British Journal of Education
Vol.8, Issue 5, pp.26-39, May 2020
Published by ***ECRTD- UK***
Print ISSN: ISSN 2054-6351: Online ISSN: ISSN 2054-636X

EFFECTS OF VIRTUAL LABORATORY EXPERIMENTS ON STUDENTS' ACADEMIC PERFORMANCE IN PHYSICS PRACTICAL

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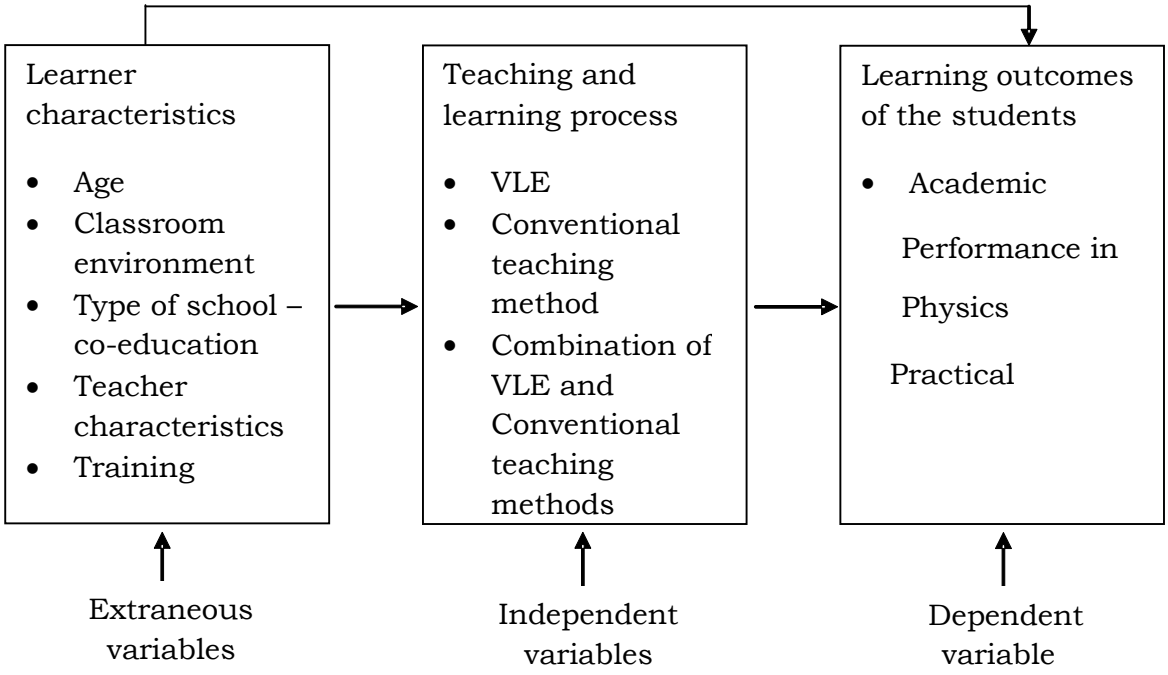
ABSTRACT: *This study investigates the effects of Virtual Laboratory Experiment (VLE) on senior secondary school students' academic performance in Physics practical. It made use of pre-test-post-test quasi experimental design with two levels of treatment and control group. The accessible population was senior secondary school two (SSS2). Purposeful sampling was used to obtain a sample of three co-educational senior secondary schools from a local government area in Niger state, Nigeria for the study. Intact classes were used. The instrument employed for the study were conventional lesson plans, an adopted computer simulation package for the Virtual Laboratory Experiments (VLE) and Researcher Made Test of Academic Performance in Physics Practical (RMTAPP). The data collected were analysed using Descriptive Statistics, Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA) and t-test statistics. The result of the study revealed that, the teaching strategies have significant effects on SSS2 academic performance in Physics practical and that, a combination of VLE and Conventional method is the most effective, followed by VLE while the Conventional is the least effective. It reveals further that gender does not have significant effect on students' academic performance in Physics practical. The study therefore recommends that, Physics teachers should employ combination of VLE and Conventional teaching method to teach Physics practical and that, in schools with non-availability/inadequacy of science equipment, VLE method should be employed among others.*
KEYWORDS: virtual laboratory experiment (VLE), conventional teaching method, academic performance and physics practical.

