

Relative Effects of Two Activity-Based Instructional Strategies on Secondary School Students' Attitude towards Physics Practical

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Abstract

The study investigated the relative effects of two activity-based instructional strategies on students' attitude towards Physics practical in secondary schools. The study adopted the quasi-experimental design of pre-test, post-test and control group. The sample for the study comprised 74 Senior Secondary two (SS II) Physics students who were randomly selected through multistage technique from three co-educational senior secondary schools in Osun state, Nigeria. The schools were randomly selected to two experimental and a control group. The experimental groups were exposed to predict-observe-explain and virtual laboratory instructional strategies while the control group was taught using conventional laboratory strategy. Physics Practical Attitude Scale (PPAS) was the instrument used to collect relevant data for the study. The general question raised for the study was answered using descriptive statistics. The hypotheses generated were analyzed using Analysis of Variance (ANOVA), Scheffe Posthoc Analysis and Multiple Classification Analysis (MCA). Decisions were taken at 0.05 level of significance. The findings from the study showed that the treatment had positive effects on students' attitude towards Physics practical. Based on the findings, it was recommended that Physics teachers should make use of predict-observe-explain and virtual laboratory instructional strategies to improve students' attitude towards Physics practical in secondary schools.

Keywords: Activity-based instructional strategies, predict-observe-explain, virtual laboratory, Attitude, Physics Practical.

Introduction

Activity-based instructional strategies are students centered instructional strategies that allow active learning, where students are engaged in writing, discussing, describing, explaining, and reflecting processes that do

not normally take place in a traditional classroom. They are structured in such a way that students are immersed in experiences within which they engage in meaning-making inquiry, action, imagination, invention, interaction, hypothesizing and personal reflection. The students use their own experiences, prior knowledge and perceptions, as well as their physical and interpersonal environments to construct knowledge and meaning. The goal is to produce a classroom environment that provides meaningful learning experiences for students.

Students-centered teaching methods promote face-to-face interaction, group discussion, intense personal involvement, open communication and focus the students' attention on the content when they participate in learning activities. The focus of activity is shifted from the teacher to the students, they actively process content and their learning often incorporates the use of materials and resources such as real materials and virtual aids. It thus allows them to learn from their own active processing of information by combining content with skill. The two activity-based instructional strategies investigated in this study are predict-observe-explain and virtual laboratory instructional strategies.

The Predict-Observe-Explain Instructional Strategy (POEIS) is an instructional strategy in which students predict the result of a demonstration and discuss the reasons for their predictions; carry out and observe the demonstration and finally explain any discrepancies between their predictions and observations. If their observations are in agreement with the predictions, it becomes stronger and convincing; thereby gives the students deeper knowledge and understanding of the concept.

Predicting is foreseeing the possible outcomes of an unrealized event depending on the past experiences and collected data. It is crucial in the teaching and learning of science. It motivates students to activate their prior knowledge and articulate their understanding of the phenomenon under investigation. Kien, Gabriela, Ok-Kyeong, Francisco, and Lisa (2010) reported that prediction plays a bridging role in helping students make connections between a physical phenomenon and associated scientific concepts. It can be a useful pedagogical means to aid student learning in several ways. In terms of concept development, prediction allows students to activate and refine their existing knowledge. It fosters learning in that it provides an opportunity for students to account for the inconsistencies between what they predict and what they observe.

After the mental effort of making a prediction, getting it wrong, and then trying to work out why they were wrong, students are far less likely to forget what they have learned compared to simply being told the facts. The benefits of POE go even further than memorable learning experiences. By asking students to describe their confidence in their prediction, this tap into a

crucial 21st Century skill – metacognition (Dalziel, 2010). Metacognition is the ability of students to reflect on their own thought. It regulates, monitors and supports self-directed learning.

Virtual Laboratory is a virtual studying and learning environment with the aim of developing laboratory skills of students by stimulating the real laboratory. It is a computer-based activity where students interact with experimental apparatus via a computer interface. It provides students with tools, materials and laboratory sets which are electronically programmed in computer to perform experiments anywhere and anytime (Babateen, 2011).

The Virtual Laboratory Instructional Strategy (VLIS) used for this study is a computer-based instructional strategy made up of three components: text, video and simulated experiment. The text section exposes the students to the title, aim, theory, apparatus and procedures of the experiments. The video section exposes the students to the steps in carrying out the experiments via video. The simulated experiment is a section where students carry out or perform experiments in virtual environment using computer program.

