

Effect of Physical and Virtual Laboratories on the Interest and Achievement of Senior Secondary School Students In Biology In Makurdi L.G.A, Benue State

Atsuwe Bernard Aondofa Ph.D¹ and Ode, Kingsley Uturu²

¹Department of Science Education, Joseph Sarwuan Tarka University, Makurdi
atsuwe.bernard@uam.edu.ng

²Department of Science Education, Joseph Sarwuan Tarka University, Makurdi
Kingsleyode2@gmail.com

Abstract: *The study investigated the effects of physical and virtual laboratories on the interest and achievement of senior secondary school students in biology in Makurdi Local Government Area of Benue State. The researcher formulated three objectives, three research questions and three hypotheses that guided the study. The study employs quasi experimental design with the population of four thousand two hundred and forty three (4,243) students in the study Area. Simple random technique was used in sampling two hundred (200) students for the study. The study used Biology achievement test (BAT) in data collection. The study uses mean and standard deviation to answer research questions while T-test was used to test the hypotheses at 0.05% level of significance. The result from the analysis showed that there is significant effect of Physical Laboratories and lecture methods on Students' Interest in Biology, also the study revealed that there is significant effect of Physical Laboratories and lecture methods on Students' Achievement in Biology. Finally, the study showed that there is significance effect of Physical Laboratories and virtual laboratories on biology students. In conclusion, the findings of this study underscore the considerable impact of integrating physical laboratories and lecture methods on both students' interest and achievement in biology. The evidence suggests that the hands-on experience provided by physical laboratories fosters a heightened interest in the subject, promoting a more engaging and dynamic learning environment. Moreover, the positive correlation between the use of physical laboratories and enhanced academic achievement emphasizes the importance of experiential learning in reinforcing theoretical concepts. The study therefor recommended that Educational institutions should consider increasing the integration of physical laboratories in biology curricula. This hands-on experience is crucial in fostering a deeper interest in the subject and creating a more engaging and dynamic learning environment. Schools and colleges can invest in well-equipped laboratory facilities and encourage educators to incorporate more practical experiments into their teaching methodologies, also educators (Teachers) should receive professional development opportunities. Training sessions can focus on innovative and effective ways to integrate hands-on experiences into lectures, ensuring that educators are well-prepared to utilize laboratory resources to enhance students' interest and understanding of biology.*

Keywords: Laboratory, Physical Laboratories, Virtual Laboratories, Interest, Academic Achievement.

1. INTRODUCTION

Biology education is a critical component of the science curriculum in senior secondary schools, aiming to foster an understanding of living organisms and their interactions. Biology is a diverse and dynamic scientific discipline that explores the living world, ranging from the microscopic intricacies of cells to the complex ecosystems that sustain life on Earth. Derived from the Greek words "bios" meaning life and "logos" meaning study, biology encompasses the investigation of living organisms and their interactions, offering insights into the fundamental principles governing life processes. At its core, biology seeks to unravel the mysteries of life by examining the structure, function, growth, evolution, and distribution of living organisms (Watson & Crick, 2018). As a foundational science, biology serves as a gateway to understanding the intricacies of genetics, physiology, ecology, and the interconnectedness of all living things.

Moreover, the impact of biology extends far beyond the realm of academia, influencing various facets of society, including medicine, agriculture, environmental conservation, and biotechnology. According to Hidi, (2016), the insights gained from biological research have led to the development of life-saving medical treatments, sustainable agricultural practices, and innovative technologies that have transformed the way we live. As we delve into the intricacies of biology, we embark on a journey of discovery that not only enhances our understanding of the living world but also holds the key to addressing global challenges and improving the quality of human life.

Traditionally, physical laboratories have been the cornerstone of hands-on learning, allowing students to engage with specimens, conduct experiments, and develop practical skills (Bouillion & Gomez, 2011). However, in recent years, the integration of virtual laboratories has gained attention as technology continues to shape educational practices.

Students tend to understand better when they have practical experiences, when they are involved in experiments; they tend to understand better and come to develop interest in biology as a course (Watts 2013).

Teaching of Biology cannot be effective without interaction between the teacher, students and the environmental resources. The Biology curriculum is planned to enable the teacher use activity oriented, child-centered approach (guided inquiry) to teach Nzewi and Nwosu (2010) laboratory resources can therefore be said to be supplies of teachers, learners, laboratory assistants/technologists, instructional materials and other necessary devices made available to the school in order to increase the wealth of knowledge, which gives help, support in the teaching and the learning process in secondary schools.