INTRODUCTION

Several research studies on the status of using laboratory to teach Physics practical in Nigerian senior secondary schools have been carried out. Such studies have revealed that there has been decline rather than improvement in the teaching of Physics practical to students (Akano and Nma, 2003; Okeke, 2003; and Okoli, 2006). In addition, there is an inadequacy of facilities in our secondary schools laboratories (Abdullahi, Lasisi and Garba, 2014). This has probably contributed to the poor learning outcome of Physics students. For more than a decade now, the different instructional strategies employed in the teaching of Physics practical in our secondary schools have not improved academic performance in the subject to any appropriate extent.

In an attempt to address the issue of failure rate in Physics, which could probably be as a result of students' poor performance in Physics practical, researchers (Ali (1983), Agbogun (1991), Isiaka (2008) and Hussaini, Azeem and Shakoor (2011) have in one way or the other studied the different methods of teaching science subjects at the practical class, and their effects on the academic performance of students. From their findings, instructional strategy was a significant

predictor of students' academic performance. Consequently, the present study was set out to examine the effects of VLE on students' academic performance in Physics practical.



Fig, 1: Conceptual Frame work.

Conceptual Framework of the Study

The conceptual framework of this study was based on the Systems Approach (Joyce and Weil, 1980). It holds that teaching and learning have inputs and outputs. This implies that good results can be achieved if the inputs have suitable materials. The study was also based on the assumption that students' failure rests with the quality of instruction and not lack of students' ability to learn (Wambugu and Changeigwo, 2008).

The framework is represented diagrammatically in figure 1. Figure 1 shows the relationship of variables for determining the effects of VLE on students' academic performance in Physics practical. The learning outcomes are influenced by various factors. They include the learners' characteristics, classroom environment and teacher characteristics as shown in figure 1. These are extraneous variables which needed to be controlled. The training the teacher acquired determines the teaching approach the teacher uses and how effective the teacher will use the approach. The learners' ages, previous knowledge, experience and their class determine what they are taught. The type of school as a teaching environment affects the learning outcomes. The study involved trained Physics teachers to control the teacher variable. The type of school used was co-educational day school to control the effect of the classroom environment. Senior Secondary School Two (SSS2) students who are approximately of the same age were involved in the study. Thus, in this study any difference found in the academic performance between the groups can therefore be attributed to the mode of instruction employed.

Instructional Strategies and Academic Achievement

Research on instructional strategies have been carried out by several scholars. Among those scholars, Fleming and Raptis (2000) analyzed 307 articles on possible effects of educational technology on the learning of pre-school through high school students revealed that only one-fourth of these articles offered empirical support and that majority of literature written between 1990 and 1999 consisted of academic and anecdotal discussion, global input-output program descriptions, and attitudinal surveys. They therefore conclude that without meaningful empirical exploration of how educational technology influence learning, no strong coherent argument for educational technology's use may be found in literature. The effects and influence of technology on students' learning may not be adequately documented; the personal computers network to the internet is evident in the classroom. In his study of the effects of investigative laboratory approach and expository methods of different levels of scientific literacy, Okoli (2006), used quasi-experimental design. It was revealed that there is significant difference in the level of acquisition of science process skills by students of different levels of scientific literacy taught with laboratory approach and those taught with the same concepts using the expository method. She therefore recommends that science education and curriculum planners should incorporate innovative instructional strategies in their various teacher education programs.

The result of the study of Dania (2014), in which different strategies were developed and tested, showed that Physics teachers' teaching methods play a major role in improving students' academic achievement. The use of appropriate teaching methods by an effective teacher is the basis for the students' academic improvement. In his study, Ogunleye (2000), pointed out that for teaching and learning to be effective, science teachers are expected to use different methodologies in order to meet the demands of the present generation of science students, the demands of new technologies and the demands of an ever-changing educational environment. The techniques which are recommended in the National Science Education Standards (NSES) are:-

- ❖ Student-centered instructions
- ❖ Teaching of critical thinking skills
- ❖ Use of "hand-on" laboratory activities

A mode of instruction that can satisfactorily satisfying all these conditions in science practical class is Virtual Laboratory Experiment (VLE). It is simulation of Science practical through the use of interactive computer programs. That is, performing Science experiments virtually on the screen of the computer. Thus, this study aims to investigate the effect of Virtual Laboratory Experiment (VLE) on senior secondary school class two (SSSC II) students' academic performance in Physics Practical.

