Innovations

Performance and practical skills of Physics students exposed to conventional and virtual Instructions in Osun state secondary schools, Nigeria

Adebisi, Thomas Ajibade (Ph.D.) & Otun, Stephen Ademola

[1]Department of Science and Technology Education
Faculty of Education
ObafemiAwolowo University, Ile-Ife, Nigeria

Abstract

The focus of the study was to examined the performance and practical skills of Physics students in secondary schools when exposed to conventional and virtual instructions with a view to see the effect of virtual instruction in this day of globalisation of Technology for effective learning outcomes. To guide this study two research questions and their corresponding hypotheses were formulated and tested at 0.05 alpha level of significance. The design for the study was non-equivalent pre-test, post-test control group quasi-experimental design.The population for the study comprised all secondary Physics students in Osun State of Nigeria.The sample of the study consisted of 90 senior secondary school Two (SSS II) Physics students in their intact class selected using multi-stage sampling procedures. PhysicsPractical Performance Task (PPPT) and Physics PracticalSkills Task (PPST) were the instruments used for the study. A validated PPPT and PPST with reliability coefficients of 0.70 and 0.81 were used for data collection.Conventional teaching instruction and virtual teaching instruction were the two packages used for treatment of conventional and virtual groups respectively.Mean, standard deviation and t test statistics were used for analysis. The result of findings showed that there were statistical significant difference in the Practical Physics skills and the performance between the two groups. The mean gain value of virtual teaching instruction group is higher than conventional teaching instruction group indicating the better improvement after exposure to virtual instruction.The researchers concluded that that virtual learning improves learning of Physics practical. It was recommended among others that Physics teachers should be enthusiastic to acquire appropriate skills in the use of ICT that can improve and facilitate their teaching promptness for virtual instruction delivery to students.Also the findings of this study should be made available to teachers and Ministry of Education official in schools department so that they will be able to present the information to appropriate quarters of the government.

Keywords*: 1.Performance, 2.practical skills, 3.Physics, 4.conventional instruction, 5.virtual instruction, 6.secondaryschools.*

Introduction

Physics as the one of the physical sciences is expected to be taught through educational based activities as specified in the national curriculum at the secondary level of Education. The reason is that effective usage of educational based activities in the classroom is to step up the understanding of concepts and to enable students to handle reality of facts empirically thereby exposing them to necessary skills for better performance in Physics. The educational based activity in Physics is no other than Physics practical to be taught in the laboratory. It is obvious that laboratory activityinvolves some skills at every point during the practical sessions. These skills in sciences can be referred to as practical skills. This made the studying of Physics to be task involving requiring the guidance of skilled teachersin the process of instructing the students to go through any experimental tasks. The reason behind the skilled physics teachers is what Adebisi (2021) alluded tothat the learning of Physics involvesconcept learning, experimentation, problem solving, and critical thinking. This complexity might be the reason why students' performance over the years in Physics is not encouraging. However, this demands on teachers' effectiveness andthe useof diversified instructions to deliver the contents of their lessonsduring the class as when as in the experimental period in the laboratory at the secondary schools.

It is a common phenomenon that over the years the trained teachers have stereotyped their teachings to conventionalinstructions in all the subjects. In sciences the conduct of teaching in Nigeria schools, especially in public schools are tiedto conventional instructions andthis has restricted students from knowing-out the procedures and application of scientific concepts on the reason of time factor; haste to cover the curriculum contents; and dearth of equipment in the schools. However, the conventional instruction is attributed with some potential. Accordingly, the aim of conventional method of teaching is to expose all students to identical knowledge, and to develop same interests (Finch, 1999).This type of instruction initiates discussions in the classroom, and focuses exclusively on knowing the contents in notes and textbooks (Yap, 2016).Thishas made manyteachers to follow on the parochial convectional method of teaching year in and out.The stereotype natureof convectional instruction has confined teachers to teach the students in the classroom onlyfor the purpose ofpassingexaminations or attaining grades only for the next level of education- a point of weakness to convectional instructions.Although conventional instructions allow for interactions during face- to- face manner in the class, the limitations are now encroaching its enriching value.Students passivelyrepeat the information memorisedforexaminationpurposes from convectional classes (McCarthy &Anderson, 2000).

