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IMPACT OF PRACTICAL LABORATORY WORK ON ACHIEVEMENT IN BIOLOGY AMONG UNITY COLLEGES STUDENTS IN NIGER STATE, NIGERIA

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Abstract

This study investigated the impact of practical laboratory work on achievement in Biology among Unity Colleges students in Niger State, Nigeria. The research design adopted for the study was a quasi-experimental: pretest, posttest and non-randomized experimental and control groups design. The population consisted of students in the five Unity Colleges with population of 576. A sample size of 92 students consisting of 54 male and 38 female students was selected and used as experimental and control groups. For the experimental group, rabbits were dissected to illustrate the digestive system of rabbit and a lesson plan on the digestive system of a rabbit was used, while the control group was taught using the alternative to practical approach. Two research questions, two objectives, and two null hypotheses were adopted to guide the study. Practical Laboratory Achievement Test Items (PLATI) was used as instrument for data collection. The instrument contained 25 items which were validated by experts in biology. A reliability coefficient of 0.66 was obtained from the instrument using split-half method. The data collected was first subjected to descriptive statistics of Mean and Standard Deviation. Thereafter, Analysis of Variance (ANOVA) was computed using the same data. The result showed that, there was a significant difference between the experimental and control groups ($F_{cal} (1, 90) = 64.209, P < 0.05$). The ANOVA analysis on gender in the experimental group indicated that there was no significant difference between male and female students ($F (1,40) = 0.35, P > 0.05$). Based on the findings of the study, it was recommended that Biology teachers should always conduct practical to convey theoretical knowledge to practice while school administrators and government should also provide the enabling learning environment and resources for practical work/exercises in our schools.

Keywords: Practical, Laboratory Work, Achievement, Unity Colleges, and Gender and biology

Introduction

According to , science takes a dominant part of school curriculum. Significantly, science is very crucial to secondary curriculum in a bid to foster scientific literacy, attitude, critical thinking, investigation and our understanding of the physical domain. The nature of science is precocious in order to be well acquainted with it's surroundings and desires to relate meaningful with it, in order to develop ideas. So, simple observation of laboratory experiment is a pre-requisite for cognition which can bring about valid reasoning to ethical scientific considerations.

At secondary level, science concepts are beyond the experiences of students, laboratory directly translates scientific phenomena through the influence of quantitative measurement, interpretation to discover theoretical principles. The laboratory is a place where scientific exercises are conducted by the science teacher for the benefit of the students (. The place of biology as a course of study cannot be over emphasized, which makes it a prerequisite subject for many fields of learning that contributes immensely to the technological growth of the nation (Ahmad, 2011). It is a requirement for a student to study science related courses such as medicine, pharmacy, Nursing, Agriculture, Forestry biotechnology.

According to , the school laboratory has become an essential component of the education process and science teaching throughout the school stage. Due to the nature of Biology, it cannot be taught effectively in the absence of practical, the quality of instruction by setting target for learning as well as finding out the appropriate instructional materials and strategies to be used in the classroom is paramount. In this plight, there is a need for the use of laboratory approach where instructional materials are used as a means of facilitating better understanding to attain better achievement in Biology and in the field of science. Although, there is no gain saying that biology is important, but the subject has not been taught and learnt well over the last decade or more. Obviously, the quality of teaching and learning has waned significantly. The evidence of this has always reflected in the poor results of students in both internal and external examinations. A lot of discoveries and inventions through laboratory experiment had been done to improve teaching and learning of the subject and science education relies on heavily on laboratory experiments.

There has been numerous discoveries and inventions aided by laboratory experimentation in teaching and learning process. The laboratory has a central and distinct role in science education. Scientific theory has to be translated into concrete terms for it make meaning and also used to solve our daily experiences in order to make an impact on physical-social environment. Some educators have questioned the effectiveness of using the laboratory in promoting science education when virtual laboratory can provide adequate and cheaper accessibility to science content with ease. However, this is not feasible in Nigeria schools for either lack of resources to use virtual laboratories or unwillingness on the part of teachers aggravated by the absence of skills to undertake such. This has made the use of Nigerian traditional laboratory settings very adequate for science education.