Research Questions.

The study set out to answer the following research questions:

i. Which of the three instructional strategies VLE combined with Conventional; VLE only; and Conventional only is most effective for teaching Physics practical in senior secondary schools?

ii. Is there any difference in the academic performance between the group of Physics students exposed to Physics practical using combined VLE and Conventional; VLE only and conventional only instructional strategies?
iii. Is there any difference between the performance of male and female Physics students taught Physics practical with VLE combined with Conventional instructional strategy?
iv. Is there any difference between performance of male and female Physics students taught Physics practical with VLE instructional strategy?
v. Is there any difference between the performance of male and female Physics students taught Physics practical with Conventional instructional strategy?

Research Hypotheses.

In order to answer the above research questions the following null hypotheses were formulated:

i. There is no significant difference in the effects of the instructional strategies (VLE combined with Conventional; VLE; Conventional) on students' academic performance in Physics practical.
ii. There is no significant difference in the academic performance of Physics students taught Physics practical with combined VLE and Conventional; VLE; Conventional instructional strategies.
iii. There is no significant difference between the performance of male and female Physics students taught Physics practical with VLE combined with Conventional instructional strategy.
iv. There is no significant difference between the academic performance of male and female Physics students taught Physics practical with VLE instructional strategy.
v. There is no significant difference between the performance of male and female Physics students taught Physics practical with the Conventional instructional strategy.

RESEARCH METHODOLOGY

Design of the Study.

The study is quasi-experimental design, employing the pre-test, post-test non-equivalent control group design. It entails the non-randomized groups when the researcher cannot randomly sample and assigns his subjects. This design is adopted because it is not possible to randomize the subjects of the study without disrupting the school settings. The study is designed to test the effectiveness of using combination of VLE and Conventional methods, VLE only and Conventional method only in teaching Physics practical on senior secondary school students' academic performance in Physics practical. The study involves groups of students in their intact classes assigned to experimental and controlled groups. The independent variable in this study is the instruction strategies. The effect of this independent variable on the dependent variable; students' academic performance in Physics practical were investigated using Researcher Made Test of Academic Performance in Physics Practical (RMTAPPP). Table 1 gives the graphic illustration of the experimental design.

Table 1: Experimental Design of the study

Grouping	Pre-test	Research condition	Post-test
Group 1 (Experimental)	T_1	Treatment (VLE combined with Conventional)	T_2
Group 2 (Experimental)	T_1	VLE only	T_2
Group 3 (control)	T_1	Conventional only	T_2

T_1 = pre-test; T_2 = post-test

Sample and Sampling Procedure

Purposive sampling technique was used to select SSS 2 from the target population. Purposive sampling was used so as to minimize experimental contamination (Fraenke and Wallen (2000) in Dania (2014)). The criteria used were:

i. Schools that lack well equipped and functional Physics laboratory
ii. Schools that are currently presenting candidates for the senior secondary school certificate examinations (SSSCE) and have at least one professional graduate Physics teacher with at least three years of teaching experience.
iii. Day schools that are co-educational (mixed).

The schools were stratified in to private and public senior secondary schools and three schools that met the criteria were selected by balloting. One from private schools and two from public schools. The schools were randomly assigned to treatment (experimental) and (control) groups. In each school, intact classes were used. The sample size of the three selected co-educational schools were as shown in Table 3.

Table 2: Subjects group distribution.

Group	Type of GROUP	Number of Subjects
A	VLE And Conventional methods	32
B	VLE only	30
C	Conventional method only	34
TOTAL		96

Description of subjects that participated in the study

The three schools were all day and co-educational. The science students that participated in the study were 60 males and 36 females with average age of 16 years. Therefore, the study started with a total number of 96 students in all, but only 67 of them were able to participate fully, up to the post test, 43 males and 24 females. Others withdrew voluntarily.