Besides the short comings on the path of convectional teaching, the smooth and regular academics in Nigeria have witnessed confrontation from militancy and insurgence resulted to closure of schools in many part of the country for number of times.A contemporary discussion on Nigeria is almost inevitably replete with issues surrounding insecurity, militancy, insurgency, and terrorism (Amalu, 2015).He maintainedthat the killings and abduction of school children and college students have forced the closures of schools indefinitely and the withdrawal of children and wards by parents from schools, therefore denying them access toface-to face learning.So far there is a need forparadigm shift from solely usage of conventional instruction to virtual instruction in this part of the world. In many part of the world the classroom environment for teaching and learning has changed from predominantly face-to face instruction delivery tovirtual or blended learning of different forms.

A virtual classroom is an online learning environment, created using internet, computers, sophisticated videoconferencing devices, in which either teacher is not physically present or students are not present at the same time in the classroom (Akpan, Etim, &Ogechi,

(2016).Similarly, the virtual instruction is a mode of delivery the curriculum contents through e-learning presentations.It has been discovered that virtual classroom, generally, is appreciated by students as a result of the abundant resources and free time it allows as well as autonomous study, intuitive knowledge and selective contents opportunity (Falloon, 2012). For virtual laboratory it is a computer-based activity where students interact withexperimental setup or other activities via a computer interface. Virtual laboratory provide forum for interaction between students and teaching materials widening students' experiences to real life situation; it is a student-centered learning where practical skills could be learnt overcoming challenges in face-to-face practical class.

In general practical skills are consequential to learning and knowing of science. Practical skills obviously include an individual's competency to deduce and represent information from experimental set-up in the practical class.Practical skills such as observation, making inference, classification, measurement, communication, integratedand evaluationskills are essentialin any experiments but teachers might not have sufficient time tosystemically explain them during convectional class; in virtual experiment these can be harmonious presented to students in virtual display succinctly. The virtual laboratory experiment potentially have a wide range of advantages over conventionallaboratory experiment (e.g., convenience, flexibility, lower costs, currency of material, increased retention, and transcending geographical barriers,(Ahmad, Piccoli& Ives,1998). Although, with a lot to derive from virtual learning the incessant and sudden closure of schools as witnesses in Nigerian schools during convectional class as a result insurgencies drive home the relevance of virtual instruction.

A pedagogical approach of virtualinstruction to learning of physics practical is worthwhile in this computer age where every student is always online, therefore the need to examine virtual instructionon the performance and practical skills is germane in this study.

Statement of the Problem

The use of conventional instructionhas been susceptible to a variety of problemsand in science the problem of laboratory learning environment, availability of apparatus, inadequate practical skills acquisition have been there overtime, these challenges are now compounded with insecurity in some part of Nigeria forcingmany schools to be shut down. These are uncontrollable situations surroundingconvectional classes.These challenges and many more might be converging reasons for abysmal performance of students in Physics,besides, practical skills competency.To surmountthese and to make learning continue atdesired time the incorporation of virtual classes call for attention since the students of nowadays are conversant to Information Communication and Technology (ICT). It is therefore necessary to examine the effect of virtual instructionson Physicspractical taking cognisance of practical skills and the performance of students.Therefore, the study was conducted.

Purpose of the Study

The broad objective of this study is to examine the performance and practical skills of physics students exposed to conventional and virtual instructions in secondary schools of Osunstate Nigeria.

Research Questions

The following research questions were raised:

(1) Is there any significant difference between the performance of studentsexposed to Conventional Teaching Instruction (CTI) and thoseexposed to Virtual Teaching Instruction (VTI) in Senior Secondary Schools in Osun State of Nigeria?

(2) Is there any significant difference betweenthe practical Physics skills of students exposed to Conventional Teaching Instruction (CTI) and those exposed to Virtual Teaching Instruction (VTI) in Senior Secondary Schools in Osun State of Nigeria?

Research Hypotheses

In the context of the above research questions the following research hypotheses were raised:

HO_1: There is no significant difference betweenthe performance of students exposedto Conventional Teaching Instruction (CTI) and those exposed Virtual Teaching Instruction (VTI) in Senior Secondary Schools in OsunState of Nigeria.

HO_1: There is no significant difference between Physics practical skills of students exposed to Conventional Teaching Instruction (CTI) and those exposed to Virtual Teaching Instruction (VTI) in Senior Secondary Schools in OsunState of Nigeria.

Methods

Research Design

The study adopted non-equivalent pre-test, post-test control group quasi-experimental design. The two groups used for the study are conventional instruction groupandvirtual teaching instruction pretested before treatment.Post-testinstruments were administered on the two groups after the treatment.

