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**ORIGINAL ARTICLE**

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# Effects of Computer Simulation and Video Based Instructional Strategies on Students' Acquisition of Skills in Practical Physics

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**ABSTRACT**
*The study was designed and conducted to determine the effectiveness of of Computer Simulations and Video based instructional strategies on Students' Acquisition of Skills in Practical Physics. A non-randomized pre-test, post-test control group of quasi-experimental Research design was adopted for the study. A sample of 315 SS II physics students, drawn by Multistage sampling techniques from six co-educational schools in Educational district III was used for the study. Instruments such as Practical Physics Achievement Test (PPAT) with reliability coefficient of 0.71, Practical skill rating scale (PSRS) with reliability coefficient of Manipulative skills = 0.81, Measurement skills=0.79, Observation skills=0.72, Mathematical Skills=0.76, Drawing Skills = 0.71, Graphing Skills= 1.0 and Inferring and Generalization skills= 0.83 were validated by experts and used to collect data for the study. Students in one of the experimental group followed the demonstration of the experiment using Simulation method while the Second experimental group followed the demonstration of the experiment using Video based method while those in the control group followed the demonstration of the experiment using the conventional method. The data collected were analyzed using Analysis of covariance (ANCOVA), Estimated Marginal Means and Scheffe's post hoc test at 0.05 level of significance. The major findings from this study include the following: The students in the experimental group (Simulations and Video based ) instructional strategies had a higher mean in acquisition of practical skills than their counter parts in the control group (conventional) instructional strategy . There are no significant interaction effects of treatment and gender on Senior Secondary Students' acquisition of skills in Practical Physics. The results revealed that the use of Simulations and Video based instructional strategies significantly improved Students' Acquisition of Skills in Practical Physics. Hence, this study suggests the need for Physics teachers to lay less emphasis on Conventional laboratory method, which is expository in nature. Based on the findings, recommendations were made which includes Physics teachers to use Simulations or Video technology into teaching laboratory Physics.*
***Keywords:*** *Practical Physics, Computer Simulations , Video based instructional strategies, Practical Skills*

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## INTRODUCTION

Physics is the backbone of technological innovations that has empowered the 21st century Students' acquisition of relevant skills such as Collaborative Learning Skills. Hence, it is essential that every child should be given the opportunity to acquire at least basic knowledge and the concept of Physics as a science subject (Adeyemo, 2011). This in turn promotes the objectives of Secondary education as stated in the National Policy on Education to provide trained manpower in the applied science, technology and commerce at sub – professional grades (FRN, 2004).

Physics being a science subject constitutes two aspects; the theoretical aspect and the practical aspect. Students' are examined in both aspects at both internal and external examination. WAEC Chief Examiner's Reports (2013, 2014 and 2015) stated that students show deteriorating performances in the Practical Physics at the School Certificate Examination level. This in turn would account for their poor performances in theoretical Physics. Besides most educators would agree that in learning physics, practical work has a very important role.

Therefore, researcher is hoping that if the teaching of practical physics is improved using instructional strategies such as Computer Simulation and video based , probably the performance in physics practical will improve and this will in turn improve the students' general performance in theoretical physics.

Students' weaknesses in Practical aspect was attributed to so many reasons, some of which are –

- There is inadequate integration of laboratory activities with theory classes (Abimbola,1994 ; Aladejana & Aderibigbe,2007).
- There are studies which pointed out that most often, practical activities are delayed until final external examinations are near (Abakpa et al., 2016; Akinbobola, 2015 ; Babajide, 2010 ; Stephen & Mboto, 2010). This might enable students to follow the procedure sheet finishing one step after another and many times they do not develop deeper understanding of experiment (Logar & Savec,2011).
- Omorogbe and Celistine (2013) stated that there are few classrooms with demonstrations, and when in use it is often teacher demonstration that makes students passive.
- lack of functional physics laboratory and inadequate equipment for physics practical in most Nigerian secondary schools (Adegoke & Chukwunenye ,2013)
- Students' are not exposed to efficient pedagogies of teaching and presenting information to learners (Buabeng et al.,2014).
- Students' taught with conventional methods instead of using laboratory-assisted instructional strategies (Abungu et al.,2014) .

