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Effects of Computer Simulations on Senior Secondary School Students' Achievements in Practical Physics in Educational District III, Lagos State, Nigeria

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Abstract- The study was designed and conducted to determine the effectiveness of Computer Simulations on Senior secondary School students' achievements in practical physics in Educational district III, Lagos state, Nigeria. A non-randomized pre-test, post-test control group quasi-experimental research design was adopted for the study. A sample of 219 Senior Secondary Two (SSII) physics students, drawn by multistage sampling method from six co-educational schools in Educational district III was used for the study. Three research instruments: Practical Physics Achievement Test (PPAT), Practical Skill Rating Scale (PSRS) and Students' Attitude Inventory Scale (SAIS) were validated by experts and used to collect data for the study. The data collected was analyzed using Analysis of Covariance (ANCOVA) and Estimated Marginal Means at 0.05 level of significance. Graphical illustrations were used to further explain the interaction effect. The study revealed that the students in the experimental group (Computer Simulations) instructional strategies had a higher mean in both the achievement and acquisition of practical skills than their counterparts did in the control group (Conventional) instructional strategy.

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Keywords: computer simulations, practical skills, practical achievement, learning.

I. Background to the Study

Physics is the backbone of technological innovations. It has empowered the new millennium students' acquisition of relevant skills such as Collaborative Learning Skills. Therefore, every child should be given the opportunity to acquire at least the basic knowledge and the concept of Physics as a science subject (Adeyemo, 2011). Physics, being a science subject, constitutes two aspects: the theoretical aspect and the practical aspect. Besides, practical work plays a positive role in science teaching and learning by making it comparatively easier to understand; and can strengthen students' content knowledge (Banu, 2011).

However, West African Examination Council [WAEC] Chief Examiner's Reports from 2006 to 2015 as shown in Table 1.1 stated that students show deteriorating performances in Practical Physics at the School Certificate Examination level.

Table 1.1: Mean and standard deviation scores of students' achievement in WAEC Practical Physics examination

Year	Mean (out of 50)	Standard Deviation
2006	24	9.54
2007	26	10.00
2008	23	11.49
2009	21	10.69
2010	23	9.90
2011	24	10.58
2012	30	9.95
2013	24	8.89
2014	24	10.00
2015	24	9.59

Source: http://waeconline.org.ng/elearning/Physics/physmain html

Students' weaknesses in Practical aspect might be due to inadequate integration of laboratory activities with theory classes (Abimbola, 1994; Aladejana & Aderibigbe, 2007) or delay in the conduct of practical activities until the final external examinations are near (Abakpa, Achor & Odoh, 2016; Akinbobola, 2015; Babajide, 2010 ; Stephen & Mboto, 2010). This delay might enable students to follow the instructions given in practical Physics question paper finishing one-step after another; however, it is not necessary that they develop deeper understanding of the experiment (Logar & Savec, 2011). Another reason might be teachers' demonstration, which makes students passive (Omorogbe & Celistine, 2013) or lack of functional Physics laboratory and inadequate equipment for practical Physics in most Nigerian secondary schools (Adegoke & Chukwunenye, 2013). In addition to all other reasons, the fact that the students were taught with conventional methods instead of using laboratory-assisted instructional strategies (Abungu, Okere & Wachanga, 2014) could also contribute to the list of reasons. That is, students are not exposed to efficient pedagogies and presenting of information to learners (Buabeng, Ossei-Anto & Ampiah, 2014).

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Physics, as a practically-oriented subject, requires continuous demonstrations with 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). In order to tackle the problems highlighted so far, the study integrated practical instructional strategies with Computer Simulations against the conventional method of teaching Practical Physics in the laboratory. During the practical Physics sessions, the teacher demonstrates the experiment using Computer Simulation in the experimental group. The strategies would help the students to acquire more content knowledge and better knowledge retention as against the conventional method of demonstration.

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. Simulations allow students to model the process of developing hypothesis, changing variables and observing the results, accumulating the data, resetting the value of variables, then running the simulation to test the hypothesis (Nesbit- Hawes, 2005).

