Effects of Virtual Laboratory Simulation Package and Demonstration Instructional Strategy on the Achievement of Secondary School Students in Biology

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Abstract: **This study investigated the Effects of Computer Laboratory Simulation and Practical Demonstration Instructional Strategy on the Achievement of Secondary School Students in practical Biology. The research design adopted for the study was Pretest-Posttest experimental group design. The population is all secondary school students in Minna Metropolis. Purposive sampling technique was used to select two secondary schools in Minna metropolis, Niger State Nigeria. The two Schools were randomly assigned to experimental group (computer simulation group) and control group (Demonstration teaching methods) respectively. Finally, stratified simple random sampling technique was used to select the 60 SSII students. The experimental group had 30 (15 males – 15 females) students and control 30 (15 males – 15 females) students. A Computer simulation laboratory Package (CSLP) was developed treatment instrument for this study. The instrument that was used in collecting data for the study was researcher adopted Biology Practical Achievement Test (BPAT). The instrument was pilot tested and its reliability coefficient determined as 0.74 using Kuder Richardson (KR-21). The data collected was subjected to analysis using t-test at 0.05 alpha level of significance. The results revealed that there is significant difference between the experimental groups and control group. The experimental group had a significant improvement in performance after they were exposed to treatment and was also found to be gender friendly Based on the findings it was recommended that Computer Laboratory Simulation Package should be adopted by biology teachers in teaching practical biology at secondary schools, since it has been found to improved academic performance.**

***Keywords*: Computer laboratory Simulation Package, Students' achievement, Demonstration and Gender.**

I. INTRODUCTION

Education plays a key role in molding the personality of any individuals in a society. It is the process of developing the potentials of an individual by equipping him or her with the required knowledge skills to live a meaningful and successful life. All over the world, the education system of each nation is expected to help children to develop skills appropriate to the age and to adopt better in the dynamics of the society. Hence, a good system of education should develop an individual holistically; (physically, socially, emotionally and intellectually).

Science and Technology Education have become important tools in the world because the economic and political strength of any nation depends on the quality of its Science Mathematics and Technology Education. It is in recognition of this that the Federal Government of Nigeria stipulated that "special provisions and incentives shall be made for the study of the sciences at each level of the education system". For this purpose, the functions of all agencies involved in the promotion of the study of sciences shall be adequately supported by government" [3]. With this commitment by the federal government it is sad to observe that in the last two decades, there has been major concern about the quality of teaching and learning in Nigeria. Several research reports indicated that students performed poorly in Secondary School Science subjects ([7]; [2]) This leaves one in doubt about the effectiveness of the teaching method popularly used by Science teachers for teaching Science subjects in secondary school especially practical lessons. In Nigeria, the biology curricular is structured such that significant amount of time is set aside for practical demonstration which include experimentation, drawings, dissection just to mention a few. But most a time these practical lessons do not hold due to lack of equipment, crowded classes, lack of space among others. Taking these limitations into consideration looking for appropriate alternative is inevitable. One method of technology-assisted learning is the use of computer simulations to instruct students in the use of laboratory equipment and procedures. This method has shown to offer an exciting opportunity to probably improve science practical demonstration.

It is a virtual reality environment that simulates the real world for the purpose of discovery learning. It allows one, to observe how experiments and operation are done while the limitation of space and time in real life demonstration is

overcome. Literatures on the findings of the effects of practical simulation of laboratory experiment have not been consistent. [8] reported that students considered the face-to-face laboratory courses to be more effective than virtual laboratory simulation. [6] Compared achievement among students instructed using hands-on Chemistry labs versus those instructed using virtual Chemistry laboratory (eLabs). They found out that there were no significant differences in achievement gain scores for the traditional versus the online students.

Similarly, [5] examined the comparative study of hands-on and remote physics labs for first year university level physics students. The findings indicated students who study using virtual physics laboratory performed better than their counterpart in the traditional classroom. Anderson (1995) in [9] reported that computer simulation experiments are more effective than physical laboratory demonstration.

Statement of the Problem

The search for innovative teaching strategies is borne out of the fact that there is a general worry about the poor quality of Nigeria students' performance. The traditional lecture method of teaching is very popular and is widely used by Science teachers even in practical lessons to convey large volumes of scientific information to senior secondary school students in a bid to prepare them for Senior Secondary School Certificate Examination. Hence the need to seek innovative instructional strategies that could improve performance and enhance learners acquisition of science process skills especially in practical lesson. In West African Examination Council (WAEC) [10]; [11] it was reported among other things that candidates were unable to make logical inferences from experimental results and inability to relate structures of specimen to their function. Hence, the WAEC Chief examiner's recommended that "Biology teachers should be sponsored and encouraged to join professional association like Science Teachers Association of Nigeria to enables them keep abreast of new teaching techniques and development in their subjects." This clearly shows that secondary school teachers still use traditional teaching technique. Hence, the aim of this study is to determine the effects of Virtual laboratory demonstration on the academic achievement of secondary school students in biology. Literatures on the finding of the effects of gender in science technology and mathematics is inconclusive, hence, gender is included as a moderating variable.

Research Objective

The aim of the study is to determine the Effects of Virtual Laboratory Simulation Package and Demonstration Instructional Strategy on the Achievement of Secondary School Students in Biology. Specifically, the following objectives were stated:

1 Develop and validate a Computer laboratory simulation package.
2 Determine the effectiveness of Computer laboratory simulation package in improving the achievement of secondary school students in biology practical
3 Determine the effect of Gender on students' biology practical with Computer Laboratory Simulation Package

Research Questions

To achieve the objectives of the study, the following research questions were stated to guide the study:

1. How do achievements of students exposed to biology practical (food test) using Computer Laboratory Simulation package differ from those in the Demonstration group?
2. Is there any difference in the achievements of male and female students exposed to biology practical (food taste) using Computer Laboratory Simulation package?