Description of Concepts Probed in the Study

The concepts probed in this study were selected from SSS1 and 2 syllabi and they include**;** Determination of acceleration due to gravity using simple pendulum, Determination of spring's

constant using elastic spring, Verification of Snell's law using rectangular glass block, Determination of focal length of a bi-convex lens using real image method, Verification of Ohm's law and Determination of internal resistance of a battery. Performing these practical required reasonable number of science process skills that are expected of senior secondary school students to have.

Validity and Reliability of the Instruments.

The instructional package employed in this study was developed by the researchers. It consisted of concepts in Physics practical from mechanics, optics and electricity. The lesson plans for the conventional teaching strategies were adjudged adequate in scope and content based on the chosen topics by subject specialists, a Physics lecturer from a College of Education and two experienced Physics teachers at the senior secondary schools. Their comments and corrections were incorporated into the final form of the lesson plan. The VLE instructional package were tested by the researchers and some computer experts and were found to be safe and educationally very useful. They both agreed that the software programs were suitable for application and so the programs were adopted.

Researcher Made Test of Academic Performance in Physics Practical (RMTAPPP) consists of three items which were drawn from Optics, electricity and mechanics. The items reflected both cognitive and psychomotor domains. The RMTAPPP items were adapted from West African Examination Council (WAEC) and National Examination Council (NECO) past Physics practical examination papers, they were used to measure the students' academic achievement. Since, the instrument is adapted from standard examination questions the instrument is assumed to be standard.

Experimental Procedure.

Teachers' qualities variables were controlled by the researchers themselves teaching the Physics practical lessons in all the groups but at different periods. In order not to disrupt the academic activities of the schools that participated in the study, lesson period were re-scheduled for 2 hr. per period after closing school hours (2 pm – 4 pm) from Monday to Thursday. Group A had two periods of two hours per period for Monday and Thursday. This enabled them to be taught with VLE and Conventional methods at different periods. Group B was taught with VLE only and group C with the Conventional method only. The groups were taught at different days but the same time. The treatment lasted for eight weeks.

The instructional package was initially introduced to the groups before treatment. This is to present students with context and conceptual frame of work that will help students to arrange, integrate and retain material other than specify content and detail. If no previous knowledge is available, the instructional package will provide a frame on which to attach knowledge. Immediately after the treatment, post test was administered to the experimental and control groups.

The score of 67 SSS 2 science students that completed the eight weeks exercise from their responses to the Researcher Made Test of Academic Performance in Physics Practical (RMTAPPP) constitute the data of this study. The data were analysed using Descriptive Statistics, Analysis of Variance (ANOVA), Analysis of Covariance (ANCOVA) and t-test statistics.

Presentation of Data, Analysis and Discussion of Result.

This section examined the analysis of data, the interpretation and discussion of results. The data for this study were derived from the response to the instrument administered on the sixty seven (67) SSS 2 science students from the three selected senior secondary schools from Kontagora metropolis in Niger state. The results were analyzed based on the specific hypotheses formulated for the study. The findings in respect of the formulated hypotheses are presented and discussed.

Presentation of Data

The presentation of data comprised of the description of the mean scores and standard deviation of the various groups. Table 4 present post-test mean academic performance scores of the various groups of the study.

Table 3. Posttest mean scores of academic performance of students according to groups.

Group	N	Mean score	Max. Score	Min. Score	SD	Gender mean score and SD			
						Female		Male	
						Mean	SD	Mean	SD
Experimental Group I.	22	63.1	86.0	34.0	3.9	61.6	11.2	64.3	14.5
Experimental Group II.	22	43.8	72.0	18.0	15.7	32.3	5.5	49.2	15.5
Control Group III.	23	39.2	78.0	22.0	13.9	51.2	14.1	40.3	10.8

Table 3 indicates the summary of the mean scores and standard deviations for students' academic performances for the various groups after being exposed to selected senior secondary school Physics practical concepts in Mechanics, Electricity and Optics. The logical conclusion from these results is that, with reference to the teaching of some selected senior secondary school Physics practical concepts in Mechanics, Electricity and Optics. The VLE combined with Conventional method is superior to VLE method only and Conventional method only. The maximum scores recorded by VLE combined with Conventional group was found to be greater than that Conventional group which is greater than that of VLE group.