Participants

The population for the study consisted of all senior secondary school Physics students in Osun State of Nigeria. The study sample comprised of 90senior secondary school Two (SSS II) Physics students selected using multi-stage sampling procedures. From the three senatorial districts inOsun state, one senatorial district was selected using simple random sampling technique and one Local Government Areas (LGA) was sampled from the selected senatorial district using simple random sampling technique. Furthermore, four schools were selected using simple random sampling technique from the selected Local Government Area. One intact SSII science class was purposively selected on the basis of science class in each of the schools making a total of four classes. The four intact classes were assigned to two classes for each group using simple random sampling technique. Students in conventional group were exposed to Conventional Teaching Instruction (CTI) while those in virtual group were exposed to Virtual Teaching Instruction (VTI) through computer and mobile devices.

Research Instruments

Two research instruments were used to collect data, namely: PhysicsPracticalPerformance Task (PPPT) and PhysicsPractical Skills Task (PPST). Physics PracticalPerformance Task (PPPT) was developed by the researchers to access students' performance in responses to their ability to use the practical skills acquired to solve Physics problems. The PPPT consists of twenty (20) multiple questions. The PPPT was prepared using cognitive domains of all six levels of knowledge, comprehension, application, analysis, synthesis and evaluation. PPST is a practical task consisting of 20 questions adapted from the standard national examination based on the contents of what the students were taught from the curriculum.The 20 items spread through observation, classification, measurement, evaluation and integrated skills.

Validation of Research Instrument

The content validity of PhysicsPractical Skills Task (PPST) was done by three experts in the Department of Science and Technology Education (STE), and two secondary schools Physics teachers that have been marking national examinations for not less than ten years. The pilot test

of the instrument was done by administering to twenty respondents outside the study area. The test-retest reliability coefficient for PPST is 0.81 using Pearson Product Moment Correlation Measure.

The pilot test of Physics Practical Performance Task (PPPT) was done by administering it to twenty respondents from the sample outside the study area. The data collected were subjected to item analysis and reliability test. Difficulty index (P) and discrimination index (D) was considered such that items whose difficulty index was $0.25 \leq P \leq 0.72$ and the discrimination index (D) was $0.4 \leq D \leq 0.6$ were retained. At the end of the validation, twenty items out of twenty five met the difficulty and discrimination criteria, hence were retained. Kuder Richardson formula 21 (KR-21) was then used to determine the reliability. A reliability score of 0.70 obtained was considered good for the study

Instructional Packages

The instructional strategy packages are:

Conventional Teaching Instruction (CTI)

The conventional teaching instruction was the treatment for the control. The instructional package used was validated by two experts from the Department of Science and Technology Education, ObafemiAwolowo University, Ile-Ife, Nigeria. The experts examined the extent to which the instructional guides conform to the conventional basis of teaching in the laboratory. Two experienced Physics secondary school teachers also validated the lesson plans with emphasis on content coverage, clarity of lesson objectives, adequacy of instructional materials, adequacy of students' activities, and the appropriateness of the evaluation items. The comments of the experts and Physics teachers were used to adjust the package. In this group experiment was carried out through face-to face class interactions with the students. The researchers explain and demonstrated setting up of apparatus following the instruction, methods of measurement, recording, communication of the results were explained. Questionings were entertained. Students were grouped infour to each experiment and every student had opportunity to handle the apparatus on his/her own. Each student carried out the observation, recording, plotting byhimself/ herself.

Virtual Teaching Instruction (VTI)

The Virtual Teaching Instruction (VTI)is an instructional package via interactive computer – simulated laboratory that could be shared throughmobile devices. Students interacted with the presentation relayed from computer and mobile devices. The presentation was done virtually by the viewed teachers explaining demonstration of setting up of apparatus, methods of measurement, recording and communication of the results. Students had opportunities of interacting with the virtual laboratory instruction package by clicking on Next, Previous, Pause and Stop button at normal time given for each of the experiment.The process of logging on to computer and mobile devices was explained to the students and the use of installed package on mobile device with clicking on Next, Previous, Pause and Stop button for each experiment. Four Students were grouped on each device. Each student carried out the observation, recording, plotting by himself/ herself.

Procedure for Data Collection

The researchers sought for permission from the schools' principals about the objectives and purpose of the research who then instructed the Physics teachers on how they should assist and work with the researchers in carrying out the research. After the permissions from each school, the researcher pre-tested the two instruments on the two groups used in the first week. This provided the researchers with information on entry status of the students before the treatment. The treatment lasted for six weeks. The post-test Physics Practical Performance Task (PPPT) and Physics PracticalSkills Task (PPST) were administered on the two groups after the treatment.

Results

Research Hypothesis One: There is no significant difference betweenthe performance of students exposed to Conventional Teaching Instruction (CTI) and those exposed Virtual Teaching Instruction (VTI) in Senior Secondary Schools in OsunState of Nigeria.