Research Hypotheses

The following research hypotheses were formulated and tested at 0.05 significant levels.

Ho_1: There is no significant difference between the mean achievement scores of students exposed to biology practical (food taste) using Computer laboratory simulation package and those in the Demonstration group

Ho_2: There is no significant gender difference in the performance of students taught biology practical (food taste) using Computer Laboratory Simulation package

II. METHODOLOGY

The research design adopted for the study is Pretest-Posttest experimental group design. The population is all secondary school students in Minna Metropolis. Purposive sampling technique was used to select two secondary schools in Minna metropolis, Niger State Nigeria. The two Schools were randomly assigned to experimental group (computer simulation group) and control group (Demonstration teaching methods) respectively. Finally, stratified simple random sampling technique was used to select the 60 SSII students. The experimental group had 30 (15 male – 15 female) students and control 30 (15 male – 15 female) students. A Computer simulation laboratory Package (CSLP) was developed treatment instrument for this study; the package consisted of three topics in food taste: taste for simple sugar, taste for complex sugar and taste for protein. The package was installed in the computer system and the computer presents the information and displays the instructional content to the learner on each of the units after which the students assessed themselves with objective questions at the end of each unit. The instrument used in collecting data for the study was researcher adopted Biology Practical Achievement Test (BPAT). The BPAT consists of 25 multiple choice objective items with four options (A–D)

The instrument was pilot tested, and its reliability coefficient determined as 0.84 using Kuder Richardson (KR-21). The study was for four weeks. Before the commencement of the treatment, the researcher administered the Biology Practical Achievement Test (BPAT) on sampled students as pretest to ascertain the equivalence of the students before the treatment. Treatment was followed immediately; thereafter BPAT was administered as post-test to measure the achievement of the students in the two groups. The scores obtained were subjected to data analysis. The data were analyzed based on the stated hypotheses, using mean, standard deviation and t-test. The significance of the various statistical analyses was ascertained at 0.05 alpha levels.

III. RESULTS

The results are presented in line with the formulated hypothesis:

Ho_1: There is no significant difference between the mean achievement scores of students exposed to biology practical (food taste) using Computer laboratory simulation package and the Demonstration group

Table 1: t-test Analysis of the Mean Achievement Scores of Experimental and Control Groups

Variable	N	df	X	SD	t-value	P	Remarks
Experimental	30	58	56.00	7.79	3.18	0.00	Significant
Control	30		45.82	8.04			

*Significant at P<.05

Table 1: presents the t-test results of experimental and control group. The mean score of the experimental group was 56.00 and 45.82 for the control. The calculated t-value of 3.18 was significant at the 0.05 level. This indicates that there is statistically significant difference between the experimental and control group (t_{cal}=3.18, df=58, P=0.00). Hence the null hypothesis one (H01) was rejected, therefore, there is a significant difference in the mean scores of experimental and control group favouring the experimental group exposed to CLSP

Ho_2: There is no significant gender influence on the performance of students taught biology practicals (food taste) using Computer laboratory simulation Package

Table 2: t-test Analysis on Achievement Scores of Male and Female Students Exposed to Animation

Variable	N	df	X	SD	t-value	P	Remarks
Male	15	28	28.36	7.79	2.15	0.30	Not Significant
Female	15		26.64	8.04			

Ns: Not significant, P>0.05

The table 2 presents the t-test of male and 9 female students of experimental group, the mean scores of the male students was 55.00 and 54.32 for the females. The calculated t-value of 2.15 was not significant at the 0.05 level. This indicates that there is statistically no significant difference between the male and female students taught with CAI, (t=2.15, df=28, P=0.30). Hence, $H0_2$ was upheld. Therefore, there is no significant difference between male and female students taught with Computer laboratory simulation Package.

IV. DISCUSSION OF RESULTS

The results of hypothesis one reveals that there is significant difference in the learning achievement in favour of the group that learned with Computer laboratory simulation Package than the control group which was taught using Demonstration method. The findings concurred with the earlier results of [5] who examined the comparative study of hands-on and remote physics labs for first year university level physics students. The findings indicated students who study using virtual physics laboratory performed better than their counterpart in the traditional classroom.

This result agrees with the findings of Anderson, (1995) in [9] reported that computer simulation experiments are more effective than physical laboratory demonstration. This result is contrary to the earlier findings of [8] who reported that students considered the face-to-face laboratory demonstration to be more effective than virtual laboratory simulation.

The results of hypothesis two show that there is no gender effect on the achievement of male and female students taught food taste with Computer laboratory simulation Package. This finding is in agreement with the results of [1], which revealed that there is no significant difference in the performance of male and female students in science concepts. This result was contrary to the finding of [4] who reported that male students performed better than their counterpart in science and mathematics concepts.

V. CONCLUSION

The paper has critically examined the effective teaching of science especially practical biology within the secondary school level in the 21st century. It is the view of the authors that there is still a wide gulf to be bridged in the area of teaching and learning. The innovative technology using computer with animation seems to be the answer. Computer laboratory Simulation package was more effective in teaching Practical biological and is also gender friendly.

VI. RECOMMENDATIONS

It is recommended that teachers should be ICT compliant in order to cope with current trends in pedagogical practices and institution needs to expand their network. Science teachers should be trained on the effective use of Computer Laboratory Simulation package through seminars, workshops and conferences.

Pre-service teachers training institutions should include innovative teaching approaches like task-based teaching strategy and its utilization into their curricular sets and be

taught so as to make teachers conversant with the use of the strategies effectively.

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