Physics as a practically oriented subject requires continuous demonstrations and many laboratory activities to explain some seemingly abstract concepts and to instill appropriate scientific skills needed for higher study and consequently technological advancement of the nation (Tamunoiyowuna & James, 2016). This tends to give importance to laboratories which are the most important learning environments that provide the development of attitudes and cognitive levels in a positive manner and that lead students to discover scientific facts and concepts in small groups as well as providing development of social relations through activities (Bilgin ,2006).

Moreover, laboratory activities are usually more engaging than formal lectures in a conventional classroom, thus the Practical activity classes offer opportunities for productive cooperative interactions among students and the teacher (House of Lords, 2006; Ajayi & Osoko,2013). There is also evidence that practical work can increase students' sense of ownership of their learning (Dillon, 2008; Musasia et al.,2012; Musasia et al.,2016) and can increase their motivation (El-Rabadi ,2013). Furthermore, the laboratory courses are given importance because it is supposed to develop students cognitive, psycho-motor, attitudinal and affective abilities related to experimental Physics, which essentially include, conceptual understanding, procedural understanding, experimental skills acquisition and experimental problem solving ability (Hughes & Overton, 2009; Khaparde , 2004; Yildiz et al., 2005).

Therefore, the researcher aims to make the Practical work in Physics curriculum to be the nucleus of the whole reform process. The Practical work assist students to develop the skills of a good scientist, helps in understanding facts and concepts , develop interest in the subject and so encourage active learning. In line with this, Adeyemo (2011) opined that for better performance in science examinations, it is essential that secondary school students acquire the necessary skills of scientists.

Musasia, Ocholla and Sakwa (2016) proved that good learner's intelligence and skills can be expressed if dynamic and creative instructional strategies are in place. This is in agreement with several studies which proved that students taught with laboratory-assisted instructional strategies are more successful than students taught with conventional methods (Okam& Zakari,2017 ; Abakpa et al.,2016); Ogundiwin et al.,2015; Adeyemo & Babajide, 2014;Azar & Sengüleç, 2011; International Baccleurate,2007). This might be because the laboratory applications could increase the permanence of students' knowledge (Azar & Sengüleç, 2011).

Those studies also claim that learning which takes place when laboratory practices are in parallel with theoretical knowledge in Physics course increases the success such that students can actually see science as one to be learnt by activity and discovery and not by memorizing notes of the theory classes (Hughes &

Overton, 2009; Kaya &Boyuk, 2011). In addition to that, the effect of practical activity being more effective in fostering students' acquisition of science process skills which may eventually improve students' performance (Nwagbo and Uzoamaka,2011).

Science process skills are activities, which students carry out in scientific investigations to enable the acquisition of scientific knowledge (Abungu et al.,2014). Therefore, the higher achievement of the students can be attributed to the laboratory work that led to the development of the students scientific and practical skills (Musasia et al.,2016; Muchai,2014; El-Rabadi, 2013).

In order to tackle the problems highlighted so far, the study integrated laboratory practical instructional strategy such as Computer Simulations or Video based strategy against Conventional methods of teaching Practical Physics in the practical physics classroom environment. During the Physics Practical sessions, the teacher demonstrates the experiment using Computer Simulation or Video based strategies.

In case of Simulations, the demonstration is performed either using Phet interactive simulation or Board works IGCSE Science which are the computer programs prepared to support physics laboratory and to teach physical topics . After watching the demonstration, the student then carries out the experiment there by helping the students to acquire the various Science process skills such as Manipulative, Measurement, Observation, Mathematical, Drawing, Graphing and Inferring and Generalization.

The researcher wants to see if these strategies might encourage teachers to conduct constant and regular practical classes early enough. Moreover, there is a need to activate and utilize the latest technological techniques to achieve effective science teaching/learning process (Al Musawi et al., 2015).

Therefore, the study investigated the effects of Computer Simulations and Video based instructional strategies on acquisition of higher order skills, reduce the gender gap and to improve the students' attitude towards the subject thereby improving students' achievement in Practical Physics.