To test this hypothesis, theperformance of students in both CTI and VTI were compared using t-test analysis.

Table 1: Independent-Sample t-test of Physics Practical Performance Task

Variable	Groups	N	Mean	Standard Deviation	t value	df	Sig	Remark
Pre-performance	Convectional	40	22.94	5.252	2.438	88	0.612	NS
	Virtual	50	20.29	4.483				
Post-performance	Convectional	40	27.31	4.854	4.899	88	0.03	S
	Virtual	50	30.96	3,392				

NS - Not significant t at 0.05 levels

S - Significant t at 0.05 levels

Table 1 shows that there was no significant difference between the performance of students exposed to Conventional Teaching Instruction (CTI) and those exposed to Virtual Teaching Instruction (VTI) in senior secondary school before the treatment was administered ($p > 0.05$), which shows that both groups have similar background knowledge. Hence, the null hypothesis was not rejected before the treatment was administered.The result of the analysis of table 1 for post treatment shows that shows that ($t = 4.899$, $p < 0.05$) there was significant difference in the physics performance task of students in Physics when taught with conventional and virtual instructions. Hence, the null hypothesis was rejected. This shows that a difference existed in the performance of the two groups as those exposed to VTI and CTI had increased mean gains of 10.67 and 4.37 respectively.

Research Hypothesis Two: There is no significant difference betweenthe Physicspractical skills of students exposed to Conventional Teaching Instruction (CTI) and those exposed to Virtual Teaching Instruction (VTI) in Senior Secondary Schools in Osun

Table 2: Independent-Sample t-test of Physicspractical skills

Variable	Groups	N	Mean	Standard Deviation	t value	df	Sig	Remark
Pre-practical Physics Skills	Convectional	40	22.54	5.452	1.507	88	0.52	NS
	Virtual	50	20.53	6.255				
Post- practical Physics Skills	Convectional	40	23.17	3.944	0.913,	88	0.00	S
	Virtual	50	28.20	2.501 -				

NS - Not significant t at 0.05 levels
S - Significant t at 0.05 levels

Table 2 shows that there was no significant differencebetween the practical Physics skills of students exposed to Conventional Teaching Instruction (CTI) and those exposed to Virtual Teaching Instruction (VTI) in senior secondary school before the treatment was administered ($p > 0.05$), which shows that both groups have similar background knowledge in Physics practical skills. Hence, the null hypothesis was not rejected before the treatment was administered.
The result of the analysis of table 2 for post treatment shows that ($t = 0.913$, $p < 0.05$) there was significant difference in thePhysics practical skills between the two groups. Hence, the null hypothesis was rejected. This shows that a difference existed in the practical Physics skills of the two groups of students as those exposed to VTI and CTI had an increased mean gains of 7.67 and 0.63 respectively.

Discussion

The finding of the study in research hypothesis 1 indicated thatthere was asignificant difference in theperformance between the two groups with those exposed to VTIhad a higher mean score than CTI. The implication is that virtual and convectional instructions both improve the performance but the formal had a higher mean score than the latter. The result of the findings is support of the work of Nikolaos, Giannousi, Derri, Michalopoulos, EKioumourtzoglou, 2012). In their study, Lund and Wang, (2019) found out that virtual reality a form of virtual classroom when used in instruction provide a small improvement in academic performance and a large improvement in student engagement. This has been attributed that virtual experiments offer efficiency over physical experiments because they typically require less time and provide results of lengthy investigations instantaneously (Zacharia.,Olympiou,.Papaevripidou,2008).

The finding of the study in research hypothesis 2 indicated thatthere was asignificant difference in Physics practical skillsbetween the two groups with those exposed to VTIhad a higher mean score than CTI. The implication is that virtualinstruction improves the practical skills acquisition in Physics better than convectional instruction during the practical class.The result of this study corroborates the research findings of Corner, Handy, and Brett (2016) that virtual instructionenhances practical skills than the studentswho had access to the usual conventionalteaching. Practical skills are learnt through interactions that might not be adequately emphasised or buttressed in convectional class. In convectional class the interactions are saddled with a lot of hectic and non-availability of the equipment in many of Nigeria public schools. The submission of many researches showed that there is considerably and rewardably academic interactions through virtual instructions if properly employed to enhance practical skills. Most of

the students preferred to have more virtual classroom activities because of the presence of cues and more human interactions (Gedera, 2014). The advantage lies in the fact that virtual classroom is an open systems with no constraints.This isso because virtual classroom potentially have a wide range of advantages over conventional environments (e.g., convenience, flexibility, lower costs, currency of material, increased retention, and transcending geographical barriers (Ahmad, Piccoli, & Ives, 1998).Practical skills are what make practical exercises interesting and non-robotic, because practical skills consist of chain of necessary skills necessary to master concept under study and this can be practicable assess in virtual learning withoutinterruption.