Moreover, simulation speeds up teachers' educational potential and students' learning thereby allowing students to learn by discovery methods (Hughes & Overton, 2009; Hursen & Asiksoy, 2015). Hursen and Asiksoy (2015) and Taskin and Kandermir (2010) in their studies found out that students who were taught using simulations were more successful than the students who were taught by the traditional approach in Physics. Besides, there is evidence that Simulations had shown a greater impact on students' achievement in other science subjects. Huppert, Lomask and Lazarowitz (2002) investigated the impact of a Biology simulation on high school students' academic achievement and the findings indicate that the achievement of students using the simulation was higher than those not using the simulation.

Plass, Milne, Homer, Schwartz, Hayward, Jordan, Verkuilen, Ng, Wang and Barrientos (2012) investigated the use of a sequence of simulations for Chemistry learning and their findings, supported the effectiveness of simulations as a teaching tool in a classroom context.

Conventional Laboratory Method: The Conventional Laboratory Method which is teacher centered is also expository in nature (Pyatt &Sims, 2007). The learner has to follow the teacher's instructions or the procedure given. The outcome is predetermined by the teacher and may be already known to the learner. This method does not promote the development of students' thinking skills: its 'cookbook' nature emphasizes the mechanical following of stipulated procedures that include collection of data in order to verify or demonstrate principles described in textbooks.

Alongside the different practical instructional strategies, the study also investigated the moderating effects of Attitude on the two dependant measures (achievement and acquisition of practical skills). Attitudes are general dispositions that stand behind people's evaluations and emotions (Zeidan & Jayosi, 2015).

Musasia, Abacha and Biyoyo (2012) in their study proved that, the girls who carried out practical investigations had developed better attitudes because of practical based instruction in Physics.

Kaya and Boyuk (2011) in their findings stated that Physics lessons being held in the classroom on the sole theoretical basis is one of the factors that influence attitude of the students toward these lessons in a negative manner. Yeşilyurt (2004) in his study developed an attitude questionnaire and applied to identify student teachers' interests and attitudes for basic Physics laboratory. The outcome of the study was that students were successful in undertaking basic Physics laboratory experiments, but they exhibited unfavorable attitudes towards laboratory experiments.

II. Statement of the Problem

The teaching of Practical Physics is the backbone of Physics as a science subject. This is because practical work assists in arousing and sustaining the students' interest as well as cultivating scientific attitude to Physics and its related phenomena (Musasia, Abacha & Biyoyo, 2012; Ojediran, Oludipe & Ehindero, 2014). Besides, for a Physics student to be successful, the student needs to perform very well in the practical aspect as much as the theoretical aspect (Godwin, Adrian & Johnbull, 2015). If this is the case, there is an urgent need to tackle the present precarious performance situation regarding the decline in students' achievement in WAEC Practical Physics examination (Akani, 2015). In the aforementioned exam, the WAEC Chief Examiners Report of 2013, 2014 and 2015 averred that several factors were attributed to the students' poor achievement in practical Physics, one of such is the tediousness of conventional strategy of demonstration of Physics experiment, as this strategy makes lab exercises not necessarily contribute to the enhancement of practical abilities or content knowledge, rather it leads to just "task completion" or "manipulating equipment" (Haagen-Schuetzenhoefer, 2012).

This calls for Computer Simulations that will help the students to be suitably prepared for West African Senior Secondary School Certificate Practical Examination to improve their achievement in practical Physics as well as acquire practical skills.

Hence, this study investigated the effects of Computer Simulation strategies on students' achievement and acquisition of skills in practical Physics.

a) Research Questions

The following research questions guided the study –

1. To what extent does the treatment (Computer simulation strategy) affect students' (a) achievement in practical Physics (b) acquisition of skills in practical Physics?
2. To what extent does attitude affects students' (a) achievement in practical Physics (b) acquisition of skills in practical Physics?
3. What is the interaction effect between treatment and attitude on students' (a) achievement in practical Physics (b) acquisition of skills in practical Physics?

b) Research Hypotheses

The following null hypotheses were tested in the study:

H_{01}: There is no significant main effect of treatment (Computer simulation strategy) on students' (a) achievement in practical Physics (b) acquisition of skills in practical Physics.

H_{02}: There is no significant main effect of attitude on students' (a) achievement in practical Physics (b) acquisition of skills in practical Physics.

