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Enhancing Secondary School Students' Retention in Geography through Physical and Virtual Laboratories in North Central Nigeria

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ABSTRACT

This study investigated the effects of Physical and Virtual Laboratories on the Retention of secondary school students towards Geography in North Central Nigeria. The study adopted a quasi-experimental research design. The sample size of the research consisted of 768 students from 12 secondary schools in the North Central zone of Nigeria. Four secondary schools from each of the three sampled states in the zone were purposively chosen and randomly assigned to research groups: experimental group I (Physical Laboratory), experimental group II (Virtual Laboratory), and control group (Lecture Method). One instrument used for collecting data in this study and its titled Geography Achievement Test (GAT). It is a 30 – item instrument covering topics in Physical Geography, a Pearson product-moment correlation formula was used to determine the reliability coefficient of GAT which yielded 0.76. The data collected were analysed using descriptive statistics of Mean and Standard Deviation and inferential statistics of Analysis of Variance (ANOVA). The null hypotheses were tested at 0.05 level of significance. The results of the study revealed that physical and virtual laboratories enhanced secondary school students' retention towards geography better than lecture method and it was therefore recommended that these laboratories should be embraced as teaching strategies for teaching geography concepts in secondary schools in order to improve students' retention towards the subject.

KEYWORDS

Geography; lecture method; physical laboratory; virtual laboratory; retention

INTRODUCATION

The transformation in technology has brought new inventions into classroom teaching and learning (Falode, 2016). Technology usage in schools today has influenced the way teachers plan, design instruction, and assess their students. Similarly, innovations in educational technology have changed systems of communication, learning resources, lesson ideas, and professional development and facilitate creativity and learning productivity (Garrett, 2015; Falode, et al. 2016; Mohammed, 2017). In addition, Mahya (2017) revealed that with the increasing usage of modern technologies, students are becoming better and faster at using new innovations.

The recent attention received by educational technology has therefore turned educators, practitioners, and researchers‟ focus towards the effects that technological tools may have on students‟ performance, both academically and behaviourally Garrett, (2015). Even though the use of technological tools such as educational games, online simulations, and virtual learning environments have increased in the field of education over the years, educational researchers need to better understand how these technological tools like virtual laboratories can affect learning (Mahya, 2017).

Furthermore, Sundara (2013) opined that the application of current technologies such as interactive multimedia tools, virtual learning environments, animations, simulations, audio and their applications to deliver courses in the science disciplines require a laboratory component to provide activity-based practices to the learner, ranging from Learning Management Systems (LMSs) to virtual avatars in digital games and virtual laboratories.

Significantly, virtual laboratories allow learners to visualize, interact, and experiment with certain visual effects, such features they may not see in their traditional face-to face environment in a science classroom (Trindale, & Almeida, 2002, Kotsilieris & Dimopoulou, 2013).

Categorically, physical laboratory has been given a central and distinctive role in science and technology education (Hofstein, 2015). According to Ratamun and Osman (2018) physical laboratory is a setting using actual experimental equipment and materials as well as undergoing hands-on activities where students hold and experience experimental experiences like a scientist. This laboratory makes it easy for students to change concepts from real to abstract and help them to connect the concept with the real world. It implies that physical laboratory is a place of practical work activities where science students manipulates and observe objects and materials in science and technology.

Science and technology educators believe that physical laboratories are the most important means of instruction in science since the 19th century. For science to be taught properly and effectively, physical laboratories must be an integral part of the science curriculum (National Science Teachers Association, 2009).

The physical laboratory is a workplace for scientific research; it is where a student develops scientific thinking, conducts scientific investigations, and obtain knowledge of physical principles and experimental techniques

through the usage of equipment. At different levels of education, starting with senior secondary school to the university level, Science laboratories are designed with certain goals, which includes to enhance the understanding of scientific concepts, interests and motivations, practical skills, and problem solving abilities (Russell & Weaver, 2008). The role of the laboratory is central in secondary school Geography courses; students construct and develop a personal understanding of Geographic ideas. This type of knowledge is developed by students in interactions by the use of experiments and practical skills. Meaningful learning will occur when laboratory activities become a well-integrated part of a learning sequence. In traditional laboratory experiments, students have direct physical involvement with laboratory materials in order to study the observable facts of the real world. Research and experience suggest that physical and virtual laboratory activities promote optimal learning for students (Tracy, 2009 & Garrett, 2015).

