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Application of Virtual Laboratory Skills on Study Habits and Academic Performance among Senior Secondary School Biology Students in Soba Local Government Area, Kaduna State

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ABSTRACT
This research centered on the application of virtual laboratory skills on study habits and academic performance among senior secondary school biology students in Soba Local Government Area, Kaduna State. It was set against the background of poor performances of students in biology. Three objectives, three research questions and three hypotheses were formulated for the study. The research design was quasi experimental. The population of the study were all 2204 biology students in Soba Local Government Area, Kaduna state, from which 240 students were selected as sample, using stratified random sampling technique. The data collected was analysed using t-test statistic at 0.05 level of significance. Findings revealed that the application of virtual laboratory skills has positive significant impact on the students' study habit in the subject, and significantly correlated with the Biology Performance Test. Also, the students' gender was not significantly different with the study habits exhibited by the students. Based on the findings of this study, it was recommended that senior secondary school students need to imbibe the use of virtual laboratory skills acquisition, which can be achieved through teacher's guidance and motivation. This study concludes that application of digital laboratory skills by senior secondary schools in Soba Local Government Area significantly correlate with academic performance in biology.

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INTRODUCTION

All societies have one form of education or another, utilising the knowledge in varying degrees. Education begins at birth and continues throughout life. It is constant and ongoing. In the past, once the formal primary and secondary schooling were completed, the process was finished. However, in today's information age, adults are quite often learning in informal setting throughout their working lives and even into retirement (Agina-Obu, Amakiri and Emesiobi in Anyanwu, 2018).

Students' academic achievement occupies a very important place in education as well as in the learning process. It is considered a key criterion to judge one's total potentialities and capacities, which are frequently measured by the examination results Nuthana and Yenagi, 2014). It is used to pass judgment on the quality of education offered by academic institutions. In fact, it is still one of the most topical debates in citadels of learning that poses great concern to educators and researchers due to the poor examination achievement of students. According to Ayodele and Adebiyi (2013), the performance in secondary education besides other factors depends greatly upon study habits and study confidence of the learner. He further argued that the quality of education is reflected through motivation, which is a function of study habits and study behavior of

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students. In school, academic performance had been attributed to students' effective study habits. This is the reason why the teacher tries to adopt many techniques to help the students to learn and discover who they are, (Ogbodo in Anyanwu, 2018).

Science education is closely linked to experimentation and laboratory work. Recent literature confirms the important role of experimentation in increasing students' active and vital participation in the learning process, as well as it helps students to acquire different skills and form positive attitudes towards science learning (Al-Shahri, 2019). The last decades have witnessed unprecedented revolution in the field of technological applications specifically in the teaching and learning process. Technology has become an essential component of this process in a way it does not affect the teacher, student or course materials but it connects all these elements and makes the output of the educational process of high quality. In particular, science education was greatly influenced by technology in terms of the nature of the laboratories' work, equipment, and media (Anyanwu, 2022).

Many methods and tools used in the traditional laboratories no longer meet the needs of learners for many reasons. Hence, there is a need to activate and utilize the latest technological techniques to achieve effective science teaching/learning process. By using innovations facilitated by the possibilities of information and communication technologies in science education and practices, we can utilize the advantages of safe interactive learning that simulates real laboratory work.

Technology integration in the teaching and learning process is no longer a luxury but has become a vital requirement to develop educational infrastructure/structures. Technology offers a qualitative leap in reprogramming all components of the educational process. Artificial intelligence (AI) and E-Learning technology and their applications have become an essential part of societies. A set of applications in education such as: mobile learning, virtual reality and electronic museums have begun (Al-Shahri, 2019). Laboratory teaching presumes that first-hand experience in observation and manipulation of the materials of science is superior to other methods of developing understanding and appreciation. Laboratory training is also frequently used to develop skills necessary for more advanced study or research. Laboratories developers have focused to take advantage of computer applications to create safe/active interactive learning environment that simulates lifelike virtual laboratory (also known as e-laboratory).