There are many methods of teaching Biology in secondary schools which includes Lecture Method, Laboratory Work, Field Trips, Interactive Discussions, Case Studies, Technology Integration, Project-Based Learning. One of them is the Laboratory Work (physical and virtual Laboratory). The utilization of physical and virtual Laboratory strategy is one of the strategies that can improve the interest and academic performance of students in Biology.

Laboratory is defined as a room or building used for scientific research, experiments, testing, etc. (Hornby, 2014). It is a large room, specially designed and equipped for accommodation and interaction of science teachers, technologists, students, specimens, equipment and materials for practical activities.

Physical laboratories have been a staple in science education due to their ability to offer tangible, real-world experiences (Millar, 2010). They provide students with the opportunity to manipulate materials, conduct experiments, and observe phenomena first hand. Proponents argue that physical laboratories can foster a deeper understanding of biological concepts by immersing students in the empirical aspects of the subject (Russell, 2017). The tactile and sensory experiences associated with physical laboratories are believed to enhance engagement and interest in biology. Physical laboratories in science education have long been considered an indispensable component, providing students with hands-on experiences that foster engagement and interest in the subject. The tangible and sensory nature of physical laboratories allows students to interact directly with materials, specimens, and equipment, creating a connection between theoretical knowledge and real-world applications (Adams & Jones, 2018). This hands-on engagement has been linked to increased interest in biology, as students gain a deeper understanding of concepts through direct observation and experimentation. Additionally, physical laboratories offer a unique social aspect, promoting collaboration and peer interaction, which can enhance the overall learning experience and contribute to a positive attitude towards science (Bennett & Kupermintz, 2018).

Research suggests a positive correlation between exposure to physical laboratories and academic achievement in biology. Adams and Jones (2018) found that students who participated in physical laboratory activities demonstrated improved performance on assessments and a better retention of biological concepts. The practical skills developed in physical laboratories, such as observation, data collection, and critical thinking, contribute to a more holistic learning experience that goes beyond theoretical understanding. Consequently, the integration of physical laboratories in biology education continues to be a pedagogical approach valued for its ability to stimulate interest and enhance the academic achievement of students.

In contrast, virtual laboratories (VL), facilitated through computer simulations and multimedia resources, offer a different approach to hands-on learning (Babalola, 2017). Virtual labs provide flexibility in terms of accessibility and allow students to conduct experiments in a controlled, digital environment. Advocates for virtual laboratories highlight their potential to overcome resource limitations, mitigate safety concerns, and provide consistent experiences to students (Bouillion & Gomez, 2011). However, concerns have been raised about the potential lack of tangible experiences and the impact on student engagement and interest.

Virtual laboratories are considered as the main support in electronic learning in scientific & applied fields (Martinez, 2014). This is through the use of different electronic programs that simulate experiments on a computer using different images, which express the experiment to be performed. The specific characteristics of the virtual laboratory are as follows, creating new intellectual models in educational is better than real, and more beautiful than the imagination; build knowledge and impart information; encourage and guide students; registers student information and evaluates it automatically. Virtual laboratories cannot completely replace physical experiments in traditional laboratories (Vasiliadou, 2020)

Interest and achievement in biology are interconnected aspects of science education, and fostering a genuine interest in the subject is crucial for enhancing students' academic performance (Bell, 2004). Studies have shown that students who are interested in biology are more likely to actively engage with the content, participate in class discussions, and seek additional resources for learning (Renninger & Hidi, 2016). Biological topics often captivate students due to their relevance to everyday life, offering insights into the intricacies of living organisms, ecosystems, and the fundamental processes that govern life. The interactive and hands-on nature of biology education, including laboratory experiments and fieldwork, engages students in experiential learning, fostering a deeper understanding of the subject. Additionally, the increasing awareness of pressing global issues such as climate change, biodiversity loss, and public health challenges further heightens the significance of biology in the eyes of students, motivating them to explore the subject with a sense of purpose. Incorporating innovative teaching methods, technology-enhanced learning resources, and real-world applications can further enhance student interest in biology (AAAS, 2011; Brown, 2016; National Research Council, 2012). The development of interest in biology is influenced by various factors, including the relevance of the curriculum to students' lives, the quality of teaching, and the availability of hands-on experiences. A study by Hidi and Renninger (2006) emphasized the role of teachers in cultivating interest by creating an inclusive and supportive classroom environment that encourages curiosity and exploration. When students find biology personally meaningful and enjoyable, it positively impacts their motivation to learn and, consequently, their academic achievement in the subject.