Virtual laboratory is perceived by Falode (2014), Chaurura and Chuma (2015) as an interactive environment without real laboratory apparatuses meant for creating and conducting simulated experiments. Similarly, Virtual laboratory is viewed by Ratamun and Osman (2018) as a computer-assisted teaching through the integration of computer simulations with laboratory activities. Virtual laboratory can change the concept of abstract teaching into concrete, linking the concepts learned with everyday life and students can learn at their own pace and needs. It is a tool that students can use to run their own experiments using mouse to control physical actions such as pushing objects, turning objects, lifting objects, changing tools or materials, heating materials, measuring material and mixing two materials. An example of a virtual laboratory is a collection of digital simulations supported by discussion forums, video demonstrations, hyperlinked glossaries, and e-mail lists organized in a World Wide Web format or on a CD in a shell produced by an authoring language.

Falode (2014) categorized virtual laboratory into five enclaves based on different sorts of simulations. They are: classical simulations which have certain elements of laboratory experiments and are available locally (Simulations);classical simulations which have certain elements of laboratory experiments and are accessible on the web and are available as JAVA-Applets (Cyber Labs); simulations which attempt to represent laboratory experiments as closely as possible (Virtual Labs); simulations of lab experiments using virtual reality techniques (VR Labs); and real experiments which are controlled via internet (Remote Labs).

The roles of virtual laboratory in teaching and learning process cannot be over emphasised, therefore, it was proposed by Ay and Yilmaz, (2015) that virtual experiments can be used in different contexts and steps to increase accessibility of laboratory activities and to assist students who previously had no access to physical laboratory. Such limit may emanate from a student‟s reduced dexterity, physical disability, or geographic distance (Chaurura & Chuma 2015). Virtual laboratory makes students become active in their learning, provide opportunities for students to construct and understand difficult concepts more easily (Gambari, Falode, Fagbemi & Idris 2012).

The use of both physical and virtual environments is useful in Geography contexts, where the virtual representations can be used to shape how students interpret the physical world. This approach has assisted in

the development of a special type of interactive animation and computer simulations especially in the field of Geography in Nigerian secondary schools.

Nigeria currently operates 9-3-4 system of education; the first 9 years is dedicated to basic education That is, six years for lower basic/primary education; and 3 years for upper basic education), which culminates in the Basic Education Certification Examination (BECE). The following three years are for a senior secondary school schooling, which is concluded with the senior school certificate examination (SSCE). Generally, two categories of examinees (internal/school and private/external candidates) take the SSCE every year. The internal candidates are the students in their third year in the senior secondary school (SSIII) who takes their examination in May/June. The external candidates are not in the school system and are composed majorly of those who take the examinations around November/December to make up for their deficiencies in certain subjects. The last stage of the Nigerian education system takes at least 4 years of study to earn a Bachelor's degree, with some courses taking up to 6 years of study. There are three major SSCE conducting bodies in Nigeria namely; West African Examination Council (WAEC); National Examination Council (NECO); National Business and Technical Examination Board (NABTEB). The recent re-organization and the improvement of the Geography educational module and recent change from 6-3-3-4 to 63-9 system of education at the Senior Secondary levels remarkably resulted to current and actual transformation in the state of geography education in Nigeria, subsequent from these, educators are more concerned simply with turning out students who are mounded with certainties and relevant expressions in Geography (Sofowora & Agbedokun, 2010).

Presently, Geography is one of the science subjects taught at the senior secondary school level of education in Nigerian schools. Aside from it being offered at the senior secondary schools (SSS) for Senior Secondary School Certificate Examination, it is a subject taught at the tertiary level and it links with a few other school subjects to make an individual an expert. The West African School Certificate Examination Council (WAEC) has been assessing its syllabi over the course of the years to reflect contemporary issues, react to open issues, and adjust to realities of time (Aderogba & Ogunnowo, 2010). The breakdown of the content of the Geography syllabus is grouped into four areas specifically: Elements of Practical Geography (Map Work); Physical Geography; Human Geography; Regional Geography (Sofowora & Agbedokun, 2010).

