, 2018). Furthermore, studies have shown lack of implementation of activity-oriented instructional strategies in Biology classrooms, as highlighted in Adebajo (2019). However, Akpan, 2017 noted that a move from a focus on more skill based education towards a more comprehensive notion of science education has resulted in competencies based on approach which should be the foundation in science learning. According to Abidoye, Abidoye & Olaide (2023), instructional materials are pivotal in Biology education, serving as indispensable tools for effective teaching. These materials play a central role in conveying complex concepts and enhancing students' learning experiences.

By employing appropriate instructional materials, educators can enhance students' understanding and academic performance in Biology, fostering an interactive and engaging classroom environment. Instructional materials serve as invaluable resources that facilitate learning and deepen students' comprehension of academic content. They function as aids or instruments that bolster effective teaching methodologies, enriching the educational journey for learners. The Utilization of instructional materials has consistently demonstrated its efficacy in enhancing students' academic performance. These materials encompass various forms such as models, educational games, computer-assisted instructional materials, and laboratory equipment. Akpan, 2018 observed that the use of laboratory facilities are very essential for good science teaching and learning as it involves manipulation of some equipment and other science laboratory materials. Among the indispensable tools in Biology laboratories is the microscope (Mahmud, Danjuma, Ibrahim, S., Ibrahim, A., Kabir, & Abdullahi 2021). Microscopes serve as windows to the micro-world, offering visual access to microorganisms and enabling exploration of intricate cellular structures (Ehtisham, 2018).

Microscopes, as described by Osamor and Odebisi (2019) are crucial for magnifying objects to reveal minute internal structures or surface details. Different types of microscopes exist, including light microscopes, electron microscopes, compound microscopes, among others, each with unique functionalities suited for specific investigations (Rušćić, 2018). For this study, the light microscope was selected, renowned for its use of a single convex lens for magnification and the formation of virtual, erect, and magnified images (Rušćić, 2018). Moreover, another instructional material that could enrich understanding of biological concepts is the Microbes

Instructional Kit. This kit comprises teaching materials such as simulation charts, role cards, and models, designed for teaching and learning about microorganisms. Microbes Instructional Kit fosters interactive learning experiences, encouraging discussions, decision-making, and imaginative exploration, ultimately enhancing performance and retention (Vlachopoulos & Makri, 2017). Through activities like role play, group discussions, and debriefing sessions, students actively engage with microorganism concepts, reinforcing their understanding and mastery of the subject matter.

Through the strategic integration of suitable instructional materials, educators stimulate active involvement and interaction among students, particularly when learners have opportunities to engage directly with and manipulate these resources (Abidoye, Aliyu, Ahmed, & Oluwole 2022). Research conducted by Awolaju, 2016 in Osun State on the correlation between instructional materials and students' academic performance in Biology at the senior secondary level highlighted that students who were taught with instructional materials outperformed those who were not provided with such resources. Additionally, school location has been identified as a significant factor influencing students' academic performance in science, including Biology (Okorie & Ezech, 2016). Research by Bizimana, Mutangana and Mwesigye (2022) further highlights the impact of school location on students' success in Biology education. Typically, schools in urban areas are associated with better infrastructure compared to those in rural areas, which often suffer from shortages of qualified teachers, poorly equipped laboratories, and inadequate access to essential facilities such as internet and electricity (Harerimana & Toyin, 2017).

Various studies have documented the relationship between school location and students' academic performance. According to Akpan and Babayemi (2022), if effective knowledge transfer is to be achieved, there should be hardly a separation between the community and the school as the community is endowed with resources. Bizimana et al. (2022), found that urban students tend to outperform their rural counterparts in science and mathematics. However, conflicting findings exist, with studies like Awodun and Oyeniyi (2018) suggesting that the location of the school has an insignificant role in students' performance in basic science. Similarly, Macmillan (2012) observed no significant difference in mean performance scores between urban and rural students when taught physics using computer-assisted instruction. Additionally, Yusuf and Adigun (2010) found that attendance at a rural or urban secondary school does not significantly influence academic performance.