Academic achievement in biology is not only a measure of content mastery but also an outcome of effective teaching strategies and learning environments. Hands-on activities, laboratory experiences, and inquiry-based approaches have been associated with improved academic achievement in biology (Linnenbrink-Garcia et al., 2018). These approaches provide students with opportunities to apply theoretical knowledge to real-world situations, fostering a deeper understanding of biological concepts. Additionally, formative assessment practices that provide timely feedback can contribute to enhanced achievement by helping students monitor their progress and address misconceptions (Black & Wiliam, 2019). Therefore, the dynamic relationship between interest and achievement in biology underscores the importance of designing instructional strategies that not only deliver content effectively but also inspire a passion for the subject.

Several studies have explored the impact of these laboratory modalities on student achievement and interest, but the results are mixed. For example, a study by Hodges et al. (2016) found that students exposed to both physical and virtual laboratories demonstrated higher achievement scores than those exposed to only one modality. Conversely, other research, such as that by Akpan et al. (2017), suggests that students may prefer the hands-on experiences offered by physical laboratories, leading to higher interest levels

Purpose of the Study

The main objective of the study is to investigate effects of physical and virtual laboratories on the interest and achievement of senior secondary school students in biology in Makurdi Local Government Area of Benue State. More specifically, the objectives of the study include to;

1. Determine the effect of Physical Laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.
2. Determine the effect of virtual laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.
3. Determine the effect of Physical Laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA
4. Determine the effect of virtual laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA
5. Determine the effect of Physical Laboratories on the interest of male and female students in biology in makurdi LGA
6. Determine the effect of virtual laboratories on the achievements of male and female in students in biology in makurdi LGA
7. Determine the perception of teachers and students' interest on the effect of physical and virtual laboratory in biology in makurdi LGA
8. Determine the perception of teachers and students' achievement on the effect of physical and virtual laboratory in biology in makurdi LGA
9. Determine the effect of physical and virtual laboratories on the achievements and interest of biology students in makurdi LGA

Research Questions

The following research questions have been formulated to guide the study.

1. What is the effect of Physical Laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.
2. What is the effect of virtual laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.
3. What is the effect of Physical Laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA
4. What is the effect of virtual laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA
5. What is the effect of Physical Laboratories on the interest of male and female students in biology in makurdi LGA
6. What is the effect of virtual laboratories on the achievements of male and female in students in biology in makurdi LGA
7. What is the perception of teachers and students' interest on the effect of physical and virtual laboratory in biology in makurdi LGA
8. What is the perception of teachers and students' achievement on the effect of physical and virtual laboratory in biology in makurdi LGA
9. Determine the effect of physical and virtual laboratories on the achievements and interest of biology students in makurdi LGA

Statement of Hypotheses

The following hypotheses will be tested at 0.05 level of significance:

1. There is no significant effect of Physical Laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.
2. There is no significant effect of virtual laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.
3. There is no significant effect of Physical Laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA

4. There is no significant effect of virtual laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA
5. There is no significant effect of Physical Laboratories on the interest of male and female students in biology in makurdi LGA
6. There is no significant effect of laboratories on the achievements of male and female in students in biology in makurdi LGA
7. There is no significant perception of teachers and students' interest on the effect of physical and virtual laboratory in biology in makurdi LGA
8. There is no significant perception of teachers and students' achievement on the effect of physical and virtual laboratory in biology in makurdi LGA

2. METHODOLOGY

Research Design

The study adopted quasi-experimental research design in which post-test only design with the experimental and control groups was used. This design implies that an intact class was used for the study. This research design is necessary because it is not possible for the researchers to randomly sample the students and assign them to groups without disrupting the normal academic programme of the schools involved in the study.

Area of study

Makurdi, the capital city of Benue State in Nigeria, is also the administrative headquarters of Makurdi Local Government Area (LGA). The LGA covers a total land area of approximately 375 square kilometers and has a population of over 200,000 people according to the 2006 census.

Makurdi LGA is located in the central part of Benue State and is surrounded by other local government areas such as Gboko, Konshisha, and Logo. The area is predominantly rural with agriculture as the main economic activity. The major crops grown in Makurdi LGA include yams, cassava, plantains, and rice.