These findings of this study provide a persuasive argument on the effect of virtual instruction in enhancingperformance and necessary skills in science especially in Physics practical in secondary schools.

Conclusion

It is imperative that teachers be made to use virtual instructionin Nigerian public schools so that when the schools are shut down with unforeseeable the classes can go on. So, a teacher adhering to conventional class in physics is limiting the students to perform creditably. The results of the study obviously indicated that practical skills and the performance in Physics were better improved through virtualinstructions thanwith convectional instruction.

Recommendations

From the findings of this study, the following recommendations are made:

(i) Physics teachers should be enthusiastic to acquire appropriate skills in the use of ICT that can improve their teaching promptness for virtual instruction delivery to students.
(ii) Physics teachers should be trained on the use of virtual environment in teaching and learning to boost their courage on virtual instructions.
(iii) Findings of this study should be made available to teachers and Ministry of Education officialin schools Department so that they will be able to present theinformation to appropriate quarters of the government.
(iv) Examinations to be conducted through virtual to serve as basic platform to stir up students and teachers alike for virtualacclimatisation.
(v) There is need to incorporate virtual learning into curriculum of science in secondary schools.

References

1. *Adebisi, T. A. (2021).Perception and practice of physics teachers towards continuousassessment in secondary schools in Osun state Nigeria: Pedagogical and curriculum implications. Journal of Educational Research on Children, Parents & teachers, 2(2): 294-309.*

2. *Ahmad, R., Piccoli, G., & Ives, B. (1998). Effectiveness of virtual learning environments in basic skills Business Education: A field Study in progress (1998). ICIS 1998 Proceedings.37. aisel.aisnet.org*

3. *Akpan, S. J., Etim, P. J., &Ogechi, U. S. (2016). Virtual classroom instruction and academic performance of Educational Technology students in distance education, Enugu State.World Journal of Education, 6(6): 83-88.*
4. *Amalu, N. S. (2015). Impact of boko haram insurgency on human security in Nigeria.Global Journal of Social Sciences, 14, 35-42.*

5. *Corner, E. J., Handy, J. M., & Brett, S. J. (2016).E learning to facilitate the education and implementation of the chelsea critical care physical assessment: A novel measure of function in critical illness [Electronic version]. British Medical Journal, 6(4): e010614.*

6. *Falloon, G. (2012). Inside the virtual classroom: Student perception on affordance and limitation. Journal of Open, Flexible and Distance Learning, 16(1): 108-126.*

7. *Finch, P. M.(1999).The effect of problem-based learning on the academic performance of students studying podiatric medicine in Ontario.Medical Education, 33: 411-417.*

8. *Gedera, D.P.S. (2014). Students' experience of learning in a virtual classroom. International Journal of Education and Development using Information and Communication Technology (IJEDICT), 10(4): 93-101.*

9. *Lund, B. D., & Wang, T. (2019). "Effect of virtual reality on learning motivation and academic performance: What value may VR have for library instruction?," Kansas Library Association College and University Libraries Section Proceedings: 9(1)*

10. *Nikolaos, V., Giannousi. M., Derri V., Michalopoulos, M.,,Kioumourtzoglou, E. (2012). The impact of blended and traditional instruction on students' performance.ProcediaTechnology , 1,439 – 443.*

11. *McCarthy, J. P. & Anderson, L. (2000). Active learning techniques versus traditional teaching styles: Two experiments from history and political science. Innovative Higher Education, 24(4):279-294.*

12. *Yap, W. L. (2016) Transforming conventional teaching classroom to learner-centred teaching classroom using multimedia-mediated learning module. International Journal of Information and Education Technology, 6(2): 105-112.*

13. *Zacharia, Z. C., Olympiou, G., Papaevripidou, M. (2008).Effects of experimenting withphysical and virtual manipulative on students' conceptual understanding in heat and temperature. Journal of Research in Science Teaching, 45:1021-1035.*

14. *Zubas, P., Heiss, C. & Pedersen, M. (2006). Comparing the effectiveness of a supplemental online tutorial to traditional instruction with nutritional science students. Journal of Interactive Online Learning, 5(1): 75–81.*

adebisithomas@oauife.edu.ng
otunshi@gmail.com