Due to the inconclusive findings in existing research, this study aims to examine whether the utilization of instructional materials such as Microscope and Microbes Instructional Kit in Biology education will lead to a significant improvement in students' academic performance, irrespective of their school location. By addressing this gap in the literature, the study aims to contribute valuable insights to the ongoing discourse surrounding the impact of school location on students' academic performance.

### **Statement of the Problem**

Despite the importance of Biology education and its practical applications in various domains, students' performance in Biology remains consistently poor in Akwa Ibom State, Nigeria, as evidenced by alarming trends in West African Senior School Certificate Examination (WASSCE) results from 2014 to 2022. Factors contributing to this poor performance include ineffective teaching strategies/materials, and disparities in school location. However, existing research on the effectiveness of instructional materials and the influence of school location on students' academic performance in Biology yields inconclusive findings. Therefore, there is a critical need to investigate whether the utilization of instructional materials, such as Microscope and Microbes Instructional Kit, can significantly improve students' performance in Biology, regardless of their school location. This study aims to address this gap in the literature and provide valuable insights to enhance Biology education in Akwa Ibom State.

## Purpose of the Study

The purpose of this study was to investigate the effect of Instructional Materials and School Location on Students' Academic Performance in Biology in Akwa Ibom State, Nigeria. The specific objectives are:

1. To determine the difference in the mean performance scores of Biology students taught the concept of microorganisms using instructional materials (Microscope, Microbes Instructional Kit) and those taught without instructional materials.
2. Determine the mean performance scores of Biology students in urban and rural schools when taught the concept of microorganisms using instructional materials (Microscope, Microbes Instructional Kit) and those taught without instructional materials.
3. Examine the two way interaction of instructional materials (Microscope and Microbes Instructional Kit) and school location on Biology students' academic performance in the concept of microorganisms.

## Research Questions

To guide this study, the following research questions were raised:

1. What is the difference in the mean performance scores of students taught the concept of Microorganisms using instructional materials (Microscope, Microbes Instructional Kit) and those taught without instructional materials?
2. What is the difference in the mean performance scores of Biology students in urban and rural schools when taught the concept of microorganisms using instructional materials (Microscope, Microbes Instructional Kit) and those taught without instructional materials?
3. What is the interaction effect of Instructional materials (Microscope and Microbes Instructional Kit) and school location on Biology students' academic performance in microorganisms?

## Hypotheses

To guide this study, the following null hypotheses were formulated.

1. There is no significant difference in the mean performance scores of Biology students taught the concept of Microorganisms using Instructional Materials (Microscope, Microbes Instructional Kit) and those taught without instructional materials.
2. There is no significant difference in the mean performance scores of Biology students in urban and rural schools when taught the concept of Microorganisms using instructional materials (Microscope, Microbes Instructional Kit) and those taught without instructional materials.
3. There is no interaction effect of instructional materials (Microscope and Microbes instructional Kit) and school location on Biology students' academic performance in the concept of Microorganisms.

## Research Methodology

The research used a pretest, posttest nonequivalent control group quasi-experimental design, specifically consisting two experimental groups and one control group. This design was instrumental in facilitating a comparison of diverse teaching strategies while mitigating disruptions to regular classroom activities. The study took place in Uruan Local Government Area of Akwa Ibom State, Nigeria, a location chosen due to the researcher's familiar knowledge of the area and its specific educational challenges, particularly within the field of Biology. The population involved all Senior Secondary One (SS1) Biology students in Uruan LGA, totaling 3074 students from 11 public coeducational secondary schools. From this population, a sample of 264 SS1 Biology students was selected utilizing a stratified random sampling technique,

drawn from six intact classes across selected public coeducational secondary schools within Uruan LGA. Data collection was conducted through the administration of the Microorganisms Unit Test (MUT), comprising two distinct sections: Section A focused on gathering demographic information, while Section B consisted of 50 multiple-choice test items centered on microorganisms. Prior to treatment, the instrument underwent thorough content validation by subject matter experts and demonstrated a commendable level of reliability (reliability coefficient = 0.87). Scoring of the MUT involved allocating one mark for each correct response, with a maximum total score of fifty. Research assistants who were trained by the researcher administered pre-test before the commencement of teaching. The experimental groups were subjected to different instructional methodologies, with Experimental Group 1 taught using Microscope, while Experimental Group 2 were taught using Microbes Instructional Kit. Conversely, the control group was taught with no supplementary instructional materials. The teaching phase extended over a period of six weeks, encompassing a total of 36 lessons across all groups. Posttests were promptly administered following the conclusion of the teaching period. Data obtained from the administration of MUT were analyzed using mean and standard deviations to answer the research questions while. Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance.