> Geography is viewed by Iwena, (2015) as the study of people, their activities, place and physical things within the earth as Geography has captured the imagination of people as buttressed by (Rosenberg, 2014). Analysts in the field of Geography still concentrate on people, culture and the planet earth. The elements of the earth are the area physical geographers and their work incorporates research about atmospheres, arrangement of area structures, plant and animal dispersion.
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> On this note, Rosenberg (2014) further asserted that being able to geographically investigate allows students to comprehend the world in which they live. Geography has continued to play significant role in the national development. It is taught in schools to offer learners a sound knowledge of their

immediate environment and develop in them the ability to comprehend, retain and give details of natural occurrence.

Ho (2009), Asthana (2012) and Falode (2014) suggested that one way to bring about more practical change in the assertiveness of learners to science subject is by using student centered approach through the integration of computer technology approach to teaching and learning process. These approaches can bring about retention of Geography concepts by the students.

Retention according to Obi, Agwagah, and Agah (2014) is the ability to recall things. In confirmation of this, Akor (2017)stressed that among the features of retention that are closely associated to retention, are the power to remember (memorise) and to identify. Memory in this case, is the ability to recollect an impression of the past experiences. Akor (2017)further categorizes memory based on period in which learning took place and retrieval of learnt items. In continuation of this, Iji (2005) lays emphasis on the fact that man is gifted with restricted ability for memorizing and to properly and efficiently apply all that he has learnt for which retention must have come to play an important role,

Furthermore, retention is perceived by Gana (2013) and Ismail (2015) as a preservative factor of the mind and a repeat of performance of a task of learnt behaviour earlier acquired. Modern studies on the effects of an instructional package on students' retention indicated that instructional package enhances the retention of students as compared to the lecture method of instruction (Ibrahim, 2015). In view of these, Hussain and Ali (2012) revealed that long- term retention of concepts by students was reported to be 67% observed after 12 months of using recent technologies. Similarly, Akengin (2011) noted that there was a mean difference of retention scores between the group of students taught with modern technologies and those instructed with conventional method. Also, Khurana (2018) initiated in Delhi India, to find out the impact of hands-on activities in relation to retention and concept retention. The result of the study indicates a significant difference favouring the experimental group.

Consequent upon the above assertion, much needs to be done because knowledge retention is an essential ingredient of learning. Several factors responsible for adequate retention of learnt materials according to Ibrahim (2015) include manipulation of the learning tool and the instructional method adopted. Research evidences continue to accumulate in support of the idea that visual learning and active involvement of students in the lesson could be more powerful than verbal communication alone (Yisa, 2014). In spite of the above statements, much need to be done by making learning more interactive to the students using various interactive packages, this could in turn enhance the retention of male and female secondary school students towards geography.

Gender has been recognized as one of the attributes that affects students' retention in science subjects at senior secondary school (Gambari, 2010). The issue of students' retention as a cause of discrepancy

in learning outcome has drawn the attention of educational researchers. It is a common attribute in most educational settings to find students of mixed academic aptitude given the same treatment. Gender issues also have been linked with performance of students in academic task in several studies some of which are those conducted by Ismail (2015) but without any definite conclusion. This trend of gender imbalances in- academic retention necessitates the need for more work. Gender as one of the variable could help clarify the assumptions investigated in this study and other associated issues in gender study which includes differences in acquisition of scientific knowledge through computer based learning, disparity in retention ofretention, and other laboratory activities in Geography related to the use of computers as investigated by previous studies of Aremu, (2008). Contrarily to the above, recent research studies by Akiengin (2011); Yusuf and Afolabi, (2010); Aniodoh and Ngozi (2012) found no significant difference between male and female students in science subjects. Aguele and Agwugah (2007), in their studies found that male students performed better than female students in the cognitive, effective and psychomotor skill retentions. The result of Makinde and yusuf (2018)shows that there was significant difference on the retention score of students taught using flip classroom. The result also revealed treatment improves learners' retention. Similarly, the finding of the study by Haghighi (2013) revealed that there was substantial difference on retention and retention in favour of brain-based learning.