**Computer Simulations** – are done by the use of the computer to predict the outcome of a real life situation by using a model of that situation. According to Cuban (1997), Computer simulations constitute powerful instructional tools, which aim at providing learners with realistic experiences from which to gain and manipulate knowledge to have better understanding of the relationship between the concepts investigated.

**Video based practical method -** The practical demonstrations of the experiments performed by the researcher are converted into production scripts then shot, edited, and dubbed onto CDs. The learners access the practical lessons using computers in their labs. Practical skills acquisition is finally consolidated through hands-on activities in the laboratories during their practical session under the supervision of their teacher.

**Statement of the Problem**

The teaching of Practical Physics is the backbone of Physics as a subject. It also makes the learning of Physics pleasurable and acceptable to students. There is an urgency to tackle the present situation regarding the decline in students' achievement in West African Senor Secondary School Certificate Practical examination (Akani,2015). This view was substantiated by the Chief examiners report of 2013, 2014 and 2015.One of the several factors that contributed to students' poor achievement in practical physics might be poor performance in Science process skills. The decline in students' acquisition of Practical skills could be due to inadequate equipment in some schools or poor use of equipment in schools. It could also be becauase of the insufficient number of equipment in comparison with the class sizes or the teachers' occasional lack of expertise in the science process skills due to inadequate and inappropriate training (Ango,2002).

In addition to it, the Conventional method of demonstration used by most teachers lead to other problems likes ineffective demonstration of Practical lessons. This may be because it might not be easy to demonstrate key techniques, use equipment and take measurements in a large class. It may also be for teachers to gather students to focus on what is being demonstrated to ensure that everyone can see and hear. Hence, to help either the students to be suitably prepared for studies beyond Senior Secondary Level in Physics that may be engineering or in Physics-dependent vocational courses that they need to improve their achievement in Practical Physics as well acquire practical skills. Therefore, there is a need to investigate the use of various laboratory practical strategies to improve the performance of students. This may involve the use of Computer Simulations or Video based methods for effective delivery of practical lessons according to the need of the situation.

This study therefore aims at investigating the effects of Computer Simulation and Video based instructional strategies on students' acquisition of skills in Practical Physics.

**The Objectives of the study**

1. Determine the main effect of treatment (Computer simulation (SS) and Video based strategies (VBS)) on students' acquisition of skills in practical physics.

2. Determine the interaction effects of treatment and gender on students' acquisition of skills in practical physics.

**Research Questions**

In order to achieve the objectives of the study the following questions are formulated:

1. What are the main effects of treatment (Computer simulation and video-based instructional strategies) on students' acquisition of skills in practical physics?
2. What is the interaction effect of treatment and gender on students' acquisition of skills in practical physics?

**Hypotheses of the study**

In the following study, the following null hypothesis shall be tested:

1. There is no significant main effect of treatment (Computer simulation and video-based instructional strategies) on students'acquisition of skills in practical physics.
2. There are no significant interaction effects of treatment and gender on students' acquisition of skills in practical physics.

## MATERIAL AND METHODS

This study adopted a non-randomized pre-test, post-test control group of quasi-experimental research design using a 3 * 2* 2 factorial representation.The aim of the researcher is to facilitate the students in acquiring the Science process skills which would enhance a greater performance in Physics Practical examination and thereby boosting their performance in Physics. The target population of this study comprised of all the public co-educational Senior Secondary schools in six educational districts of Lagos state. Multistage sampling method was adopted to select 315 Senior Secondary Two (SSII) students (164 males and 151 females) who offer Physics from six co-educational Schools in Educational district III.There are two experimental groups and one control group. One of the experimental group used Simulation strategy to perform the demonstration of the experiment, while the other experimental group performed demonstration using video stategy method and the control group followed the demonstration of the experiment using the conventional method. Data was collected using two research instruments Practical Physics Achievement Test (PPAT) and Practical skills rating scale (PSRS).Practical Physics Achievement Test (PPAT) questions were adapted from WAEC Physics practical examination from the selected Physics unit of "Hookes law", "Lenses" and "Electric Current" and would be used to evaluate the effect of instructional strategies on students acquisition of Practical skills. A Practical skills rating scale (PSRS) was used by the researcher during the Practical lessons to measure the Practical skills acquired by the students. PPAT was pilot tested and Kuder Richardson formula 20 (KR20) was used to establish the reliability coefficient ($r = 0.71$). The reliability coefficient of PSRS was found using Scott pi for each of the skills - Manipulative skills = 0.81, Measurement skills=0.79, Observation skills=0.72, Mathematical Skills=0.76, Drawing Skills = 0.71, Graphing Skills= 1.0 and Inferring and Generalization skills= 0.83. The analysis of covariance (ANCOVA) was used to compare the pretest and posttest scores, with Simulation and Video based instructional strategy used in both groups as the independent variable, the pretest scores as a covariate and the posttest scores as the dependent variable. ANCOVA takes into account the differences between the pretest means of the groups to compare their post-test scores. Then Estimated Marginal Means was done gives the adjusted means (controlling for the covariate 'pretest') for each treatment group. Scheffe's post hoc test was carried to show pairs of groups that are significantly different.