H_{03}: There are no significant interaction effects of treatment and attitude on students' (a) achievements in practical Physics (b) acquisition of skills in practical Physics.

III. Methodology

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 independent variables of this study are the different laboratory instructional strategies: Simulation strategy and Conventional method. The Moderator variables that intervene with independent variable are Attitude at two levels (positive and negative).These variables are dependent on the dependent variable, which are the Achievement scores and acquisition of Practical skills. Lagos is a cosmopolitan city; a former capital of Nigeria that is divided into six education districts. The study was conducted in Educational district III of Lagos State. The Educational district III covers four (4) zones namely Epe, Eti-Osa, Ibeju-Lekki and Lagos Island. The population of this study comprised of all the public co-educational Senior Secondary schools in six educational districts of Lagos state. Senior Secondary Class II (SSII) students of the participating schools were used for the study. This is because the bulk of the Physics content is covered in SS2, thereby making the class more attractive to research. The sample used for the study consisted of 219 Senior Secondary Two (SSII) students who offer Physics from six co-educational schools in Educational district III. Multistage sampling method was adopted for this study. First simple random sampling was used to select Educational District III out of six educational districts because all Educational districts have schools following NERDC curriculum. Out of the four Zones in Educational District III, two zones, that is, zone two (Eti-Osa) and zone four (Lagos Island) were randomly selected. From each zone, two schools were purposively selected. The selection is motivated by decision to choose such type of schools that have qualified Physics teachers with equipped laboratories, presenting students for WAEC examination, ready to assist the researcher in carrying out the treatment and have generator installed for power supply or constant power supply during teaching hours. Simple random sampling technique was used to assign the selected schools to various strategies (balloting) as the selected schools satisfy the requirements by the researcher. In experimental group, SS group had 116 students and the control group that is CM strategy had 103 students. Four research instruments were used in this study for data collection: Instructional procedural steps (Lesson plans), Practical Physics Achievement Test (PPAT), Practical Skills Rating Scale (PSRS) and Students' Attitude Inventory Scale (SAIS).Practical Physics Achievement Test (PPAT) was adapted from WAEC Practical Physics examination which was used to measure the students' achievement and their acquisition of higher order Practical skills. The reliability coefficient of the PPAT items was determined using Kuder and Richardson Formula 20 (KR-20) as 0.71. Practical Skills Rating Scale (PSRS) adapted from Babajide (2010) was revalidated by the researcher and the reliability coefficient for each of the skills determined using the Scott Pi statistical tool was- 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 reliability coefficient of Students' Attitude Inventory Scale (SAIS) determined by the researcher using Cronbach's Alpha was 0.76.

IV. Development of Instructional Strategies Package

The instructional strategies package contains Simulations and Video footages of practical works in the contents of the curriculum that includes Hooke's law, Lenses and Ohm's law. The researcher prepared the Computer Simulation instructional strategy package as follows- Simulations for Hookes law experiment was adapted from Physics Educational Technology (PhET) which was developed by the Physics Education Research (PER) group of University of Colorado while Simulations for Lenses and Ohms law experiments were extracted from Board works IGCSE Triple Science software. Then the simulations were copied into CDs. The simulations were performed using the CD, a computer and projector by the teacher in front of the students.

V. Data Analysis and Presentation of Results

Research Question 1(a): To what extent does the treatment (Computer simulation strategy) affect students' achievement in Practical Physics?

Table 4.1: Mean and Standard Deviation Scores of Students Pre-test Post-test Achievement Scores in Practical Physics

Treatment		N	Pre-test		Post-test		
			Mean	Std.Dev	Mean	Std.Dev	Mean Diff.
Experimental	Computer Simulation(SS)	116	1.66	.845	94.84	4.25	93.18
Control	Conventional strategy(CM)	103	1.24	.975	73.56	7.65	72.32

As the mean difference obtained by students in SS is 93.18 and the CM is 72.32, this means that there is effect of treatment on Students' achievements in Practical Physics with Computer Simulation strategy scoring the highest mean and the conventional method has the least.

Research Question 1(b): To what extent does the treatment (Computer simulation and strategy) affect students' acquisition of skills in Practical Physics?