Further more, Table 4 reveals that the mean scores of male SSS 2 Physics students' academic performance is better than their female counterparts in both experimental groups except in control group where the mean score of female is better than that of the male.

METHOD OF DATA ANALYSIS

The research hypotheses were tested in this section.

i) There is no significant difference in the effects of the instructional strategies (VLE combined with Conventional; VLE; Conventional) on students' academic performance in Physics practical.

Table 4:- One way Analysis of Covariance (ANCOVA) of post test scores of students taught with VLE combined with Conventional, VLE only and Conventional only.

Source of Variation	**Type of III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig**
Main Effect	1953.019[a]	1	1953.019	11.301	.001
Explained	62.010	1	62.010	0.359	.552
Posttest	1953.019	1	1953.019	11.301	.001
Error	9677.878	56	172.819		
Total	23224.000	58			
Corrected Total	11630.897	57			

Table 4 indicates that the teaching effect was significant at P<0.05. Therefore, the null hypothesis stating that a non-significant effect of teaching strategies (VLE combined with Conventional; VLE only and Conventional only) on students' academic performance in Physics practical was rejected. This implies that the three methods differ significantly in their enhancement of the academic performance of SSS 2 science students. Consequently upon the observed difference in the instructional methods, Multiple Classification Analysis (MCA) was considered to determine the index of relationship and also to determine the variance of the dependent variable (Academic performance in Physics practical) that is attributable to the effect of the independent variable (Instructional strategies). This is shown in Table 5.

Table 5: Multiple Classification Analysis (MCA) of the post test scores of students taught with VLE and Conventional, VLE only and Conventional methods.

Grand Mean =	**N**	**Unadjusted**		**Adjusted for Independent variable and Covariate**	
Variable Category		**Davin**	**Beta**	**Davin**	**Beta**
Teaching Strategies.			.44		.55
VLE and Conventional	22	11	44.0	11.301	.001
VLE	22	11	43.00	.359	.552
Conventional	23	12	45.00	11.301	.001

R square = 0.168. Adjusted R square = 0.153

As shown in Table 5, the teaching methods have an index relationship of 0.30 (Beta value of 0.55) hence the observed relationships in favour of instructional methods shows that the instructional methods have a significant relationship (0.30) (Beta value of 0.55^2) with academic achievement of students in Physics.

Following the above results that the three methods of teaching Physics practical were not equivalent, the need arose to locate the sources of the significance and state which is superior to the others and the order of superiority. To find the direction of significance under

investigation, the post test scores were subjected to Tukey HSD multiple comparison tests for a post hoc analysis as shown in Table 6.

Table 6. Results of Tukey HSD post hoc test for Multiple Comparison of Instructional Methods on Students' Academic performance in Physics Practical.

Dependent Variable	I Group	J Group	Mean Difference (I – J)	Std. Error	Sig	95% Confidence Interval	
						Lower Bound	Upper Bound
Post Test	VLE + Conventional	VLE.	5.800 *	5.762	.581	-8.78	20.38
		Conventional	16.800 *	10.214	.251	-9.04	42.64
	VLE	VLE + Conventional	-5.800 *	5.762	.581	-20.38	8.78
		Conventional	11.000 *	10.136	.534	-14.64	36.64
	Conventional	VLE	-11.000 *	10.136	.534	-36.64	14.64
		VLE + Conventional	-16.800 *	10.214	.251	-42.64	9.04

** The mean difference is significant at 0.05 level.*

As shown in Table 6, the mean difference between VLE + Conventional and VLE only was 5.800, between VLE + Conventional and Conventional was 16.800 and between VLE and Conventional was 11.000. this means that VLE + Conventional method is the most effective in facilitating students' academic performance in Physics practical after being taught some selected Physics practical concepts in Mechanics, Optics and Electricity and exposed to RMTAPPP. This is followed by VLE method while the Conventional method is seen to be the least effective.

ii) There is no significant difference in the mean academic performance of Physics students taught Physics practical with (i) Combined VLE and Conventional, (ii) VLE only and (iii) Conventional only Strategies.

The summary of the Analysis of Variance (ANOVA) of the data collected on science students' academic performance due to the strategies adopted in this study is presented in Table 7.