As a technique for instruction, simulation allows students to deal in a realistic way with matters of vital concern but without dire consequences should they make wrong choices. Simulations enable students to understand complex interactions of physical or social environment factors. As techniques for experimentation, simulations permit researchers to perform exotic “dry lab” experiments or demonstrations without using rare materials or expensive equipment. Time compression is another cost-saving feature of simulation technology. Events that can take hours to eons in real time can be simulated in a few minutes (Encyclopaedia Britannica, 2010).

Among the various ICT applications, computer simulations are of special importance in Physics teaching and learning. Li, Ma, and Shi (2011) asserted that computer simulations are now an integral part of contemporary basic and applied Physics, and computation has become as important as theory and experiment. With the help of a powerful simulation many of Physics topics which are difficult to teach and transfer can be made simpler and clearer. Also, some experiments which are difficult to make or hard for the students to understand in a real laboratory can be made much simpler with the help of simulations. In this way Physics courses are becoming a fun and immersive. Simulations offer new educational environments, which aim to enhance teachers' instructional potentialities and to facilitate students' active engagement.

Virtual laboratory makes students active learners. It provides opportunities for students to learn at their own pace and understand difficult Physics practical concepts. Students are placed in a virtual learning environment where they can bridge new knowledge with previously learned knowledge through direct manipulation of apparatus using computer program.

This study is anchored on pragmatism learning theory propounded by John Dewey and experiential learning theory propounded by David Kolb. The two learning theories draw their roots from constructivist learning theory which advocates learner-centered approach in teaching-learning process.

Constructivism is a view of learning based on the belief that knowledge is not a thing that can be simply given by the teacher at the front of the classroom to students in their desks. Rather, knowledge is constructed by students through an active, mental process of development; students are the builders and creators of meaning and knowledge.

It suggests that students would benefit from learning opportunities that not only expose them to new information or experiences but also enable them: to examine their own ideas, to determine the extent to which the new experiences make sense in light of these ideas, to consider a number of possible alternative explanations for what they have experienced, and to evaluate the usefulness of a number of different perspectives.

Constructivist teaching fosters critical thinking. The teacher and the students share responsibility and decision making and demonstrate mutual respect. The democratic and interactive process of a constructivist classroom allows students to be active and autonomous learners. Using constructivist strategies, teachers are more effective. They are able to promote communication and create flexibility so that the needs of all students can be met. The learning relationship in a constructivist classroom is mutually beneficial to both students and teachers.

John Dewey introduced Pragmatism in Education. Pragmatism is a practical and utilitarian philosophy. It makes activity the basis of all teaching and learning. It is activity around which an educational process revolves. It makes learning purposeful and infuses a sense of reality in education. It makes schools into workshops and laboratories. It gives an experimental character to education. According to pragmatism, all education is “learning by doing”. So, it must be based on the students’ experiences as well as activities.

The principle of philosophy of pragmatic method of teaching is practical utility. The students are the central figure in this method. Pragmatic method is an activity-based method. The essence of pragmatic method is learning through personal experience of the student. Pragmatic method is thus a problem-solving method. Education to the pragmatists is not teaching the students things they ought to know but rather engaging them to learn for themselves through experimental and creative activity. Learning by doing makes students creative, confident and cooperative. Pragmatic education is thus auto-education or self-education.

Experiential learning theory propounded by David Kolb (1984) explains knowledge as being constructed through effective and purposeful hands on materials. Experiential learning is an instructional strategy where

learners gain knowledge by the experiences they encounter during the learning process. Kolb's experiential learning model was first published in 1984 with dramatic impact on the design and development of long life learning model when he advocated experience as the source of learning and development. Experiential learning is the acquisition of knowledge and skills through observations, discovery and hands-on experience: learning by doing. Kolb built on the work of Dewey and advocated a four-stage cycle involving concrete cycle: experience, reflective observation, abstract conceptualization and active experimentation.

Kolb's experiential learning model described a learning cycle in which experience leads to observation and reflection, followed by concept formation. New concepts in turn, may guide choices for new experiences. Kolb's experiential learning theory is explained in the model below.