Statement of the Problem

In spite of the importance attributed to Geography as stated in the National Policy on Education, prior researches by Falode et al. (2015), Falode et al. (2016), Amosun (2016), Usman (2019), Eze (2020) and Falode et al. (2020) concerning students' performances in Geography have shown unsatisfactory, poor and discouraging achievement arising from acute lack comprehension and retention among Nigerian secondary school geography students. The findings of this research further reveal that students' poor retention towards the subject is one of the factors responsible for the failure in Geography. Additionally, West African Examination Council's examiners WAEC, (2008), (2013); and (2018) reports in recent years, had linked inadequate explanation of points, inadequate preparation and poor presentation of geographical features and concepts that were required to be taught practically thereby making its concepts highly theoretical and difficult for the students to retain which leads to the students' failure in the subject. The records in Appendix A illustrate WAEC chief examiners' report, the record specifically depicts candidates' area of weaknesses in Geography. The weaknesses are not unconnected with the poor retention of students towards the subject as aforementioned by researchers. This has become a source of concern for all stakeholders in the Nigerian education system. Thus, the search for effective strategies that could improve students' poor retention towards Geography and enhance the teaching and learning of the subject in schools. Hence, the need for this study.

Research Questions

The following research questions were raised for the study.

1. What is the difference in the mean retention scores of students taught Geography using physical laboratory, virtual laboratory and lecture method?
2. Could there be any difference in the mean retention scores of male and female students taught Geography using physical laboratory?
3. Could there be any difference in the mean retention scores of male and female students taught Geography using virtual laboratory?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 alpha level of significance.

HO_1 There is no significant difference in the mean retention score of Geography student after being taught using physical laboratory, virtual laboratory and lecture method.

HO_2: There is no significant difference in the mean retention score of male and female Geography student taught using physical laboratory and lecture method.

HO_3: There is no significant difference in the mean retention score of male and female Geography student taught using virtual laboratory and lecture method.

Methodology

The study adopted a pre-test, post-test non-randomized quasi-experimental research design and used an intact class. The population for this study was made up of the entire Senior Secondary school students of the 2018/2019 session in the North-Central geopolitical zone of Nigeria. Twelve (12) co-educational public senior secondary schools in North-Central Geopolitical Zone of Nigeria (Niger, Kwara, Kogi, Benue, Plateau and Nasarawa states and the Federal Capital Territory, Abuja) were used for the study. The states in the zone were clustered into three regions A, B, and C. Out of the three regions, one state was selected from each region using a simple random sampling technique. Thereafter, three co-educational schools were purposively chosen from each of the three states at random and were assigned to experimental group I (Physical Laboratory: PL), experimental group II (Virtual Laboratory: VL), and control group (Lecture Method: LM). The reason for the purposive sampling of the schools is to select schools with common conditions such as manpower, gender composition, and exposure to the use of computer and geography laboratories. The target population was 768-year two Geography students in senior secondary school (SSII). The choice of year two senior secondary school class was based on the fact that the class was the most stable one as at the time the study was being conducted as they were not preparing for any examination which could threaten the outcome of this study. Also, the concepts of geography taught were meant for the class. The sample size was 768 Senior Secondary School Geography students in class II. This sample which is made up of students that falls between 14-17 age

group comprises of (Experimental Group I; 242= Males= 142, Females= 95); (Experimental Group II; 269= Males= 159, Females= 110); (Control Group; 257= Male= 185, Female= 72). The geography concepts taught were Contour representation of landforms, Gradient, and relief features, the content was selected because they are difficult concepts and fell in the SSII class syllabus. The Virtual Laboratory Package (VLP) was developed

Results

Research Question One

What is the difference in the mean retention scores of students towards geography after being taught physical laboratory, virtual laboratory and lecture method?