Thus, a virtual/digital laboratory can be defined as an environment in which experiments are conducted or controlled partly or wholly through computer operation, simulation, and/or animation either locally or remotely via the internet (Al-Shaiey, 2016). The use of digital laboratory technology implies great importance and many advantages, including:

1. Dealing with some of the phenomena that are difficult to apply in a traditional laboratory.
2. Implementing many difficult and dangerous experiments through simulations.
3. Boosting the learner's study habits to learn, and by extrapolation his academic performance

The Oxford Advanced Learners' Dictionary (2021) defines study as an "activity of learning, either from books or from examining materials to obtain knowledge". This means that studying is an art of learning which helps the learner to not only acquire knowledge but also afford him the skill and the habit to study. Osa-Edoh and Alutu (2014) defined the term 'study' as a systematic acquisition of knowledge and an understanding of facts and principles that calls for retention and application. Akinboye (2020) defined study habits as the learning tendencies that enable students work privately. Furthermore, Anyanwu, (2018), defined study habits as those habits and skills that are particularly important for secondary school students, whose needs include; time management, note-taking, internet skill, the elimination of distractions, and assigning a high priority to study.

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Study habits encompass a variety of activities, including time management, setting appropriate goals, selecting an appropriate study environment, employing appropriate note-taking strategies, concentrating, selecting main ideas, self-testing, organization, and managing anxiety. Effective study habit refers to a situation in which a learner studies regularly to achieve maximum success in his schoolwork. Study habit therefore, can be referred to as learning which leads to the achievement of the learner's goal, through a prescribed pattern of consistent and steady behaviour. Numerous studies (Ali, Toriman and Gasim 2014; Akinsanya, Ajayi and Salami, 2014) had demonstrated the link between study habits and academic success. Researchers like Ayodele & Adebiyi (2013) refer to poor study habits as one of the major causes of poor academic performances among Nigerian universities.

The perennial under-achievement in science among students in secondary schools is a serious problem facing science education in Nigeria. Anyanwu (2018) noted that in recent times, there had been complaints from almost every part of the country about the falling standard of education. This claim is supported by Chief Examiner's report (2022) on students' performance in Senior Secondary School Certificate Examination (SSSCE) administered by the West African Examinations Council (WAEC), where he decried the yearly deterioration of students' performance, particularly in the area of sciences. This situation does not favour Nigeria's move towards developing scientific and technological society. It is therefore important to undertake a study of this kind, to investigate the application of digital laboratory skills on students' study habits and academic performance among senior secondary school biology students in soba local government area, Kaduna state.

STATEMENT OF THE PROBLEM

With a fast growing global scientific and technological society, the decline in students' interest in science courses and careers is a worldwide poses a concern that has prompted reform efforts in science education on an international scale (Onwuegbuzie, 2016). Students' attitudes toward science determine course and career choices. As science has become ever more deeply embedded in everyday life, how people perceive and study science has attracted more attention not only from the scientific community, but also from social scientists (Anyanwu, 2018). Students' achievement in Biology subject in Senior Secondary School Certificate Examination (SSSCE) has been unsatisfactory over many years. Anyanwu (2018) analysed the statistics of candidates' achievement in biology in Kaduna state between the years 2013-2017, and noted fluctuation in the achievement of students in biology, as indicated in the Table 1.1:

Table 1.1: Students academic Achievement in Biology in Kaduna State (2010-2016)

Year	Total No of Candidates that sat	No of candidates with A1-C6	No of candidates with D7-F9
2013	134,852	56570	78282
	100%	41.95%	58.05%
2014	130,653	56155	74498
	100%	42.99%	57.01%
2015	150,925	72204	78722
	100%	47.85%	52.15%
2016	143,936	62008	81928
	100%	43.09%	56.91%
2017	136,462	66314	70148
	100%	48.59%	51.41%

Source: West African Examination Council, Kaduna Office (2018)

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A cursory look at the table shows fluctuation in academic achievement in biology in Kaduna State. This development is not healthy for a nation that intends to have achieved Sustainable Development Goals (SDG) and be among the twenty economic and technologically viable nations by the year 2030. Usually, the teacher is blamed for the poor academic performance. Little or no attention is paid to the learning strategies employed by the student to learn and the study habits/skills the child employs in studying, which could influence his performance in the subject. While the causes of low academic performance are diverse and cannot be associated with a single major factor alone, the possibility of ameliorating the performance through digital laboratory skills cannot be overlooked.