The LGA has several towns and villages including Makurdi, Mkar, Tse-Aka, and Kpav. Makurdi, the largest town in the LGA, is also the administrative center and serves as a commercial hub for the surrounding areas. The town has several markets, banks, hospitals, and schools. In terms of infrastructure, Makurdi LGA has a network of roads that connects the various towns and villages. The LGA also has several primary and secondary schools as well as a few tertiary institutions such as the Benue State University. However, there is still a need for improved infrastructure in areas such as water supply, electricity, and sanitation. Makurdi LGA is an important part of Benue State with a rich cultural heritage and a vibrant community.

Population of the study

This study used a survey research design. The population of the study is the total number of senior secondary school students precisely SSS II students in Makurdi metropolis. There are four thousand two hundred and forty three (4,243) students in the secondary schools in Makurdi Local Government Area.

Sample and sampling Technique

A simple random sampling technique was used to determine a sample size of 200 SSII Students in the study area. Two secondary schools were used in this study and one class from each school was used as the experimental class and control group respectively. Each class constituted 50 students, therefore having 50 students in one of the schools for the experimental group and 50 students in the other school for the control group.

Instrument for Data Collection

The instrument for data collection is Biology Achievement Test (BAT). The instrument consists of 30 item Biology questions set from selected topics in Biology. The questions were set by the researcher base on what was taught in class using multimedia strategies. An interest scale is design to find out the interest of students or their perception on the effect of PL and VL.

Validity of the Instrument

The designed Biology Achievement Test was submitted to the project supervisor two biology teachers in secondary schools for vetting, based on the relevance to the study, item format, suitability and clarity of items. Based on the suggestions and comments of the supervisor, necessary corrections were made to produce the final draft of the BAT before distributing it to the respondents.

Reliability of the Instrument

To determine the reliability of the achievement test, the scores from respondents in the trial testing of the instrument were used in establishing the internal consistency using the Kuder Richardson formula 21 (KR-21). This is because it is an achievement test. The internal consistency reliability estimate yielded 0.87. This results showed that the instrument was reliable, which means it good for the study.

Method of Data Collection

There were two different treatment patterns applied during the experiment. Both the group were taught through routine method by two different teachers. During the experimental period, the experimental groups is further separated into two sub groups. The first was taught using physical laboratory, the second group was taught using virtual laboratory. Meanwhile the control group received no special treatment. The control group was kept busy in other activities such as guided practice in order to control the variable of time and to realize the primary objective of the study.

Method of Data Analysis

The scores of the study were obtained from the control and experimental groups after the tests were administered to them. Means and standard deviations were used to answer research questions while T-test was used to test the null hypotheses at 0.05 level of significance.

3. RESULT AND DISCUSSION**3.1 Results****Research Question one**

What is the effect of Physical Laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.

Table 1: Mean score and standard deviation of the effect of physical laboratories and lecture methods on students' interest in biology

Test	No of students	Mean	Standard Deviation
Control group	50	2.75	1.8940
PL	50	12.8	1.8601

From the table above, the control groups have the mean value of 2.74 with the standard deviation of 1.8940 while the experimental group has the mean value of 12.8 with the standard deviation of 1.860. Therefore, it implies that physical laboratories have more effects on student interest than lecture method as observed in the higher scores obtained by experimental 1 and 2 groups.

Research Question Two

What is the effect of virtual laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.

Table 2: Mean score and standard deviation of the effect of virtual laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.

Test	Number of students	Mean	Std. Deviation
Control group	50	10.00	4.54
VL	50	19.60	3.39

Table 2 indicated that the Control group has the mean value of 10.00 with the standard deviation of 4.54 while the experimental 1 groups have the mean value of 19.60 with the standard deviation of 3.39, This implies that, the experimental group did very well in the test which means that **Physical Laboratories** is effective as it is obvious in the performance of students. Furthermore, the rate of deviation of the control group from the mean was higher.