Table 4.2: Mean and Standard Deviation Scores of Students Pre-test Post-test Acquisition of skills in Practical Physics

Treatment		N	Pre-test		Post-test		
			Mean	Std.Dev	Mean	Std.Dev	Mean Diff.
Experimental	Computer Simulation(SS)	116	8.37	.775	85.50	3.59	77.13
Control	Conventional strategy(CM)	103	8.08	.269	75.89	6.44	67.81

As the mean difference obtained by students in SS is 77.13 and the CM is 67.81, this means that there is effect of treatment on Students' acquisition of practical skills with Computer Simulation strategy scoring the highest mean and the conventional method has the least.

Research Question 2 (a): To what extent does attitude affects students' achievements in Practical Physics?

Table 4.3: Mean and Standard Deviation Scores of Students Pre-test Post-test Achievement Scores in Practical Physics According to Attitude.

Attitude		N	Pre-test		Post-test		
			Mean	Std.Dev	Mean	Std.Dev	Mean Diff.
	Positive	198	1.46	.932	85.81	11.72	84.35
	Negative	21	1.43	.926	75.62	13.65	74.19

Table 4.3 shows that positive attitude obtained a mean difference score of 84.35 while the negative attitude had a mean difference score of 74.19. It is evident that there is a considerable mean difference shown in positive and negative attitude of students. Therefore, attitude has influence on achievement in practical Physics.

Research Question 3(b): To what extent does attitude affects students' acquisition of practical skills?

Table 4.4: Mean and Standard Deviation Scores of Students Pre-test Post-test Acquisition of skills in Practical Physics According to Attitude

Attitude		N	Pre-test		Post-test		
			Mean	Std.Dev	Mean	Std.Dev	Mean Diff.
	Positive	292	8.24	.606	81.37	6.67	73.13
	Negative	23	8.14	.655	77.29	9.17	69.15

Table 4.4 shows that positive attitude obtained a mean difference score of 73.13 while the negative attitude had a mean difference score of 69.15. It is evident that there is mean difference in positive and negative attitude of students. Therefore, attitude has influence on acquisition of skills in practical Physics.

Research Question 4(a): What is the interaction effect between treatment and attitude on students' achievements in Practical Physics?

Table 4.5: Mean and standard Scores of Students Post-test Achievement scores in Practical Physics According to the Interaction Effects of Treatment and Attitude.

Treatment	Attitude	Mean	N	Std. Deviation
SS	Negative	96.60	5	2.608
	Positive	94.77	111	4.300
	Total	94.84	116	4.250
CM	Negative	69.06	16	7.344
	Positive	74.39	87	7.457
	Total	73.56	103	7.654
Total	Negative	75.62	21	13.647
	Positive	85.81	198	11.721
	Total	84.84	219	12.259

Table 4.5 shows that overall mean score of 85.81 and standard deviation as 11.72 for positive attitude and while negative attitude has mean score of 75.62 and standard deviation as 13.65. Overall, there is a considerable difference between the mean scores of positive and negative attitude; this means there is interaction effect between treatment and attitude on students' achievements in Practical Physics.

Research Question 5(b): What is the interaction effect between treatment and attitude on students' acquisition of practical skills?

Table 4.6: Mean and Standard Deviation Scores of Students Post-test Acquisition of skills in Practical Physics According to the Interaction Effects of Treatment and Attitude.

Treatment	Attitude	Mean	N	Std. Deviation
SS	Negative	87.60	5	3.435
	Positive	85.41	111	3.584
	Total	85.50	116	3.591
CM	Negative	74.06	16	7.903
	Positive	76.23	87	6.130
	Total	75.89	103	6.441
Total	Negative	77.29	21	9.171
	Positive	81.37	198	6.665
	Total	80.98	219	7.022

Table 4.6 shows that overall mean score of 81.37and standard deviation as 6.67 for positive attitude and while negative attitude has mean score of 77.29 and standard deviation as 9.17. Overall, there is a considerable difference between the mean scores of positive and negative attitude; this means there is interaction effect between treatment and attitude on students' acquisition of practical skills.

Hypothesis Testing

H_{01} *(a):* There is no significant main effect of treatment on Students' Achievements in Practical Physics.