This study therefore, investigate the application of digital laboratory skills on students' study habits and academic performance among senior secondary school biology students in soba local government area, Kaduna state

Objectives of the Study

The objectives of the study are to:

1. Determine the effect of the application of digital laboratory skills on the study habits of Biology students in Soba Local Government Area, Kaduna State;
2. Determine the impact of digital laboratory skills on the academic performance of biology students in Soba Local Government Area, Kaduna State;
3. Determine if there is any significant differences in the study habits of male and female students in biology in Soba Local Government Area, Kaduna State

Research Questions

The following research questions guided the study:

1. What is the effect of the application of digital laboratory skills on the study habits of Biology students in Soba Local Government Area, Kaduna State?
2. What is the effect of the application of digital laboratory skills on the academic performance of Biology students in Soba Local Government Area, Kaduna State?
3. Is there any difference in the study habits of male and female students in Biology in Soba Local Government Area, Kaduna State?

Null Hypotheses

The following hypotheses were formulated for testing:

Ho_1: There is no significant difference between students' application of laboratory skills and their study habits in biology in Soba Local Government Area, Kaduna State.

Ho_1: There is no significant difference between students' application of laboratory skills and their academic performance in biology in Soba Local Government Area, Kaduna State.

Ho_2: There is no significant difference between male and female students in the study habits they exhibit in Soba Local Government Area, Kaduna State.

METHODOLOGY

Research Design

The study used quasi-experimental research design. A quasi-experimental design is an empirical study used to estimate the causal impact of an intervention on its target population. As recommended by Kerlinger (1983), pretest and posttest were administered to the experimental and control groups. Pretest was administered in order to determine the equivalence of the two groups in their ability level before treatment administration, while the posttest was given to determine the effectiveness of the treatment. The experimental group was exposed to digital laboratory simulation, study habits mediation package, alongside selected topics in biology (excretion), while control group will be exposed only to the selected topics in biology.

Population of the Study

Population of the study comprised all SS II biology students of Soba local government area, Kaduna State. As at the time of this research, there were 8 registered Government senior

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secondary schools in Soba local government area, with student population of 2204. SS II students was used for this study because they have been taught a considerable size of concepts in biology, and are stable, unlike the SS I who are beginners and SS III who are preparing for their SSCE examinations. Details of the population of the education zone are presented in Table 2.1.

Table 2.1: Population of the Study

Name of School	Type	Males' population	Females' population	Total
GTC Soba	Males	370	--	**370**
GSSSS Soba	Females	--	683	**683**
GSS soba B/R	Mixed	394	144	**538**
GSS R/Soba	Mixed	57	20	**77**
GSS Danwata	Mixed	27	7	**34**
GSS Turawa	Mixed	62	31	**93**
GSS G/Gwanki	Mixed	137	60	**197**
GSS T/Lafiya Soba	Mixed	160	52	**212**
Total		**1207**	**997**	**2204**

Source: Kaduna State Ministry of Education (Soba Educational Division) 2024

Sample and Sampling Technique

Two co-educational secondary schools were selected as sample for the study. 240 students was selected as sample using Taro and Yemane (1970) sampling method. Co-educational schools was selected for the study because it enabled the researcher observe the effect of gender as a variable of students performance within the same environment, without having to observe the gender separately as would have been the case in single-gendered schools.

Stratified random sampling technique was employed to obtain the sample for the study. Thus, 120 students each for experimental and control groups was used for the study. Details of the sample are presented in Table 2.2.