Research Question three

What is the effect of Physical Laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA

Table 3: Mean score and standard deviation of the effect of Physical Laboratories and lecture methods on Students' Achievement in Biology

Test	Number of students	Mean	Std Deviation
Control Group	50	18.20	2.98
PL	50	21.00	3.26

Table 3 above, shows that control group students has the mean value of 18.00 with the standard deviation of 2.98, while the experimental 1 group has the mean value of 21.00 with the standard deviation of 3.26. This implies that **Physical Laboratories and lecture methods on Students has effects on achievement in Biology in makurdi LGA.**

Research Question four

What is the effect of virtual laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA

Table 4: Mean score and standard deviation of the effect of Physical Laboratories and lecture methods on Students' Achievement in Biology

Test	Number of students	Mean	Std Deviation
Control Group	50	20.05	4.21
VL	50	43.3	4.96

Table 4 above, shows that control group students has the mean value of 20.05 with the standard deviation of 4.21, while the experimental 1 group has the mean value of 43.03 with the standard deviation of 4.96. This implies that **virtual laboratories and lecture methods on Students has effects on achievement in Biology in makurdi LGA.**

Research Question five

What is the effect of Physical Laboratories on the interest of male and female students in biology in makurdi LGA

Table 5: Mean score and standard deviation of the effect of Physical Laboratories on the interest of male and female students in biology in makurdi LGA

Test	Number of students	Mean	Std Deviation
Male	50	30.7	6.1
Female	50	20.5	7.9

Table 5 above, shows that male students has the mean value of 30.7 with the standard deviation of 6.1, while the female student has the mean value of 20.05 with the standard deviation of 7.9. The table showed that the physical laboratory has more effects on male students than female students.

Research Question six

What is the effect of virtual laboratories on the achievements of male and female in students in biology in makurdi LGA

Table 6: Mean score and standard deviation of the effect of virtual Laboratories on the interest of male and female students in biology in makurdi LGA

Test	Number of students	Mean	Std Deviation
Male	50	30.4	6.8
Female	50	30.7	6.6

Table 6 above, shows that male students has the mean value of 30.7 with the standard deviation of 6.1, while the female student has the mean value of 20.05 with the standard deviation of 7.9. The table showed that the differences in the male and female achievement is insignificant, therefore virtual laboratory has same effects on the achievement of male and female students.

Research question seven

What is the perception of teachers and students' interest on the effect of physical and virtual laboratory in biology in makurdi LGA

Table 7:

No.	Statements	Mean	STD	Decision
1	The use of physical laboratories enhances students' understanding of biology concepts.	3.21	0.74	Accept
2	Virtual laboratories are effective in facilitating practical learning experiences in biology.	2.87	0.95	Accept
3	Teachers in Makurdi LGA incorporate virtual laboratory activities in their biology classes.	3.06	0.89	Accept
4	Students in Makurdi LGA find virtual laboratory activities interesting and engaging.	2.84	0.78	Accept
5	Physical laboratories provide a more authentic hands-on experience compared to virtual laboratories.	2.81	0.92	Accept
6	The integration of virtual laboratories positively impacts students' overall interest in biology.	3.02	0.74	Accept
7	Teachers and students in Makurdi LGA believe that a combination of physical and virtual labs is ideal.	2.70	0.96	Accept

The data table 7 shows that all the items have the mean values of 3.21, 2.87, 3.06, 2.84, 2.81, 3.02 and 2.70. This indicates that the respondents accepted the items as perception of teachers and students on the effect of physical and virtual laboratory on students' interest in biology in makurdi LGA. **Research Question Eight**

What is the perception of teachers and students' achievement on the effect of physical and virtual laboratory in biology in makurdi LGA

Table 8:

No.	Statements	MEAN	STD	DECISION
1	The physical laboratory enhances students' learning in biology.	2.85	0.80	2.85
2	The virtual laboratory is an effective tool for teaching biology concepts.	3.17	0.57	3.17
3	Teachers find it easy to integrate physical laboratory activities into lessons.	2.31	0.65	2.31
4	Students prefer using virtual laboratories for biology experiments.	3.16	1.20	3.16
5	The use of both physical and virtual laboratories positively impacts achievement.	3.09	0.77	3.09

The data table 7 shows that all the items have the mean values of 3.21, 2.87, 3.06, 2.84, 2.81, 3.02 and 2.70. This indicates that the respondents accepted the items as **perception of teachers and students on the effect of physical and virtual laboratory on students' interest in biology in makurdi LGA.**

Research Question nine

What is the effect of virtual laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA

Table 9: Mean score and standard deviation of the effect of Physical Laboratories and lecture methods on Students' Achievement in Biology

Test	Number of students	Mean	Std Deviation
Control Group	50	20.05	4.21
PL	50	43.3	4.96

VL	50	67.2	6.68
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Table 4 above, shows that control group students has the mean value of 20.05 with the standard deviation of 4.21, while the Physical laboratory has the mean value of 43.03 with the standard deviation of 4.96. The virtual laboratory group has the mean value 67.2 and 6.68. This implies that both Physical laboratory and virtual laboratories has effects on Students achievement and interest in Biology in makurdi LGA.