### Analysis and Result

**Research Question 1:** What is the difference in the mean performance scores of students taught the concept microorganisms using instructional materials and those taught without instructional materials?

To answer research question one, Pre-test and Posttest data generated using MUT were subjected to descriptive statistics to calculate mean and standard deviation. Summary of the analysis are shown in Table 1.

**Table 1: Mean and Standard Deviation of students pre-test and posttest when taught the concept of Microorganisms using Instructional Materials and without instructional material**

Groups	N	Pre-test		Posttest		Mean Gain
		Mean	SD	Mean	SD	
EG1 (Microscope)	90	9.43	4.56	40.77	7.04	31.34
EG2 (MIK)	91	9.11	4.15	40.29	8.27	31.18
CG (without IM)	83	9.90	4.62	21.13	7.94	11.23

The results presented in table 1 show that the mean difference in performance scores (pre-test and posttest) of Biology students who were taught the concept of Microorganisms using instructional materials (Microscope, Microbes Instructional Kit) and without instructional materials were 31.34, 31.18, and 11.23, respectively. These findings suggest that Biology students taught using instructional materials exhibited better performance compared to those taught without instructional materials. Additionally, students taught with Microscope showed superior performance compared to those taught with Microbes Instructional Kit.

**Research Question 2:** What is the difference in the mean performance scores of Biology students in urban and rural schools when taught the concept of microorganisms using instructional materials (Microscope, Microbes Instructional Kit) and those taught without instructional materials?

**Table 2: Mean and standard deviation of urban and rural students' pre-test and posttest when taught the concept of microorganisms using instructional materials and without instructional material**

Groups	N	Pre-test		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Urban	151	9.59	4.36	35.07	10.83	25.48
Rural	113	9.31	4.56	33.58	13.16	24.28

Results in table 2 shows the mean difference (mean posttest-pre-test scores) of Biology students in urban and rural schools when taught the concept of Microorganisms using instructional materials (Microscope, Microbes instructional Kit) and without instructional material to be 25.48 and 24.28 respectively. This result indicates that Biology students in urban schools performed better than students in rural schools when taught Microorganisms using instructional materials and without instructional material.

**Research Question 3:** What is the interaction effect of Instructional materials (Microscope and Microbes Instructional Kit) and school location on Biology students' academic performance in microorganisms?

**Table 3: Interaction effect of instructional material and school location on the mean performance scores of Biology students in Microorganisms**

Groups	N	Pre-test		Posttest		Mean Gain
		Mean	SD	Mean	SD	
EG1 (Microscope)						
Urban	53	8.98	4.39	40.74	7.11	31.76
Rural	37	10.08	4.77	40.81	7.05	30.73
EG 2 (MIK)						
Urban	47	8.70	3.80	40.92	6.99	32.22
Rural	44	9.45	4.50	39.61	9.42	30.16
Control Group						
Urban	51	11.04	4.51	23.78	7.57	12.74
Rural	32	8.09	4.28	16.91	6.65	8.82

Result on table 3 shows the mean difference (posttest - pre-test) of the interaction between school location and instructional materials on the mean performance of Biology students taught Microorganisms using Instructional materials (Microscope, Microbes Instructional Kit) and without instructional material. The result showed that Biology students in urban schools who had 31.76, 32.22 and 12.74 mean when taught microorganisms using instructional materials and without instructional materials performed better than students in the rural schools who had 30.73, 30.16 and 8.82 respectively. This implies that the use of instructional materials (Microscope and Microbes Instructional Kit) prove to be effective in increasing the mean performance score of students in urban schools in the concept of microorganisms more than their rural counterparts. However, both students in urban and rural schools performed better when taught using Microscope and Microbes Simulation Kit as compared to students taught without instructional material. The implication of this is that both Microscope and Microbes Instructional Kit are effective in teaching Microorganisms irrespective of location. Inference drawn is that there is no significant interaction effect of instructional materials (Microscope and Microbes Instructional Kit) and school location on Biology students' academic performance in the concept of Microorganisms.