Table 2.2: Sample of the Study

Name of School	Type of School	No. of Males	No. of Females	Total
GSS, Soba B/R	Mixed	64	56	120
GSS R/Soba	Mixed	63	57	120
Total		127	113	240

Instrumentation

The instruments that be used for data collection in this study are: Digital laboratory stimulation package (LabXchange, MIT open lab resources) Study Skills Inventory (SSI) to measure study habits, and; Biology Performance Test (BPT) to measure academic performance.

Validity of Instrument

The instruments were validated by two experts with minimum qualification of PhD from the Department of Educational Psychology, Ahmadu Bello University, Zaria.

Reliability of Instrument

The instrument's reliability Study Skill Inventory and Biology Performance Test was determined using split-half method (odd and even number procedure) and the result was analysed using Kudder-Richardson (K_{21}) statistical tool. A coefficient of 0.76 was obtained.

Data Collection Procedure

The researcher personally administered the instrument to avoid malpractices. The researcher inquired whether the concepts of excretion have been taught after which the pretest was be administered to the respondents. After the

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pretest, the researcher then teaches the students for six weeks before the posttest. The necessary instruction needed for the successful completion of the test was clearly stated on the research instrument and verbally explained to the students before the commencement of the test.

Procedure for Data Analysis

The data collected for this study was analyzed using t-test statistics, at 0.05 level of significance. This method was considered appropriate because the variables were measured on interval scale. All the hypotheses were tested at the 0.05 probability level of significance.

RESULTS AND DISCUSSION

The hypotheses formulated to test the statistical significance of the relationship of the investigated variables and observed variability in the mean scores of the groups involved in the test is conducted in this section. The hypotheses were formulated along the specific objectives and research question of the study. The posttests were carried out on the hypothesis as follows:

Ho_1: There is no significant difference between students' application of laboratory skills and their study habits in biology in Soba Local Government Area, Kaduna State.

This hypothesis was tested with the posttest scores of all the students in the Study Skills Inventory and their study habits examined in research question one. The t-test statistical tool was used to test and establish the significance of the impact of the digital laboratory skills on students' study habits scores. A summary of the test is presented in Table 3.1.

Table 3.1: Independent t-test Analysis on Difference between use of Digital Lab skills and Students' Study Skills Test

Variables	N	Mean	S.D	S.E	t-calc.	t-crit.	DF	P	Remark
A (SSI)	120	12.55	6.43	.41	4.02	2.07	238	0.00	S
B	120	2.02	0.51	.024					

Significant at p≤0.05

The result in the Table 3.1 reveals that students' application of digital laboratory skills positively affect their study habits in biology in the selected senior secondary schools. The observed t-calculated (4.02) is higher than the t-critical value and this indicates a positive difference between the two variables that directly imply that the consistent use of digital laboratory skills, the habits the better their study habits development in the biology subject. The observed probability level of significance for the test is 0.001 (P<0.05) at 238 degree of freedom (Df). With these observations, there is enough evidence to reject the null hypothesis. Therefore, the null hypothesis which states that there is no significant difference between students' application of laboratory skills and their study habits in biology in Soba Local Government Area, Kaduna State. is thus rejected.

Ho_2: There is no significant difference between students' application of laboratory skills and their academic performance in biology in Soba Local Government Area, Kaduna State.

The second hypothesis was tested with the posttest scores of all the students in the Biology Performance Test and the digital skill examined in research question one and Table 3.2. The t-test statistical tool was used to test and establish the significance of the impact of the students' application of digital laboratory skills on the BPT scores. A summary of the test is presented in Table 3.2.