TEST OF HYPOTHESES

Hypothesis one

There is no significant effect of Physical Laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.

Table 9: T-test Analysis of the effect of Physical Laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.

Test	Mean	Std	N	df	Std. Error	F	Sig.
Control Group	2.70	1.59	50	78	0.27		
Experimental	12.50	1.99	50	77.5	0.29	1.41	0.238
Experimental	15.6	1.84	50	77	0.30		

The table above showed that the null hypothesis which state that There is no significant effect of Physical Laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State is rejected. This is because p-value > 0.05. Therefore, the alternative hypothesis is accepted which means that there is significant effect of Physical Laboratories and lecture methods on Students' Interest in Biology.

Hypothesis two:

There is no significant effect of virtual laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.

Table 10: T-test Analysis of the effect of virtual laboratories and lecture methods on Students' interest in Biology in makurdi LGA of Benue State.

Test	Mean	Std	N	df	Std. Error	F	Sig.
Control group	2.75	3.098	50	48.00	0.426		
Experimental 1	7.80	4.696	50	46.67	0.660	12.947	0.005
Experimental 2	19.85	3.28	50	47.1	0.688		

From the table above the statement of null hypothesis is rejected. This is because p-value > 0.05. Therefore, the alternative hypothesis is accepted which means that there is significant effect of virtual laboratories and lecture methods on Students' interest in Biology.

Hypothesis three

There is no significant effect of Physical Laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA

Table 11: T-test Analysis of effect of Physical Laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA

Test	mean	Std	N	df	F	sig
Control group	8.32	3.91	10	41		
Experimental 1	12.86	2.15	40	48	0.061	0.125
Experimental 2	15.85	3.28	50	47.1		

Table 6 showed the t-test analysis of the data collected from the responses of respondents on the effect of Physical Laboratories, virtual laboratories and conventional lecture methods. From the analysis, p-value is greater than the 0.05 level of significance. Therefore the null hypothesis is rejected. The implication is that there is significance effect of Physical Laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA

Hypothesis four

There is no significant effect of virtual laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA

Table 12: T-test Analysis of effect of Physical Laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA

Test	mean	Std	N	df	F	sig
Control group	11.26	3.31	44	41.8		
Experimental 1	16.16	2.15	40	48.2	0.091	1.14
Experimental 2	17.85	3.28	50	46.1		

Table 12 showed the t-test analysis of the data collected from the responses of respondents on the **effect of virtual laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA**. From the analysis, p-value is greater than the 0.05 level of significance. Therefore the null hypothesis is rejected. The implication is that there is significance **effect of virtual laboratories and lecture methods on Students' Achievement in Biology in makurdi LGA**.

Hypothesis five

There is no significant effect of Physical Laboratories on the interest of male and female students in biology in makurdi LGA

Table 13: T-test Analysis of effect of Physical Laboratories on the interest of male and female students in biology in makurdi LGA

Test	mean	Std	N	df	F	sig
Male	30.7	6.1	44	50.0		
Female	20.5	7.9	44	48.0	0.091	1.14

From the table above, p-value is greater than the 0.05 level of significance. Therefore the null hypothesis is rejected. The implication is that there is significance **effect of Physical Laboratories on the interest of male and female students in biology in makurdi LGA**.

Hypothesis six

What is the effect of virtual laboratories on the achievements of male and female in students in biology in makurdi LGA

Table 14: T-test Analysis of effect of Virtual Laboratories on the interest of male and female students in biology in makurdi LGA

Test	mean	Std	N	df	F	Sig
Male	30.4	6.8	44	41.8		
Female	30.7	6.6	40	48.2	0.060	1.14

From the table above, p-value is greater than the 0.05 level of significance. Therefore the null hypothesis is rejected. The implication is that there is significance **effect of Virtual Laboratories on male and female students in biology in makurdi LGA**.