## Discussion of Findings

Data in table 1 examined the difference in the mean performance scores of Biology students taught the concept microorganisms using instructional materials and those taught without instructional materials. The result showed that students taught using instructional materials exhibited better performance compared to those taught without instructional materials. This finding aligns with the study by Edet (2017) which emphasized the positive impact of appropriate instructional materials on student learning outcomes. Hande et al. (2017) found that combining conventional microscopy with virtual microscopy enhanced students' understanding of dental histology compared to using conventional microscopy or virtual microscopy alone. Similarly, Habib (2016) observed that students taught with a Teaching Kit outperformed those taught through traditional lecture methods. These findings collectively suggest that adopting appropriate instructional strategies along with suitable instructional materials like Microscope and Microbes Simulation Kit can enhance meaningful learning in Biology, particularly in teaching the concept of Microorganisms. Consequently, Microscope and Microbes Simulation Kit can be considered effective resources for teaching Microorganisms in Biology.

However, it's worth noting that the findings conflict with those of Kara (2018), who found that microscope simulation software had no effect on laboratory performances but aided in developing the ability to use microscopes. Data analyzed on table 2 examined the difference in the mean performance scores of Biology students in urban and rural schools when taught the concept of microorganisms using instructional materials (Microscope, Microbes Instructional Kit) and when taught without instructional materials. The result showed that Biology students in urban schools performed better than students in rural schools when taught Microorganisms using instructional materials and without instructional material.

This finding agrees with the finding of Yohanna and Muhammad (2022) who conducted a research to establish the influence of location and gender on students' achievement in WASSCE Agricultural Science in Zaria Educational Zone from 2014 – 2018. Results showed significant difference between the performance of urban and rural students; the mean scores of rural students was relatively higher than urban students comparatively. Also, the result corresponds with findings of a study conducted by Okorie and Ezech (2015) to ascertain Influence of Gender and Location on Students' Achievement in Chemical Bonding. Result of the study showed that mean performance score of rural students was higher than that of the urban students. However, this finding does not agree with the finding of Bizimana et al., (2022) to examine the effects of school location on lower secondary school students' academic achievement in photosynthesis based on the concept mapping (CM) instructional strategy.

The result showed no significant difference between rural and urban students' achievement and retention taught photosynthesis using the CM. Data on table 3 examined the interaction effect of Instructional materials (Microscope and Microbes Instructional Kit) and school location on Biology students' academic performance in microorganisms. Results indicated no significant interaction effect of instructional materials (Microscope and Microbes Simulation Kit) and school location on Biology students' academic performance in the concept of Microorganisms. This finding is consistent with the findings of Iserameiya and Ibeneme (2018), who found no significant interaction effect between instructional strategy and school location on students' performance in basic science in Nigeria. However, the finding is at variance with Udoh and Udo (2020) who found in their study that instructional strategy and school location significantly interacted to affect students' performance in integrated science and chemistry respectively.

## Conclusion

Based on the findings of the study, it was concluded that both the Microscope and Microbes Instructional Kit serve as effective tools for enhancing students' performance in the teaching of Microorganisms, compared to teaching without instructional materials. While

students taught with Microscopes exhibited slightly higher performance than those taught with the Microbes Instructional Kit, both materials were deemed beneficial. Furthermore, the research indicated that there was a significant difference in the mean performance scores of Biology students in urban and rural schools when taught the concept of Microorganisms using instructional materials (Microscope, Microbes instructional Kit) and taught without instructional materials. Additionally, no significant interaction effect of instructional materials (Microscope and Microbes instructional Kit) and school location was observed. These findings underscore the effectiveness of both the Microscope and Microbes Instructional Kit in improving students' learning outcomes in Microorganisms, irrespective of school location. Consequently, Biology teachers are encouraged to integrate these instructional materials into their teaching processes to enhance students' performance in Microorganisms and other challenging Biology concepts.

### Recommendations

In view of the findings of this study, the following recommendations were made:

Biology teachers should be encouraged to use Microscope and/or Microbes Instructional Kit to teach the concept of Microorganisms. This will make learning to be real and reduce abstraction of Microorganisms thus enhancing students' performance.