Table 4.7: Summary of 3 X 2X 2 Analysis of Covariance (ANCOVA) on the Post-test Achievement Scores of Students' achievements in Practical Physics According to Treatment and Attitude.

Dependent Variable: Post Test Achievement						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	25128.707[a]	4	6282.177	176.119	.000	.767
Intercept	229878.512	1	229878.512	6444.594	.000	.968
Pretest achievement	19.385	1	19.385	.543	.462	.003
TREATMENT	8030.623	1	8030.623	225.137	.000*	.513
Attitude	40.081	1	40.081	1.124	.290	.005
TREATMENT * Attitude	186.734	1	186.734	5.235	.023*	.024
Error	7633.375	214	35.670			
Total	1608923.000	219				
Corrected Total	32762.082	218				

**Significant at $P < 0.05$.*

The table 4.7 shows significant main effects of treatment on students' achievements in Practical Physics, [F (2, 219) = 225.137; $P < 0.05$]. Hence, H_{01} (a) is not accepted. This implies that the achievement in Practical Physics was associated with the instructional strategy used by teacher.

Furthermore, Estimated Marginal Means (Table 4.8) of the output gives the adjusted means (controlling for the covariate 'pre-test') for each treatment group.

Table 4.8: Estimated Marginal Means of Achievements in Practical Physics by Treatment.

Estimates				
Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
SS	95.801[a]	1.375	93.092	98.511
CM	71.656[a]	.818	70.043	73.268

It is evident from Table 4.8 that students who were subjected to SS method obtained the highest achievement score (M=95.801) while the CM method obtained the lowest achievement score (M=71.656). The order of magnitude of the Physics achievement scores of the group is represented as SS>CM.

H_{01} (b): There is no significant main effect of treatment on students' acquisition of practical skills.

Table 4.9: Summary of 3 X 2X 2 Analysis of Covariance (ANCOVA) on the Post-test Acquisition of skills in Practical Physics According to Treatment and Attitude.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5186.328[a]	4	1296.582	49.872	.000	.482
Intercept	5853.290	1	5853.290	225.143	.000	.513
Pretest acquisition skills	64.698	1	64.698	2.489	.116	.011
TREATMENT	1639.146	1	1639.146	63.049	.000*	.228
Attitude	.042	1	.042	.002	.968	.000
TREATMENT * Attitude	57.839	1	57.839	2.225	.137	.010
Error	5563.599	214	25.998			
Total	1446961.000	219				

**Significant at $P < 0.05$*

The table 4.9 shows significant main effects of treatment on students' acquisition of practical skills in Physics, [F (2,219) =63.049; $P < 0.05$]. Furthermore, the greater eta value of 0.228 signifies the main effect of treatment. Hence, H_{01} (b) was not accepted. This implies that the acquisition of practical skills in Practical Physics was associated with the instructional strategy used by teacher. Furthermore, Estimated Marginal Means (Table 4.10) of the output gives the adjusted means (controlling for the covariate 'pre-test ') for each treatment group.

Table4.10: Estimated Marginal Means of students' acquisition of skills in Practical Physics by Treatment

Estimates				
Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
SS	86.275[a]	1.174	83.960	88.590
CM	75.319[a]	.702	73.935	76.702

It is evident from Table 4.10 that students who were subjected to SS method obtained the highest acquisition of practical skills score (M=86.275 while the CLM method obtained the lowest acquisition of practical skills score (M=75.319).This explains why SS was more effective than CM. The order of magnitude of the Physics acquisition of practical skills scores of the group is represented as SS>CM.

H_{02}(a): There is no significant main effect of attitude on students' achievements in Practical Physics.

Table 4.7 reveals that there is no significant main effect of attitude on students' achievements in Practical Physics, [F (1, 219) = 1.124; $P > 0.05$]. Hence, H_{03} (a) was accepted.

H_{02} (b): There is no significant main effect of attitude on students' acquisition of practical skills.

Table 4.9 shows there is no significant main effects of attitude on students' acquisition of skill in Practical Physics [F (1, 219) = 63.049; $P > 0.05$]. Hence, H_{03} (b) was accepted.

H_{03} (a): There are no significant interaction effects of treatment and attitude on students' achievements in Practical Physics.