Table 7: ANOVA of Sources of Variance by Strategies.

Sources of Variance		Sum of Square	DF	Mean Square	F	Sig
Pre Performance	Btw group	4962.875	3	2481.438	36.467	.000*
	Within group	3742.504	55	66.046		
	Total	8705.379	57			
Post-Performance	Btw group	2330.232	2	1165.116	4.532	.015*
	Within group	1440.112	55	257.093		
	Total	16470.345	57			

***** *Significant at P<.05*

It is revealed from Table 7 that there was a significant main effect of the strategies adopted on students' performance in Physics ($F_{(2, 55)}$ = 4.532; p<.05). This implies that a significant difference in Physics students mean academic performance scores for combined VLE and Conventional, VLE and Conventional groups; as a result, the null hypothesis 2 is rejected.

Table 8: Tukey HSD Post hoc test of Academic Performance by Strategies

Strategy	N	Subset for alpha = 0.05			
		Pre		Post	
		(1)	(2)	(1)	(2)
VLE	22	2.27	---	45.91	45.91
VLE & Conventional	22	---	24.35	---	58.35
Conventional	23	3.08	---	44.62	---
Mean($\bar{x}$)		13.10		50.55	
Standard deviation		12.36		17.00	

The source of the significant effect of the strategies on the academic performance traceable through Tukey HSD post hoc test on Table 8 reveals that there was no significant difference in the pre application of strategies mean performance between VLE ($\bar{x}$ = 2.2) and Conventional ($\bar{x}$ = 44.62), and between VLE ($\bar{x}$ = 45.91) and combined VLE and Conventional ($\bar{x}$ = 58.35), there was a significant difference in the post treatment mean performance between combined VLE and Conventional ($\bar{x}$ = 44.62). The post treatment mean performance was highest for combined VLE and Conventional strategy ($\bar{x}$ = 39.65), followed by the VLE strategy ($\bar{x}$ = 32.91) and least for Conventional strategy ($\bar{x}$ = 27.08). The results further reveals that there was a significant improvement in students' academic performance in Physics (pre-$\bar{x}$ = 13.10; std. dev. = 12.36 and post-$\bar{x}$ = 50.55; std. dev. = 17.00)

iii) There is no significant difference between the performance of male and female Physics students taught Physics practical with VLE combined with Conventional instructional strategy.

Table 9: T – test comparison of performance of mean scores of male and female Physics students taught with VLE combined with Conventional instructional strategies.

Sex	N	$\bar{X}$	SD	DF	T_{cal}	T_{crit}	Sig. at 0.05
Male	12	64.3	14.01	20	0.49	2.086	NS
Female	10	61.6	11.25				

NS = Not significant at 0.05 alpha level.

The analysis in Table 9 shows that the calculated t – value of 0.49 is less than the critical t – value of 2.086 at $p<0.05$. Therefore, the null hypothesis stating a non-significant difference in the mean scores of male and female Physics students taught with a combination VLE and Conventional instructional strategy was not rejected. This indicates that gender does not significantly affect students' performance in Physics practical when taught with a combination of VLE and Conventional instructional strategies.

iv) There is no significant difference between the academic performance of male and female Physics students taught Physics practical with VLE instructional strategy only.

Table 10: **t - test comparison of performance of mean scores of male and female Physics students taught with VLE instructional strategy**.

Sex	N	$\bar{X}$	SD	DF	T_{Cal}	T_{Crit}	Sig. at 0.05
Male	15	49.2	15.48	20	2.77	2.086	S
Female	7	32.3	5.55				

S = Significant at 0.05 alpha level.

Table 10 is a display of t – test statistics on the post-test Researcher Made Test of Academic Performance in Physics Practical (RMTAPPP) mean scores of male and female students in the VLE group. The calculated t – value of 2.77 and critical value of 2.086 showed that significant difference occurred at 0.05 alpha levels. Hypothesis H_{04} stating no significant difference between the mean scores of male and female Physics students taught Physics practical with VLE instructional strategy was therefore rejected.

v) There is no significant difference between the performance of male and female Physics students taught Physics practical with Conventional instructional strategy.

Table 11: t – test comparison of performance of mean scores of male and female Physics students taught with Conventional instructional strategy.