1. There should be workshops, seminars, conferences, and mentorship activities for teachers to enable them to update their knowledge on new developments in the use of instructional materials.
2. Further research is needed in different educational settings to determine the effects of the use of Microscope and other instructional Kits in teaching other difficult topics in Biology.

### References

- Abakpa, V. O., Achor, E. E., & Odoh, C. O. (2016). Effect of laboratory strategy on senior secondary students' achievement in Biology. *ICSHER Journal*, 29(2), 68 – 75.
- Abidoye, F. O., Abidoye, A. A. & Olaide, M. S. (2023). The effect of Biology teaching materials on the academic performance of senior secondary school students in Ilorin west, Ilorin, Kwara State. *International Journal of Educational Innovation and Research*, 2(2), 142-150.
- Abidoye, F. O., Aliyu, M. Z., Ahmed, A. R., & Oluwole, O. S. (2022). Instructional resources for teaching Biology in secondary schools in Moro, Kwara State-Nigeria. *JPBI (Journal Pendidikan Biologi Indonesia)*, 8(2), 187–193.
- Adebanjo, A. A. & Omoniyi, T. (2018). Effect of Dick and Carey instructional model on students' academic achievement in Biology. *Journal of the Science Teachers Association of Nigeria*, 53, 136 – 150.
- Adebanjo, A.A. (2019). Attitude and Gender difference in the Utilization of computers among Undergraduates. *Nigerian Journal of Computer Literacy*, 5(1), 170-184.
- Akpan, I. F. & Babayemi, J. O. (2022). The availability, utilization and efficacy of community resources in the teaching and learning of science for knowledge transfer in secondary schools in Akwa Ibom State, Nigeria. *KIU Journal of Social Sciences*, 8 (2), 257-265.
- Akpan, I. F. (2017). Reform and quality science education in Nigeria: The needed benchmark for Sustainable National Development. *African Journal of Educational Assessors*, 4 (1), 91-97.
- Akpan, I. F. (2018). The influence of availability and utilization of science laboratory facilities on knowledge transfer for problem solving in community based skills. *Nigerian Journal of Curriculum studies*, 25 (4), 389-397.



- Awodun, A. O., &Oyeniyi, A. D. (2018). Influence of school location on students' academic achievement in junior secondary school basic science in Ekiti State, Nigeria. *Journal of Emerging Technologies and Innovative Research*, 5(2), 23-27.
- Awolaju, B. A. (2016). Instructional materials as correlates of students' academic performance in Biology in senior secondary schools in Osun State. *International Journal of Information and Education Technology*, 6(9), 705–708.
- Bello, G and Abimbola, I. O (2012). Gender influence on Biology students' concept mapping ability and achievement in evolution. *Journal of Science and Technology Education*, 9 (2), 87-94.
- Bizimana, E., Mutangana, D. &Mwesigye, A. (2022). Effects of school location on students' achievement in photosynthesis based on concept mapping instructional strategy. *Eurasian Journal of Science and Environmental Education*, 2(1), 1-10.
- Cimer, A. (2012). What makes Biology learning difficult and effective: Students' views. *Educational Research and Reviews*, 7, 61-71.
- Edet, C. G. (2017). *Relative effects of the use of improvised DNA discovery kit and flip chart on students' performance and retention in the concept of genetics in Biology*. [Unpublished M.Sc (Ed) Thesis]. Department of Science Education, University of Uyo.
- Ehtisham, M, Khan R., Gupta S., Etishree, Bhagat, Synthia. (2016). Oral Pathology and Microbiology: Microscope. *Heal Talk: A Journal of Clinical Dentistry*, 8(6) 47-49.
- Habib, Z. (2016). Effect of use of teaching kit on performance of students at primary level. *Journal of Pakistan Vision*, 2(1), 8-13.
- Hande, A. L., Vidya, C, Minal, G., Madhuri P. & Swati, Z. (2017). Impact of virtual microscopy with conventional microscopy on student learning in dental histology. *Dental Research Journal*. 14 (2). 111-116.
- Harerimana, J., &Toyin, A. O. (2017). In-service education programs for secondary school teachers and students' academic performance: A case study of Nyarugenge district in Rwanda. *Journal of Humanities and Social Science*, 22(2), 100-115.
- Iserameiya, F. E., &Ibeneme, O. T. (2018). Effect of mastery learning strategy on junior secondary school students' academic achievement in basic technology in Edo State, Nigeria. *International Journal of New Technology and Research*, 4(3), 95-101.
- Kara, Y. (2018). Determining the effects of microscope simulation on achievement, ability, reports, and opinions about microscope in general Biology laboratory course. *Universal Journal of Educational Research*, 6(9) 198-199.
- Kulak, V., & Newton, G. (2015). An Investigation of the Pedagogical Impact of Using Case-Based Learning in Undergraduate Biochemistry Course. *International Journal of Higher Education*, 4(4), 13–24.
- Macmillan, M. J. (2012). School location versus academic achievement in physics: Does computer-assisted instruction (CAI) has any effect? *Journal of Educational and Social Research*, 2(10), 162-168.
- Mahmud, A., Danjuma, S., Ibrahim, S., Ibrahim, A, Kabir, M. and Abdullahi, S. (2021). Effect of Laboratory Activity on Academic Achievement in Ecology Concepts among Secondary School Biology Students in Kaduna State. *Journal of Science Technology and Education* 9(3) 132-143.
- Neji, H. A., &Ntibi, J. E. E. (2019a). Effect of E-learning devices on chemistry students' academic performance in Calabar Municipality, Cross River State. *Interdisciplinary Journal of Science Education*, 1(1), 170–178.
- Okorie, E. U., & Ezech, D. N. (2016). Influence of gender and location on students' achievement in chemical bonding. *Mediterranean Journal of Social Sciences*, 7(3), 309-318.
- Olutola, A. T. (2016). Assessing students' performance in senior school certificate multiple-choice test in Biology. *Liceo Journal of Higher Education Research*, 12(1), 11-20.