In answering research question four the retention scores of experimental group I, II and control group were analyzed using mean and standard deviation as shown in table 1

Table 1: Mean and Standard Deviation of Retention of Experimental Group I, II and the Control Group.

Group	N	Posttest $\bar{X}$	SD	Retention $\bar{X}$	SD	Mean difference
Experimental Group I	242	80.62	9.68	72.63	9.243	7.99
Experimental Group II	269	78.02	11.47	68.08	11.510	9.94
Control Group	257	73.12	11.56	65.04	11.61	8.08

Table 1 shows the mean and standard deviation retention scores of experimental group I, II and control group at post-test and retention-test. From the table, it can be deduced that the mean and standard deviation scores at post-test and retention test for experimental group I are $\bar{X}$=80.62, SD= 9.68 and $\bar{X}$= 72.63, SD= 9.243 respectively. This gives the mean gain of 7.99 in favour of retention test. Similarly, the mean and standard deviation scores at post-test and retention-test for the experimental group II are $\bar{X}$= 78.02, SD= 11.47 and $\bar{X}$= 68..08 SD= 11.51 respectively. This gives the mean difference of 9.94 in favour of post-test. On the other hand, the mean and standard deviation scores at post-test and retention test for Control group are $\bar{X}$= 73.12, SD= 11.56 and $\bar{X}$= 65,04, SD= 11.61 respectively. This gives the mean gain of 8.08 in favour of post-test. As a result of this identified difference in mean retention scores, ANCOVA was used at 0.05 level to determine if the observed difference was significant as presented in table 2.

Hypothesis HO_1: There is no significant difference in the mean retention score of Geography student after being taught using physical laboratory, virtual laboratories and lecture method.

Table 2: Summary of Analysis of Covariance of Post-test Retention Scores of Students taught Geography through Physical laboratory and Virtual Laboratory and Lecture Method

Source	Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	80989.618[a]	3	26996.539	1148.457	.000
Intercept	79135.926	1	79135.926	3366.512	.000
Covariate (post-test)	72578.203	1	72578.203	3087.541	.000
TRTMT	2249.318	2	1124.659	47.844	.000
Error	17959.195	764	23.507		
Total	4695024.000	768			
Corrected Total	98948.812	767			

*: Significant at 0.05 level

Table 2 showed the ANCOVA result of the comparison of retention score of students taught Geography using physical laboratory, virtual laboratory and lecture method. An examination of the table shows that there is significant difference between the mean retention scores of the three groups ($F_{(1, 764)} = 47.85$, $p < 0.05$). On the basis of this, hypothesis four was rejected. Therefore, the result revealed that there was significant difference in the mean retention scores between the three groups.

Research Question Two:

Could there be any difference in the mean retention scores of male and female students taught Geography using physical laboratory?

In answering research question five the post-test mean retention scores of male and female students taught Geography using physical laboratory were analyzed using mean and standard deviation as shown in table 3.

Table 3: Mean and Standard Deviation of Retention scores of Male and Female Students taught Geography through Physical Laboratory

Group	**N**	**Post-test**		**Retention**		
			SD		**SD**	**Mean difference**
Male	147	80.56	10.50	65.72	11.58	0.505
Female	95	80.71	11.40	62.83	9.24	0.525

Table 3 shows the mean and standard deviation of male and female students taught Geography using physical laboratory at post-test and retention-test. From the table, it can be deduced that the mean and standard deviation scores at post-test and retention test for the male students are $\bar{X}$= 80.56, SD= 10.503 and $\bar{X}$= 65.72, SD= 11.576 respectively. This gives the mean gain of 0.505 in favour of posttest. Similarly, the mean and standard deviation scores at post-test and retention-test for the female students are $\bar{X}$= 80.71 SD= 11.40 and $\bar{X}$=62.83, SD= 9.240 respectively. This gives the mean gain of 0.525 in favour of posttest. As a result of this identified difference in mean achievement scores, ANCOVA was used at 0.05 level to determine if the observed difference was significant as presented in table 4.

Hypothesis Two HO_2: There is no significant difference in the mean retention score of male and female Geography student taught using physical laboratory.