Developed nations around the world have devised effective instructional strategies to translate theory to practical. Learning is achieved at the point where the individual is able to draw a link between theoretical constructs and real life application. A point of scientific readiness that will enable it translates it's contents in school curricular to drive the nation's economy. Objectives of laboratory work in science includes amongst others; familiarizing the students with the operation with the operation of laboratory equipment, training the students on laboratory steps, fostering the students social attitudes, providing the students with skills of obtaining, classifying, tabulating data and coming up with results, training the students on the scientific method, discovery and investigation, integrating the theoretical with practical knowledge, enhancing the students understanding of the scientific concepts, developing the mental skills like observation, interpretation, prediction, and developing the students' creativity and innovations. Science students have need for practical skill and experiences. This will simplify abstract and complicate concepts. Participation of students ensues cooperative work attitude for problem solving. noted that, students can undertake laboratory experiments using simple tools. Thus, the laboratory plays a very important role in the realization of the objectives of teaching process by supporting the intellectual capacity (achievement), the emotional stability (affective) and the psychomotor (skill) objectives of science teaching.

To carry out laboratory experiments, the teacher must have the readiness and positive attitude towards laboratory work and should be able to guide the students and advise them so that they carry the work successfully. Again, in his study compared knowledge cognition and the learning outcomes of the preparatory stage students who were taught by the traditional teaching method in the capital city of Singapore. The study showed that, there were significant differences in the Mean(X) scores of the students who studied Science through experiments and those who studied through the traditional method. The students taught by using the laboratory experimental method scored higher than the students taught by the traditional

method. Zaytoun (1996), emphasized the necessity of introducing laboratory experiments in Science Curriculum to help achievement of the objectives of teaching science.

Furthermore, Hussein (2001), also investigated the effect of laboratory experiments on the Send grade secondary students' achievement in chemistry in Abyan Governorate in Yemen. The result showed that the experimental group students scored higher than the control group students, due to the positive effect of laboratory experiments on the students' achievement. El-shemaly (2006), studied the laboratory effect on the tenth grade students' achievement of physics concepts. The sample of the study consisted of 96 students divided equally into an experimental and control groups. The study showed that they were statistically significant differences in the Mean (\bar{X}) scores of both groups. The students in the experimental group scored significantly higher than those of the control groups, but there were no significant differences at α 0.05 that could be attributed to the student gender in both the control and experimental groups. El-Rabadi (2013) investigated the effect of laboratory experiments on grade ten students' achievement in Physics. The result showed that the experimental group students achievement was higher than that of the control group. observed that biology is seen as one of the main subjects acknowledge in the Nigerian secondary school curriculum. The nature of its relevance has ignited the interest of more students to enroll for the subject than they do for Physics and Chemistry Examinations (SSCE), (WAEC 2014).

Achievement is learning outcomes of students, which include the knowledge, skills, and ideas acquired and retained through what they have learnt within and outside the classroom environment. proposes that the school laboratory has a significant role in accomplishing the cognitional, emotional and psychomotor objectives. Chukwu, (2015), observed that achievement has to do with situation here teachers are concerned with academic scores of their students as this will assist them to plan better instruction and use better learning methodologies to convey instruction. Furthermore, when teachers are conscious of improving performance scores of their students, they experience success and this gives room for students to be sure of their ability to get better result. The issue of gender is very important in Science education especially with increasing emphasis on ways to boost man power for technological development as well as increasing the population of females in science and technology fields (Ogunkola & Bilesanmi- Awoderu, 2000), especially in Nigeria, and perhaps the whole of Africa, gender bias is still very prevalent.

In spite of the importance of biology, the teaching and learning of biology have not been very successful over the last decade or more and there has been a gradual depreciation in the quality of teaching and learning, this is characterized by poor performance of students in schools and public examinations. Over the last decades and more, the performance of students in science oriented subjects, biology inclusive in senior secondary certificate examination (WAEC) and National Examination Council (NECO) has been poor. This poor performance is really a case of worry and concern among teachers, parents, students, government and other stake holders and if not properly checked, it may jeopardize the placement chances of students into higher institution, especially biology related fields as this has an adverse effect in the Nation achieving her vision 20;20;20.

National Institute for Educational Planning and Administration (NIEPA) (2017), pointed out that students weakness is associated with inability to draw guidelines to touch the label on the diagram, using wrong magnification or not writing down the magnification of the diagram, using wrong titles for the diagram and inability to label diagrams correctly. It is also observed in the Chief examiners' report of NECO (2016), that the problem responsible for the poor performance in biology can be attributed to insufficient laboratory equipment and students

not being exposed to the NECO marking scheme guiding drawing in external examinations, poor teaching delivery and teachers method of presenting the content of the Biology curriculum to the students. Therefore, these above stated problems necessitated this study which seeks to examine and determines the aim and objectives of the impact of practical laboratory work, on achievement, in Biology among Unity Colleges students in Niger State, Nigeria. Gender in this study is considered as a moderating variable.