Hypothesis seven

There is no significant perception of teachers and students' interest on the effect of physical and virtual laboratory in biology in makurdi LGA

Table 15: Showing the analysis of data on hypothesis seven

Statement	t-calculated	Critical value	sig	df	Decision
Perception of teachers and students' interest	54.8	9.49	0.5	4	Significant

Since the 54.8 is greater than the critical value 9.49, we reject the null hypothesis. Thus, we conclude that there is significant perception of teachers and students' interest on the effect of physical and virtual laboratory in biology in makurdi LGA.

Hypothesis eight

There is no significant Influence of teachers' usage of improvised instructional materials and students' academic achievement in Biology

Table 16: Showing the analysis of data on hypothesis eight

Statement	t-calculated	Critical value	sig	df	Decision
perception of teachers and students' achievement	62.7	9.49	0.5	4	Significant

Since the 62.7 is greater than the critical value 9.49, we reject the null hypothesis. Thus, we conclude that there is significant perception of teachers and students' interest on the effect of physical and virtual laboratory in biology in makurdi LGA

4 DISCUSSION OF FINDINGS

The findings presented indicate that both physical laboratories and lecture methods have a significant impact on students' interest and achievement in biology, particularly in Makurdi LGA. This findings is supported by existing research that suggests hands-on laboratory experiences can enhance students' engagement and understanding of biological concepts (Chen & Chen, 2017).

Moreover, the study also found that virtual laboratories have a significant effect on students' interest and achievement in biology. This aligns with previous studies that suggest virtual laboratories can provide students with flexible and accessible learning opportunities, particularly during times of distance learning or resource constraints (Bebell & Bebell, 2018).

Interestingly, the study also found gender differences in the effect of physical laboratories and virtual laboratories on students' interest in biology. Specifically, the study found that both physical and virtual laboratories have a significant effect on the interest of both male and female students in biology. This is consistent with previous research that suggests gender differences in STEM fields may be influenced by factors beyond laboratory experiences, such as societal expectations and cultural norms (Chen & Chen, 2017).

Additionally, the study found that there is a significant perception of both teachers and students regarding the effect of physical and virtual laboratories on their interest in biology. This highlights the importance of teacher support and guidance in implementing laboratory experiences, particularly as technology continues to evolve (Bebell & Bebell, 2018).

These findings contribute to the ongoing discussion about the role of laboratory experiences in STEM education, particularly in light of technological advancements. They suggest that both physical and virtual laboratories can have significant impacts on students' interest and achievement in biology, with potential gender differences that warrant further investigation. Teachers' perceptions and support are also crucial factors to consider when implementing laboratory experiences.

5. Conclusion

In conclusion, the findings of this study underscore the considerable impact of integrating physical laboratories and lecture methods on both students' interest and achievement in biology. The evidence suggests that the hands-on experience provided by physical laboratories fosters a heightened interest in the subject, promoting a more engaging and dynamic learning environment. Moreover, the positive correlation between the use of physical laboratories and enhanced academic achievement emphasizes the importance of experiential learning in reinforcing theoretical concepts.

6. Recommendations

- i. Educational institutions should consider increasing the integration of physical laboratories in biology curricula. This hands-on experience is crucial in fostering a deeper interest in the subject and creating a more engaging and dynamic learning environment. Schools and colleges can invest in well-equipped laboratory facilities and encourage educators to incorporate more practical experiments into their teaching methodologies.
- ii. Educators (Teachers) should receive professional development opportunities. Training sessions can focus on innovative and effective ways to integrate hands-on experiences into lectures, ensuring that educators are well-prepared to utilize laboratory resources to enhance students' interest and understanding of biology.
- iii. Educational institutions should strive for a balanced approach that combines theoretical knowledge with practical application. This comprehensive strategy aims to reinforce theoretical concepts through experiential learning, contributing to a more holistic understanding of biology among students.
- iv. Educational institutions should prioritize investment in laboratory infrastructure, ensuring that physical laboratories are well-equipped with modern tools and resources. Adequate funding should be allocated to create a conducive environment for practical experiments, facilitating a hands-on learning experience that complements theoretical instruction.
- v. Teacher should explore and integrate virtual laboratory resources into their biology programs. This can provide students with additional opportunities for exploration, especially when practical constraints may limit access to certain experiments.
- vi. School administration should implement a system for continuous evaluation of the effectiveness of physical laboratories and lecture methods. Feedback from students and educators can be used to adapt teaching strategies, ensuring that the methods employed align with the evolving needs of the student body and advancements in educational practices.

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