Table 4: Summary of Analysis of Covariance of Post-test Retention Scores of Male and Female Students taught Geography through Physical Laboratory

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	995.908[a]	2	497.954	3.216	.042
Intercept	9485.460	1	9485.460	61.260	.000
Covariate (Posttest)	790.816	1	790.816	5.107	.025
Gender	202.392	1	202.392	1.307	.254
Error	36852.025	238	154.840		
Total	904968.000	242			
Corrected Total	37847.934	241			

*: Significant at 0.05 level

Table 4 showed the ANCOVA result of the comparison of post-test retention scores of male and female students taught Geography using virtual laboratory. An examination of the table shows that there is no significant main difference between the mean scores of the two groups ($F_{(1,238)} = 1.307$, $p > 0.05$). On the basis of this, hypothesis six was retained. Therefore, the result revealed that there was no significant difference in the retention scores of male and female students taught geography using virtual laboratory.

Research Question 3:

Could there be any difference in the mean retention scores of male and female students taught Geography using virtual laboratory?

In answering research question six the post-test mean retention scores of male and female students taught geography using virtual laboratory were analyzed using mean and standard deviation as shown in Table 5.

Table 5: Mean and Standard Deviation of Retention scores of Male and Female Students taught Geography through Virtual laboratory

Group	N	Post-test $\bar{X}$	Post-test SD	Retention $\bar{X}$	Retention SD	Mean difference
Male	159	79.27	10.92	74.85	12.232	4.42
Female	110	76.09	11.97	71.43	15.53	4.66

Table 5 shows the mean and standard deviation of male and female students taught Geography using virtual laboratory at post-test and retention-test. From the table, it can be deduced that the mean and standard deviation scores at post-test and retention test for the male students) are $\bar{X}$= 79.27, SD= 10.92 and $\bar{X}$= 74.85, SD= 12.232 respectively. This gives the mean difference of 4.42 in favour of post-test. Similarly, the mean and standard deviation scores at post-test and retention-test for the female students are $\bar{X}$= 76.09, SD= 11.97 and $\bar{X}$=71.43, SD= 15.53 respectively. This gives the mean difference of 4.66 in favour of post- test. As a result of

this identified difference in mean achievement scores, ANCOVA was used at 0.05 level to determine if the observed difference was significant as presented in table 6

HO_3: There is no significant difference in the mean retention score of male and female Geography student taught using virtual laboratory.

Table 6: Summary of Analysis of Covariance of Post-test Retention Scores of Male and Female Students taught Geography through Virtual Laboratory

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	85.342[a]	2	42.671	.204	.816
Intercept	21768.051	1	21768.051	104.056	.000
Covariate (Posttest)	82.846	1	82.846	.396	.530
Gender	4.653	1	4.653	.022	.882
Error	55646.108	266	209.196		
Total	1436581.000	269			
Corrected Total	55731.450	268			

Table 6 showed the ANCOVA result of the comparison retention test scores based on gender of students taught Geography using virtual laboratory. An examination of the table shows a no significant difference of male and female students ($F_{(1,266)} = .022$, $p > 0.05$). On the basis of this, hypothesis six was retained. Therefore, the result revealed that there was no significant difference between male and female students taught Geography using virtual laboratory.

Discussion

The results of this study in table 4.5(a) indicated that the post-test mean retention score (72.63) of experimental group I (Physical Laboratory) is higher than the post-test mean retention score (68.08) of experimental group II (Virtual Laboratory) while the control group had the least post-test mean retention score of (65.04). This is further confirmed by ANCOVA result in Table 4.5(b) which shows that the retention scores of experimental I, II, and control groups were differed significantly. The difference in the retention of male and female geography students after being exposed to virtual laboratory could be attributed to distinctiveness and real nature of learning strategies and duration between the post-test and the retention test. The result on the retention of students taught Geography using physical laboratory, virtual laboratory and those taught with lecture method shows that treatment using physical laboratory produced significant difference on students' retention in geography.

This result is in consonance with the study of Khurana (2018) initiated in Delhi India, to find out the impact of hands-on activities in relation to retention and concept retention. The result of the study indicates a significant difference favouring the experimental group.