Research Questions

The following research questions were raised to guide the study:

- (i) Is there any difference in the mean achievement scores of students taught dissection of rabbit through practical and those taught through alternative to practical method?
- (ii) Is there any difference in the mean achievement scores of male and female students' taught practical dissection of rabbit through practical method?

Null Hypotheses

The following null hypotheses were tested at the 0.05 alpha level:

- H_{01} , There is no significant difference in the achievement of students taught dissection of Rabbit using practical method and those taught using an alternative to practical method.
- H_{02} , There is no significant difference in the achievement scores of male and female students taught practical dissection of Rabbit through practical method.

Methodology

The research design adopted for the study is quasi-experimental research design i.e. Pre-test, post-test non-equivalent experimental and control groups design. The population of the study was five thousand and forty-four (5,044) which consisted of biology students in the five (5) Unity Colleges in Niger State. The target population consist of 539 students (male & female) SS2 biology students. Sample size was ninety-two (92) students. Purposive sampling technique was used to select two co-educational colleges from the five Unity colleges in Niger State. Random sampling technique (hat and draw method) was used to select the experimental and control classes from the co-educational colleges which are intact classes.

Practical Laboratory Achievement Item (PLATI) instrument which consist of twenty-five objective test questions was used for data collection. The questions items were constructed by the researcher and it covered the concept digestive system of rabbit. The instrument was validated by experts for content and face validity by senior lecturers in Federal University of Technology, Minna. A reliability coefficient of 0.66 was obtained using Pearson Product Moment Correlation (PPMC). The study lasted for a period of four weeks during which pre-test and post test data were collected. The data collected was subjected to statistical analysis of Mean and Standard Deviation (SD) for the research questions, while Analysis of Variance (ANOVA) was used to analyze the null hypotheses and alpha 0.05 level to use for decision rules. The Analysis was carried out using statistical package of Social science (SPSS) version 20.

Results

Research Question One: Is there any difference in the mean achievement scores of students taught practical laboratory work through dissection of rabbit and those taught through alternative to practical method?

Table 1: Mean and standard deviation of achievement scores of experimental and control groups

Group	N	Pre-test		Post-test		Mean Diff
		\bar{X}	SD	\bar{X}	SD	
Practical Dissection	44	38.23	6.69	74.36	10.25	36.13
Alternative to Practical	48	37.83	7.61	51.52	16.15	13.69

Table 1 reveals the Mean and standard deviation of pre-test and post-test scores of students taught dissection of rabbit in experimental (practical method) and control (alternative to practical) groups. It is observed that, the mean scores of the two groups at post-test differ ($\bar{X} = 74.36$; $SD = 10.25$ & $\bar{X} = 51.52$; $SD = 16.15$). A mean difference of 36.13 was obtained for the experimental group and 13.69 was obtained in the control group, in favor of experimental.

Research Question Two: Is there any difference in the mean achievement scores of male and female students' taught practical dissection of rabbit and through alternative to practical method?

Table 2: Mean and standard deviation (SD) of male and female students achievement scores at pre-test and post-test of experimental group

Group	Gender	N	Pre-test		Post-test		Mean Gain
			\bar{X}	SD	\bar{X}	SD	
Experimental	Male	26	39.62	5.76	74.46	11.32	34.82
	Female	18	36.22	7.57	74.22	8.80	38.00

Table 2 reveals the mean and standard deviation of the pre-test and post-test scores of male and female students in the experimental group. From the table, the mean scores of the two groups at post-test differs, where male students had mean scores of 74.46 with a standard deviation of 11.32, while their female counterparts had mean scores of 74.22 with a standard deviation of 8.80. The table further shows that male students recorded mean gain score of 36.42 as against 38.00 recorded by their female counterparts.

Null Hypotheses

Result of analysis of variance (ANOVA) of the null hypotheses.

Table 3: Pre-test analysis of experimental and control groups results

Source of Variation	Sum of Square	df	Mean Square	F_{crit}	P value
Between Groups	3.563	1	3.563	0.069	0.793 ^{NS}
Within Groups	4648.394	90	51.649		
Total	4651.957	91			

NS: Not Significant at 0.05 level

Table 3 shows the ANOVA comparison of pre-test scores of experimental and control groups. The table reveals that no significant difference exists in the post-test scores of the two groups ($F_{(1,90)} = 0.069$, $p > 0.05$). Hence, Analysis of Variance (ANOVA) was used in testing all the null hypotheses in this study.