Sex	N	$\bar{X}$	SD	DF	T_{cal}	T_{crit}	Sig. at 0.05
Male	16	40.3	10.83	21	1.85	2.080	NS
Female	7	51.1	14.14				

NS = Not Significant at 0.05 alpha level.

The t – test statistics analysis in Table 11 reveals that the calculated t – value of 1.85 is less than the critical t – value of 2.080 at $P<0.05$. The null hypothesis stating a non-significant difference in the mean scores of male and female Physics students taught with Conventional instructional strategy was therefore not rejected.

DISCUSSION OF RESULTS

The findings of this work were based on the research questions and hypotheses that were stated at the beginning of this study and analysed in the tables. The factors which were analysed in the hypotheses are effects of instructional strategies (VLE + Conventional, VLE only and Conventional only) and gender on students' academic performance in Physics practical. The findings of this study revealed that Physics students' academic performance in Physics practical is a function of the instructional strategy employed.

The study further indicated that instructional strategy has a significant effect on student's academic performance in Physics practical. This agrees with the findings of Fleming and Raptis (2000) who identified instructional method as a major factor responsible for students' poor performance in Physics. The result further confirms the findings of Wambugu and Changeigwo (2008), who pointed out that students' poor performance is as a result of the quality of instruction.

The analysis of data on the effect of instructional strategies on students' academic performance in Physics practical revealed that students taught with the combination of VLE and Conventional instructional strategies performed better than those taught with VLE method only and those taught with Conventional method only. The mean performance was highest for combined VLE and Conventional strategy followed by VLE strategy only and then conventional strategy only. A critical look at the study revealed a significant difference in the VLE combined with Conventional compared to other groups. Thus, it can be inferred that the use of combination of VLE and Conventional strategy is superior to both VLE and Conventional strategy only. This implies therefore that there is a likelihood of improvement in students' performance in Senior Secondary Certificate Examination (SSCE) of both West Africa Examination Council (WAEC) and National Examination Council (NECO) if the combination of these strategies are implemented at all SSS levels.

The results of hypotheses H_{03}, and H_{05} shown in tables 9 and 11 indicated that no significant difference was found to exist in the academic performance of male and female Physics students taught with the same teaching strategy in Physics practical. This is expected to be so as no teaching strategy discriminates between the sexes of the students. This result is consistent with the finding of Akinbobola and Afolabi (2009) and Olatoye and Afuwape (2004) that showed no significant difference in the mean performance between boys and girls in the manipulation of the same instructional material as well as their rate of contribution and class participation. However, result of hypothesis H_{04} as shown in table 10 indicated that there is a significant difference between the mean scores of male and female Physics students taught with VLE instructional strategy. This agrees with the findings of Adeoye and Sotayo (2003), who found a significant difference between the performance of male and female Physics students in favour of males.

CONCLUSION AND RECOMMENDATIONS

In conclusion, the study has revealed that the effects of teaching strategies on students' academic performance in Physics was significant. This implies that students' academic

performance in Physics practical could be based on the teaching strategy employed in teaching. Also, VLE combined with Conventional strategy was found to be most effective, followed by VLE strategy alone and lastly, the Conventional strategy. The VLE mode of instruction only can be used effectively to teach Physics practical to senior secondary school students. Lastly, the research revealed that the students' gender in all teaching strategies employed in this study except VLE only has no significant effects on students' academic performance in Physics practical.

Based on the findings of this study and their educational implications, the study recommend that Physics teachers should employ combination of VLE and conventional teaching strategy to teach Physics practical. In schools with non-availability/inadequacy of science equipment, VLE method should be employed. Schools owners (Government and Proprietors/Proprieties) should provide computers and projectors for effective implementation of VLE. Adequate training on how to download and use VLE should be organised for science teachers. Government should see to the training and retraining of science educators and teachers to be able to modify existing VLE and possibly develop theirs. The gender of a student should not be a factor to determine the choice of Physics in senior secondary school. Thus, both male and female students should be given equal opportunity and encouragement to study Physics and science in general.

Acknowledgement.
The authors are grateful to Tertiary Education Trust Fund (Tetfund) for sponsoring this research through an Institution Based Research (IBR) grant.

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