In the same way, the result is in compliance with the study of Haghighi (2013) targeted at finding out the effects of brain-based learning in sophomore students' academic retention and achievement. The finding of the study shows a substantial difference on retention and achievement in favour of brain-based learning. Also supporting this current study is the results of Kurumeh, Onah, and Mohammed (2012), Agwagah (1994), and Obi, Agwagah, and Agah (2014) whose studies were respectively meant to investigate the impact of the van Hiele model over conventional strategy on retention of retention.

The post means retention scores for both males 65.72 and female 62.83 in a physical laboratory in table 4.6(a) were improved significantly. This is further confirmed by ANCONVA result in table 4.6(b) which shows that there was no significant difference in the retention of male and female geography students when exposed to physical laboratories.

The result indicated no significant difference existed between the retention score of male and female. Therefore, the result shows that gender had no influence on the retention of among geography students taught using physical laboratory. It can be deduced that the use of physical laboratory enhanced the retention of both male and female students because of the uniqueness of the treatment instrument used for the two groups. This concurs with the result of Kurumeh et al. (2012) on the effect of the ethno teaching approach and gender on junior secondary three student retention that confirmed no substantial difference between treatment and control group. Supporting the above finding, the work of Obi, Agwagah, and Agah (2014) on effect of origami instructional approach is in agreement with the current study. The result revealed that the use of origami had no statistical differential effect on male and female. The result of the study by Makinde and Yusuf (2018) opposed the result of this study. The result revealed that there was significant difference on the retention score of students taught using flip classroom. The result also revealed treatment improves learners' retention. It was in view of this that flipped classroom approach was recommended as it enhanced students' academic retention and retention. The finding of the study by Haghighi (2013) revealed that there was substantial difference on retention and retention in favour of brain-based learning. Therefore, the result disagrees with the result of current study.;

The post means retention scores for both males 74.85 and female 71.43 in virtual laboratories on table 4.7(a) were improved significantly. This is further confirmed by ANCONVA result in table 4.7(b) which shows that there was no significant difference in the retention of male and female geography students when exposed to virtual laboratory. The similarity in the retention of male and female geography students after being exposed to virtual laboratory could be the result of the distinctiveness of the treatment instrument used for the two groups.

The result revealed that no significant difference existed between the retention score of male and female. Therefore, the result shows that gender had no influence on the retention of geography students taught using virtual laboratory. It can be inferred that the use of virtual laboratory enhanced the retention of both male and female students. This coincides with the result of Kurumeh et al. (2012) on the effect of the teaching approach

and gender on junior secondary three student retention that confirmed no substantial difference between treatment and control group. Following the above finding, the work of Obi, Agwagah, and Agah (2014) on effect of origami instructional approach is in conformity with the current study. The result revealed that the use of origami had no statistical differential effect on male and female. However, the result of the study by Makinde and Yusuf (2018) opposed the result of this study. The result showed that there was significant difference on the retention score of students taught using flip classroom. The result also revealed treatment improves learners' retention. The finding of the study by Haghighi (2013) revealed that there was substantial difference on retention and retention in favour of brain-based learning. Therefore, the result disagrees with the result of current study.

RECOMMENDATIONS

Based on the major findings of this study, the following recommendations are proffered as follows:

i. It is recommended that geography students should be exposed to physical laboratory to encourage and encourage student's retention social interaction, active learning, motivation, learning by doing and learning by experience.

ii. Virtual laboratory should be used to complement physical laboratory as a mutually beneficial interface between both (laboratories) could impact positively on the learners retention.

iii. The use of the package will enhance the retention of students in geography irrespective of their gender.

iv. The Federal and State Ministries of Education and other stakeholders such as Nigerian Teachers Institute (NTI), Nigerian Education and Research Development Council (NERDC), Non-Governmental Organisations (NGOs), United Nations International Children's Emergency Fund (UNICEF) and United Nations Scientific and Cultural Organisation (UNESCO) should ensure that there is availability of both physical and virtual laboratory, this will enable both teachers and students' retention ability to recall geographic concepts.

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