## RESULT

**Table 1: Summary of 3 X 2X 2 Analysis of Covariance (ANCOVA) on the Posttest Achievement Scores of Students' acquisition of skills in Physics Practical According to Treatment, Gender, and Attitude.**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 5994.478[a] | 6 | 999.080 | 23.578 | .000 |
| Intercept | 8069.175 | 1 | 8069.175 | 190.432 | .000 |
| pretestachievement | 224.124 | 1 | 224.124 | 5.289 | .022 |
| Treatment | 5110.453 | 2 | 2555.227 | 60.303 | .000* |
| Gender | 79.410 | 1 | 79.410 | 1.874 | .172 |
| Treatment * Gender | 14.301 | 2 | 7.151 | .169 | .845 |
| Error | 13050.900 | 308 | 42.373 | | |
| Total | 2037286.000 | 315 | | | |
| Corrected Total | 19045.378 | 314 | | | |

*Significant at $P < 0.05$.

 

Table 1 showed that there is main effect of treatment on Senior Secondary Students' acquisition of practical skills.There is no significant interaction effect of treatment and gender on students' acquisition of skills in practical physics.
Further, Estimated Marginal Means (Table 2) of the output gives the adjusted means (controlling for the covariate 'pretest') for each treatment group.

**Table 2: Estimated Marginal Means of students' acquisition of skills in Physics Practical by Treatment.**

| Estimates | | | | |
|---|---|---|---|---|
| | | | 95% Confidence Interval | |
| TREATMENT | Mean | Std. Error | Lower Bound | Upper Bound |
| SS | 85.348[a] | .611 | 84.146 | 86.550 |
| VBS | 77.900[a] | .664 | 76.593 | 79.207 |
| CM | 76.112[a] | .648 | 74.837 | 77.388 |

Table2 shows the magnitude of the mean scores of students'acquisition of skills in Physics Practical in each of the treatment and control group. It is evident from Table 2 that students exposed to laboratory instructional strategies acquisition of practical skills was better compared to students who were taught using the conventional method (CM). This is because students who were subjected to SS method obtained the highest acquisition of practical skills score (M=85.348). This group is followed by those exposed to VBS method (M=77.900) while the CM method obtained the lowest acquisition of practical skills score (M=76.112).This explains that SS was more effective than VBS and CM. The order of magnitude of the physics acquisition of practical skills scores of the group is represented as SS>VBS>CM.
Table3 reveals the mean scores of each treatment group based on the Science process skills gained.This facilitates an understanding of the effect of treatment on the acquisition of skills in Physics practical.

**Table 3: Mean scores of Science process skills acquired in Physics Practical by Treatment.**

| TREATMENT GROUP | MANIPULATIVE SKILLS | MEASUREMENT SKILLS | OBSERVATION SKILLS | MATHEMATICAL SKILLS | DRAWING SKILLS | GRAPHING SKILLS | INFERRING AND GENERALIZATION SKILLS |
|---|---|---|---|---|---|---|---|
| EXPERIMENTAL GROUP | 91 | 90 | 94 | 98 | 90 | 92 | 87 |
| CONTROL GROUP | 81 | 79 | 88 | 97 | 92 | 80 | 67 |

Table 3 shows that experimental group achieved higher mean in acquiring the majority of science process skills compared to control group. This shows that the Computer Simulations and video-based strategies might be useful to facilitate in gaining skills. Both the groups reported that they acquired mathematical skills the maximum .Experimental group had acquired observation and graphing skills more compared to control group which had acquired more drawing skills.
It is also necessary to trace the source(s) of the significant effect of treatment obtained on students' acquisition of skills in Physics practical. The Scheffe post hoc analysis was therefore carried out.