Table 4.7 showed that two-way interaction effect of treatment and attitude has effect on achievements in Practical Physics [F (2, 219) =5.235; $P < 0.05$]. In other words, treatment with attitude is dependant. Hence, H_{03} (a) was not accepted.

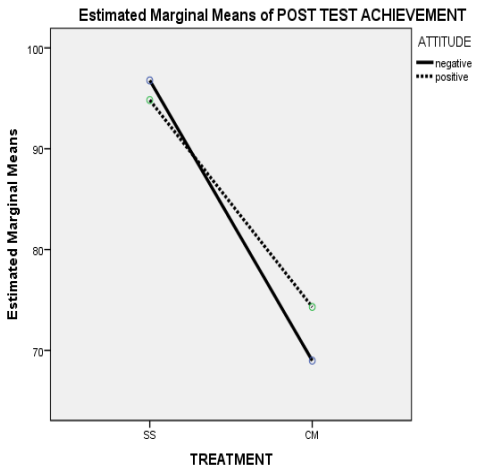

Figure 1: Graphical illustration of an interaction effect of treatment and attitude on students' Achievement in practical Physics.

Figure1 shows that there is no significant difference in attitude when SS method is used, but comparatively when CM is used, there is a slight significant difference in their attitude, that is more of positive attitude than negative attitude.

$H_{03}(b)$: There are no significant interaction effects of treatment and attitude on students' acquisition of practical skills.

Table 4.9 showed that two-way interaction effect of treatment and attitude is not significan [F (2, 219) =2.225; $P < 0.05$], it then means that the treatment does not depend on attitude to be effective. Hence, H_{05} (b) was accepted.

VI. Discussion of Findings

The findings of the study in table 4.1 and 4.2 show significant main effects of treatment on students' achievements and acquisition of practical skills in Practical Physics. The result of the findings in Table 4.7 and 4.9 showed that out of the two strategies, Computer Simulation had greater effect on both achievement and acquisition of Practical skills in Practical Physics. This is because Simulation creates game like environment and with animations, it helps the students to visualize abstract concepts thus, helping the learners to be interactive and reflective. Simulations help the learners to demonstrate a clear understanding of the concept by giving the learner opportunity to repeat the entire process. The findings of this study are consistent with other previous findings which shows that simulated instructional approach fostered higher achievement than the conventional approach (Huppert, Lomask & Lazarowitz, 2002; Chang, Chen, Lin & Sung, 2008; Ezeudu & Ezinwanne, 2013; Umoke & Nwafor, 2014; Mengistu & Kahsay, 2015). This study proved that SS method enhances students' acquisition of skills in practical Physics while Kaheru (2014) conducted a study where no significant effect was found in the acquisition of the skill when computer simulations were used.

Table 4.3 and 4.4 shows that attitude may influence on students achievements and acquisition of Practical Skills in Practical Physics. However, Table 4.7 and 4.9 using ANCOVA revealed that there is no significant main effect of attitude on students' achievement and acquisition of skills in Practical Physics. Hence, the results revealed in Table 4.5 and 4.6 were due to chance factor.

Furthermore, ANCOVA Table 4.7 established that there is interaction effect of attitude and treatment on student's achievements while Table 4.9 showed that there is no interaction effect of attitude and treatment on students 'acquisition of practical skills in practical Physics.

VII. Conclusion

This study has concluded that Computer Simulation strategy proved superior to conventional strategy in enhancing the students' achievement in practical Physics and acquisition of skills in practical Physics. It has shown that there is no main effect of attitude while there is interaction effect of treatment and attitude on students' achievement in Practical Physics.

VIII. Recommendations

Based on the findings, the following recommendations were forwarded

1. Since this research demonstrated the importance of Computer Simulations strategies, it is therefore necessary for teachers to include Computer Simulations into teaching laboratory Physics.
2. The curriculum developers need to incorporate SS into the Physics curriculum to ensure that schools support integrating technology into practical work.

The government should provide appropriate infrastructure to incorporate technology into laboratory teaching. Government should prepare teacher educators who would introduce Computer Simulations practical method as Laboratory teaching strategies at Colleges of Education and Faculties of Education in the Universities.