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Table 3.2: Independent t-test Analysis on Difference between Students' Digital Skills Application and their Performance in Biology Performance Test

Variables	N	Mean	S.D	S.E	t-calc.	t-crit.	DF	P	Remark
A (DLS)	120	13.55	6.83	.39	4.03	2.08	238	0.00	S
BPT	120	2.02	0.49	.028					

Significant at p≤0.05

The result in the Table 3.2 reveals that students' application of digital lab skills positively impact on their academic performance in biology in the selected senior secondary schools. The observed t-calculated (4.03) is higher than the t-critical value and this indicates a positive difference between the two variables that directly imply the more positive the students study habits the higher their academic performance in the subject. The observed probability level of significance for the test is 0.001 (P<0.05) at 238 degree of freedom (Df). With these observations, there is enough evidence to reject the null hypothesis. Therefore, the null hypothesis which states that there is no significant difference between students' application of laboratory skills and their academic performance in biology and the study habits in Zaria Educational zone of Kaduna state is thus rejected.

Ho$_3$: There is no significant difference between male and female students in the study habits they exhibit in Soba Local Government Area, Kaduna State.

In the test of this hypothesis, the posttest scores on the study habits of the male students and female students were compared using the two sample t-test to determine the significance of the observed variability and the mean scores were assessed. The use of the two sample t-test procedure is based on the fact that two independent variables were involved in the test. The result of the test is summarized in Table 3.3.

Table 3.3: t-test on Study Habits by Male and Female Students

School type	N	Mean	S.D	S.E	t-value	t-crit.	DF	P	Remark
Male students	127	2.04	0.51	0.038	0.84	2.08	218	0.39	NS
Female students	113	1.99	0.45	0.043					

Not Significant at p≤0.05

The t-value of 0.84 obtained in the test at the 238 degrees of freedom compared with the critical value of 2.08, the variability between the mean could be considered not statistically significant. The observed probability level obtained for the test is 0.39 (P>0.05). With these observations, there is no sufficient evidence to reject the null hypothesis. Therefore, the null hypothesis that there is no significant difference between male and female students in the study habits they exhibit in Soba Local government Area of Kaduna State is thus retained. The result imply that gender orientation of students has no effect on their study habits in relation to biology.

DISCUSSION OF RESULTS

From the result of the test of the hypothesis, it was found that the application of digital lab skills has positive significant impact on the students' study habit in the subject. The null hypothesis was therefore rejected. This finding agrees with the report of Al-Shaiey (2016), who noted that the use of e-lab enhances the development of practical skills and achievement of students at the post basic education. It also align with the study of Al-Shahri, A. (2019), who stated that the use virtual labs on laboratory experiments skills acquisition in biology course boost the performance of students. The fining here is consistent with Mace (2002) where it was opined

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that study habits is a systematic acquisition of knowledge and understanding of facts and principles that calls for retention and applications.

Hypothesis two revealed that the students' application of digital lab skills positively impact on their academic performance in biology in the selected senior secondary schools. Rana and Kausar (2016), Osa-Edoh and Alutu (2014), Nuthana and Yenagi (2019) who respectively reported a significant relationship between digital skills and academic performance of students through critical reflection in skills outcomes such as selecting, analyzing, critiquing and synthesizing. The finding is also in agreement with the findings of Al-Shaiey (2016), who noted that the quality of education is reflected through motivation, which happen to be a function of students' use of digitals skills and study habits.

Hypothesis three tested for significant difference between male and female students in the study habits they exhibit towards biology in the selected senior secondary schools. The result of the two-sample t-test procedure used for the test did not reveal significant difference in the study habits of the male and female students in the study. It was therefore observed that gender orientation of students may not necessarily play a significant role in the study habits students' exhibit towards biology in the selected senior secondary schools of the Educational Zone. This finding disagrees with the report of Bruni, Ferini-Strambi, Russo, Antignani, Innocenzi and Ottaviano, (2016) who reported a significant difference in the academic performance between males and females.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. Senior secondary school students need to imbibe the use of digital laboratory skills acquisition, which can be achieved through teacher's guidance and motivation.
2. Senior secondary school students need to cultivate better study habits, which will influence their academic outcome.
3. The teaching and learning of biology should be devoid of any gender bias since this factor has no impact on the students' academic performance in the subject.

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