**Table4: Summary of Scheffe Post Hoc Test on Posttest acquisition of skills Mean Scores According to Treatment Groups**

**POST TEST ACQUISITION OF SKILLS**

Scheffe[a,b,c]

| | | Subset | |
|---|---|---|---|
| TREATMENT | N | 1 | 2 |
| CM | 103 | * | |
| VBS | 96 | * | |
| SS | 116 | | * |
| Sig. | | .087 | 1.000 |

Table 4 reveals the mean score of the experimental group one SS differs significantly from those of second experimental group VBS and the control group CM. Hence, the differences between condition Means are not likely due to change and are probably due to the independent variable manipulation.

 

However, the table reveals that there is no statistically significant difference between the mean score of CM and VBS strategies.

## FINDINGS

1. There is significant main effect of treatment (Computer simulation and video-based instructional strategies) on students'acquisition of skills in practical physics. This indicated that the treatment given to the experimental group enhances their performance better than the treatment given to the control group.
2. There are no significant interaction effects of treatment and gender on students' acquisition of skills in practical physics.

## DISCUSSION

The findings of the study in table 1 show significant main effects of treatment on students' acquisition of practical skills in Physics. That is the findings revealed that laboratory strategies are a worthwhile exercise that helped students to enhance their acquisition of practical skills which is in line with previous studies (Johnson,2016; Yadav & Mishra ,2013 ; Ojediran et al.,2014; Raimi & Adeoye,2004). The result of the findings in Table 2 showed that out of the two strategies, Computer Simulation had greater effect on acquisition of Practical skills in Practical Physics. Simulation method had benefitted the students more as indicated in their mean scores in table 2. In line with the study , Smetana and Bell (2012), suggested that simulations can be as effective, and in many ways more effective, than traditional (i.e. lecture-based, textbook-based and/or physical hands-on) instructional practices in promoting science content knowledge, developing process skills, and facilitating conceptual change. On the contrary, Kaheru (2014) conducted a study where there is no significant effect was found in the acquisition of the skill when computer simulations were used. Simulation method is followed by the Video based practical instructional method which is another laboratory teaching strategy with the next higher mean score as reflected in table 2. This is because videos enabled students to become more autonomous and efficient learners in the laboratory and allowed more time during the practical for higher level interaction with demonstrators, including time to pool and analyse group data (Croker, Andersson, Lush, Prince & Gomez,2010). The findings shows that there is no significant interaction effect of treatrment and gender on students acquisition of skills which is in line with some previous studies which revealed that there was no interaction between teaching methods and gender to influence students' acquisition of science process skills (Nwagbo & Uzoamaka,2011; Ajayi & Osoko,2013). On the contrary, study conducted by Babajide (2010) revealed that there is significant interaction effect of gender on practical skills.

## CONCLUSION

It might be concluded from this study that the effects of laboratory strategies on Senior Secondary Students' acquisition of skills in Practical Physics is not comparable for students across the various treatment groups. The students in the experimental group had a higher mean in the acquisition of practical skills than their counter parts in the control group. This could imply that these strategies could contribute in transforming Physics concepts from theoretical to practical form, helping students' to understand concepts in physics and hence motivating students to learn.

## RECOMMENDATION

Based on the findings, it was recommended that Physics teachers need to include simulations or video technology into teaching laboratory physics. These strategies are very useful in a large class where it is difficult to meet each student's need. It helps in making the students focus on the demonstration and thus making learning deeper and meaningful. In addition, it motivates the teachers to perform physics practical by integrating it with theory. Government should aim at introducing teachers to various Professional Development Programs so that they could be continuously stimulated, trained, supported and motivated. Teacher educators should introduce Simulations and Video based practical method as Laboratory teaching strategies at colleges of education and faculties of education in Universities.

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