- Osamor, O. N. G., & Odebisi, P. (2019). Effect of instructional materials on the academic achievement of Biology students in senior secondary schools in Delta state. *South Eastern Journal of Research and Sustainable Development (SEJRSD)*, 2(1), 214–227.
- Ruščić, M., Vidović, A., Kovačević, G & Sirovina, D (2017). The Use of microscope in school Biology teaching. *Resolution and Discovery*, 1(1), 4-6.
- Udoh, A. I., & Udo, M. E. (2020). Effects of blended learning and expository instructional strategies on senior secondary school students' performance based on the concept of atomic. *International Journal of Multidisciplinary and Current Educational Research*, 2(5), 361-371.
- Udosen, I. K., Ogbonna, C. I., Jerzy, M. P., Iwuji, S. & Ozurumba-Dwight, L. (2024). The Biology of history and developmental trends: a review. *Quantum journal of medical and health sciences* 3(1), 39-54.
- Vlachopoulos, D. & Makri, A. (2017). The effect of games and simulations on higher education: a systematic literature review. *International Journal of Educational Technology in Higher Education*, 14(22), 118-143.
- West African Examinations Council (2018). *Chief Examiner's Report*: Retrieved September, 2023 from <https://www.scirp.org/reference/referencespapers?referenceid=2817374>
- West African Examinations Council (2018). *Chief Examiner's Report*: Retrieved September, 2023 from <https://scirp.org/reference/referencespapers?referenceid=3015169>
- West African Examinations Council (2020). *Chief Examiner's Report*: Retrieved December, 2023 from <https://www.waeconline.org.ng/e-learning>.
- West African Examinations Council (2020). *Chief Examiner's Report*: Retrieved December, 2023 from <https://img1.wsimg.com/blobby/go/7c4463e3-109c-48af-b9be98e22cdf2116/downloads/rebiranugurizalojosagozu.pdf>
- Yohanna, J. & Muhammad, H. B. (2022). Location and Gender as Determinants of Students' Academic Performance in Agricultural Science in Zaria Education Zone, Kaduna State. *International Journal of Innovative Science and Research Technology*, 7(2) 245-216.
- Yusuf, M. A., & Adigun, J. T. (2010). The influence of school sex, location, and type on students' academic performance. *International Journal of Educational Sciences*, 2(2), 81-85.