References Références Referencias

1. Abakpa, V. O., Achor, E. E., & Odoh, C.O.(2016).Effect of Laboratory Strategy on Senior Secondary Students' Achievement in Biology . *Journal of the International Centre for Science, Humanities and Education Research, 2*(2), 68-75.
2. Abimbola, I. O. (1994). A critical appraisal of the role of laboratory practical work in science teaching in Nigeria. *Journal of Curriculum and Instruction, 4*(1&2), 59-65.

3. Abungu, H. E., Okere, M. I., & Wachanga, S. W. (2014). Effect of Science Process Skills Teaching Strategy on Boys and Girls' Achievement in Chemistry in Nyando District, Kenya. *Journal of Education and Practice*, *5*(15), 42-48.
4. Adegoke, B. A., & Chukwunenye, N. (2013). Improving Students' Learning Outcomes In Practical Physics, Which Is Better? Computer Simulated Experiment or Hands-On Experiment? *IOSR Journal of Research & Method in Education, 2*(6), 18-26.
5. Adeyemo, S. A. (2011). The effect of teachers' perception and students' perception of Physics classroom learning environment on their academic achievement in Senior Secondary School Physics. *International Journal of Educational Research and Technology,2(1)*, 74 – 81.
6. Akani, O. (2015). Laboratory teaching: Implication on Students' achievement in Chemistry in Secondary Schools in Ebonyi state of Nigeria. *Journal of Education and Practice, 6*(30), 206-213.
7. Akinbobola, A. O. (2015.). Evaluating Science Laboratory classroom learning environment in Osun State of Nigeria for National development. *An International Peer-reviewed Journal, 9, 14-19*.
8. Aladejana , F., & Aderibigbe, O. (2007). Science Laboratory environment and academic performance. *Journal of Science Education and Technology, 16*(6), 500-506.
9. Babajide .V. F. T. (2010).*Generative and Predict-Observe-Explain instructional strategies as determinant of Secondary School Student achievement and Practical skills in Physics*, (Ph.D thesis). University of Ibadan, Nigeria.
10. Banu. S. (2011). *The role of practical work in teaching and learning Physics at Secondary level in Bangladesh*. (Master's thesis, University of Canterbury).
11. Buabeng, I., Ossei-Anto, T. A., & Ampiah, J. G. (2014) . An investigation into Physics teaching in Senior High Schools. *World Journal of Education, 4*(5), 40. doi:10.5430/wje.v4n5p40
12. Chang, K., Chen, Y., Lin, H., & Sung, Y. (2008). Effects of learning support in simulation – based Physics learning. *Computers & Education, 51*, 1486–1498.doi:10.1016/j.compedu.2008.01.007
13. Ezeudu, F. O. & Ezinwanne, O. P.(2013). Effect of Simulation on students' achievement in Senior Secondary School Chemistry in Enugu East Local Government Area of Enugu State, Nigeria. *Journal of Education and Practice, 4*(19), 84-89.
14. Godwin, O., Adrian, O., & Johnbull, E. (2015). The impact of Physics laboratory on students offering Physics in Ethiope West Local Government Area of Delta state. *Educational Research and Reviews, 10*(7), 951 – 956. doi:10.5897/EPR2014.1943
15. Haagen-Schuetzenhoefer, C., (2012). Improving the quality of Lab reports by using them as Lab instructions. The *Physics Teacher*, *50*, 430.
16. Hughes, I., & Overton, T. (2009). Key aspects of learning and teaching in experimental sciences. In H. Fry, S. Ketteridge &S. Marshall (Eds.), *A Handbook for Teaching and Learning in Higher Education Enhancing Academic Practice* Third edition (pp. 236-245).
17. Huppert, J., Lomask,S. M., & Lazarowitz, R. (2002). Computer simulations in the high school: Students' cognitive stages, science process skills and academic achievement in microbiology. *Universal Journal of Educational Research, 4*(1), 12-25, 2016. doi:10.1080/09500690110049150
18. Hursen, C., & Asiksoy, G. (2015). The effect of simulation methods in teaching Physics on students' academic success. *World Journal on Educational Technology, 7*(1), 87-98. doi: http ://dx.doi.org/10.18844/wjet.v7i1.26
19. Kaheru, S. J. M. (2014). *The use of computer simulations for cognitive load change and acquisition of knowledge and skills in geometrical optics* (Doctoral dissertation, University of South Africa, Pretoria).Retrieved from http:// hdl. handle.net/10500/18609
20. Kaya, H., & Boyuk, U. (2011). Attitude towards Physics lessons and physical experiments of the High school students. *European Journal of Physics Education, 2*(1), 23 - 31.
21. Logar, A., & Savec, V. F. (2011). Students'Hands-on Experimental Work vs Lecture Demonstration in Teaching Elementary School Chemistry. *Acta Chimica Slovenica., 58 ,*866–875.
22. Mengistu, A., & Kahsay, G. (2015). The effect of computer simulation used as a teaching aid in students' understanding in learning the concepts of electric fields and electric forces. *Latin American Journal of Physics Education, 9*(2), 2402/1-242/8.
23. Musasia, A.M., Abacha, O.A., & Biyoyo, M. E. (2012). Effect of practical work in Physics on girls' performance, attitude change and skills acquisition in the form two-form three secondary schools' transition in Kenya. *International Journal of Humanities and Social Science, 2*(23), 151-166.
24. Nesbit- Hawes, P.J. (2005).*Higher order thinking skills in a Science Classroom Computer Simulation*. (Master's thesis, Queensland University of Technology, Australia). Retrieved from http://eprints.qut.edu.au/16201//1/Philip_Nesbitt-Hawes Thesis.pdf
25. Ojediran, I. A., Oludipe, D. I., & Ehindero, O. J. (2014). Impact of Laboratory-based instructional intervention on the learning outcomes of low performing senior secondary students in Physics. *Creative Education, 5,*197-206.