H_{01} There is no significant difference in the achievement of students taught dissection of Rabbit using practical method and those taught using an alternative to practical method.

Table 4: Summary of ANOVA result of post-test achievement scores of experimental and control groups

Source of Variation	Sum of Square	df	Mean Square	F_{cal}	P value
Between Groups	11978.567	1	11978.567	64.21	.000*
Within Groups	16790.161	90	186.557		
Total	28768.728	91			

*: Significant at 0.05 level

Table 4 shows the ANOVA comparison of post-test scores of experimental and control groups. The table reveals a significant difference in the post-test scores of the two groups ($F_{(1,90)} = 64.21, p < 0.05$). Hence, hypothesis one was rejected. This implies that a significant difference exists between the achievement of students taught dissection of rabbit using practical laboratory method and those taught through alternative to practical method.

H_{02} There is no significant difference in the achievement scores of male and female students' taught practical dissection of rabbit and those taught using alternative to Practical method.

Table 5: Analysis of Variance (ANOVA) result of post-test achievement scores of male and female students in the experimental group

Source of Variation	Sum of Square	Df	Mean Square	F_{cal}	P value
Between Groups	32.508	1	32.508	0.356 ^{NS}	0.554
Within Groups	3655.111	40	91.378		
Total	3687.619	41			

NS: Not Significant at 0.05 level

Table 5 shows the ANOVA comparison of post-test scores of male and female students in the experimental group. The table reveals that no significant difference exists in the post-test scores of the two groups ($F_{(1,40)} = 0.356, p > 0.05$). Hence, hypothesis two was not rejected. The implication should be that both male and female students exposed to practical laboratory work achieved equally.

Discussion

The finding that practical laboratory work is gender friendly shows that, there is a significant difference between the two groups in favor of the experimental group that were taught rabbit dissection in the laboratory. This finding corroborates that of [1], that school laboratory has a significant role in accomplishing the cognitional, emotional and psychomotor objectives. The finding is also in line with the finding of Hussein (2001) which investigated the effects of laboratory experiments on the sixth grade secondary students' achievement in chemistry in Yemen. Furthermore, the finding of this research study supports another earlier study by El-Shemaly (2006) on the effect of laboratory work on tenth grade students' achievement in physics. Chukwu, (2009) in his findings that, practical laboratory work enhances inquiry and performance, especially when students are taught through practical work. This agrees with the finding of [2] who found out that students exposed to practical laboratory work strategy performed significantly better than their counterparts who were taught using traditional

method. Therefore, laboratory experiments have a very significant effect on the overall performance of students in Biology and other science fields.

This has shown that, male and female students can perform equally when subjected to practical laboratory approach to learning biology concepts at secondary school level. Because then the result of ANOVA analysis showed that there was no significant difference in the achievement of male and female students. This finding is in agreement with the finding of who found out that male and female students performed equally well when exposed to adequately equip laboratory. This finding disagrees with Galadima (2003) and Ekeh (2004) that reported male superiority in achievement in science. While Shuaibu and Mari (1997) reported female superiority in achievement in science. The researcher could not find any literature on practical laboratory works that indicated differences in achievement between male and female students in biology and other science related subjects at secondary school level of education in Nigeria.

Conclusion

From the findings of the study, the following conclusion was raised: That secondary school students' achievement in biology can be enhanced when practical laboratory works/dissection is used as a technique for teaching rabbits' internal physiology. Because, practical activities have helped students to make an observation, identification, analysis and inferences which are both cognate and skills required for optimum performance in science. Male and female students were affected positively by practical laboratory work, showing that this approach is gender friendly. That practical laboratory work/exercises do not differentiate between male and female students. This can be adjudged as a good approach to learning biology and science.

Recommendations

The following recommendations were made:

- (i) Science teachers and students should be encouraged to use laboratory for conducting Biology practical to enhance better achievement.
- (ii) Secondary schools training must science be equipped with the skill to be able to prepare and undertake laboratory practical exercises for students.
- (iii) Secondary school science laboratories should be established and equipped for teachers to conduct practical works.
- (iv) School administrators should be interested in providing necessary support and equipment for practical laboratory exercises, since practical works are capital intensive.

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