26. Omorogbe, E., & Celestine, E. J. (2013. The challenge of effective science teaching in Nigerian Secondary Schools. *Academic Journal of Interdisciplinary Studies, 2(7), 181-188.* doi:10.5901/ajis.2013.v2n7p181
27. PhET, (2013, January 5). Interactive simulations. *University of Colorado at Boulder*. Retrieved from http://phet.colorado.edu.
28. Plass, J. L., Milne, C., Homer, B. D., Schwartz, R. N., Hayward, E. O., Jordan, T., Verkuilen, J., Ng, F., Wang, Y., & Barrientos, J. (2012), Investigating the effectiveness of computer simulations for chemistry learning. *Journal of Research in Science Teaching, 49*, 394–419. doi: 10.1002/tea.21008
29. Pyatt, K., & Sims, R. (2007). Learner performance and attitudes in traditional versus simulated laboratory experiences. In R. J. Atkinson, C. Mc Beath, S. K. A. Soong & C. Cheers (Eds.), *ICT: Providing choices for learners and learning*. *Proceedings ascilite Singapore 2007*, (pp. 870-879).
30. Stephen, U., & Mboto, F. A. Z. (2010). The Effects of Integrating Laboratory Work with Theory on Academic Achievement in Secondary School Physics. *African Research Review*, *4*(4), 412-419.
31. Tamunoiyowuna, S., & James, J. R. (2016). Effect of Video-Taped instruction on senior secondary students' performance in Physics Practical in Port-Harcourt Metropolis, Nigeria, *Science Journal of Education*, *4*(6), 169-174.doi: 10.11648/ j.sjedu. 20160406.11
32. Taskin, N., & Kandemir, B. (2010). The affect of computer supported simulation applications on the academic achievements and attainments of the seventh grade students on teaching of science. *Procedia Social and Behavioral Sciences*, *9*, 1379–1384.
33. The West African Examination Council (2015). Retrieved from Chief Examiner's Annual Report: https://waeconline.org.ng/elearning/Physics/physmain.html
34. Umoke, J. C., and Nwafor, C. C. (2014). Effects of Instructional Simulation on Secondary School Students' Achievement in Biology. *Journal of Education and Practice, 5*(19), 101-110.
35. Yeşilyurt, M.(2004). Student teachers' attitudes about basic Physics Laboratory. *The Turkish Online Journal of Educational Technology, 3*(4), 49-57.
36. Zeidan, A. H. & Jayosi, M. R. (2015). Science Process Skills and Attitudes toward Science among Palestinian Secondary School Students. *World Journal of Education*, 5(1), 13-24.

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