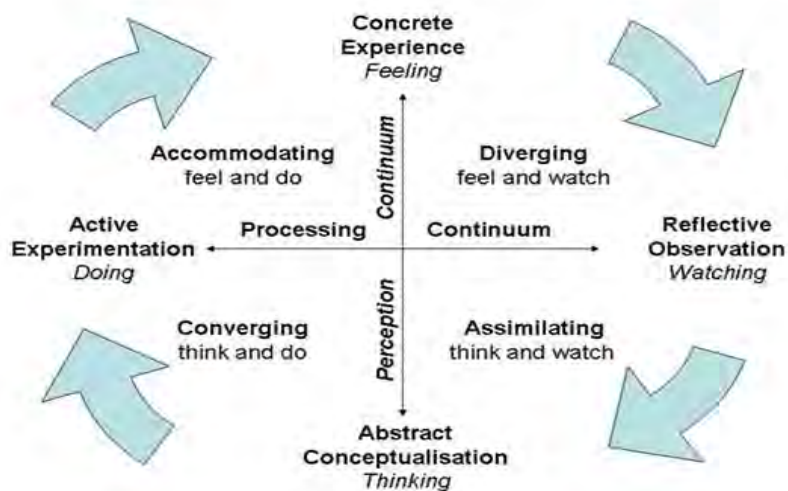


Figure 1: Adopted David Kolb learning Model (1984)
 Source: <https://www.simplypsychology.org/learning-kolb.html>

In this model knowledge construction is conceived as a four stage process. Concrete experience is the first stage, it represents the immediate tangible experiences (hands on materials) that learners are involved in. During this process they physically manipulate apparatus. The experiences in the first stage lead to the second stage of observation and reflection, this stage basically entails the use of senses, which triggers sensory stimulus. The stimulus triggered lead to the third stage that is formation of abstract concepts. It is the stage where stimulus is assimilated into the learner's mind, as such

concreteness turn out to abstractness. From the assimilation, new experiences and concepts are created leading to the fourth stage of creation of new experiences. These experiences generate new knowledge and represent the instructional objectives/expected learning outcomes. The four stages are interlinked as one leads to the other.

Kolb views the learning process as a context of people moving between the modes of concrete experience and abstract conceptualization, and reflective observation and active experimentation. Thus, the effectiveness of learning relies on the ability to balance these modes. Effective learning is seen when a person progresses through a cycle of four stages: of having a concrete experience followed by observation of and reflection on that experience which leads to the formation of abstract concepts (analysis) and generalizations (conclusions) which are then use to test hypothesis in future situations, resulting in new experiences.

In the model, diverging (feeling and watching) emphasizes the innovative and imaginative approach to doing things. Views concrete situations from many perspectives and adapts by observation rather than by action. Assimilating (watching and thinking) pulls a number of different observations and thoughts into an integrated whole. Converging (doing and thinking) emphasizes the practical application of ideas and solving problems. It fosters decision-making, problem-solving, and the practical application of ideas. Accommodating (doing and feeling) uses trial and error rather than thought and reflection. Solves problems in an intuitive, trial-and-error manner, such as discovery learning.

In teaching and learning of Physics, ineffectiveness in practical instructions can be ultimately traced to lack of adequate link within the four stages in the model explained above. Adoption and proper implementation of this model in Physics practical instructions will develop laboratory skills of the students, enhance their scientific knowledge and transpose the students from passive learning to active students-centered learning process by hands on material. The model makes students the central figure of Physics practical activities by making use of their hands, senses and mind. This ultimately drives the students towards the process of assimilating and accommodating new knowledge into their existing knowledge.

The focus of this study is to find out how the two activity-based instructional strategies investigated affect students attitude towards Physics practical in secondary schools. Attitude is disposition towards something based on experience, it can either be positive or negative. Positive attitude springs out of good experience, if the experience is bad the attitude will be negative. Veloo, Nor and Khalid (2015) opined that negative attitude towards a certain subject makes learning difficult, while positive attitude stimulates students to put effort and leads to the high achievement in the subject.

The research of Kaya and Boyuk (2011) revealed that students' positive attitudes towards science highly correlate with their achievement in science. Determining students' attitude towards Physics is therefore a useful task in order to improve the performance of students in the subject. The estimation of students' attitude towards Physics has been carried out by many researchers. Many of them (Akinbobola, 2009; Alimen, 2009; Mekonnen, 2014) came to the same conclusion that the decrease in Physics academic achievement is alarming. The outstanding factor that caused this is the students' attitude towards the subject.

The report of Adebisi and Ajayi (2015) on correlation of students' attitude and gender differences on understanding of concept in Physics practical showed that students' attitude is significantly related to understanding of concept in Physics practical. The higher the students' attitude, the higher the understanding of the concept of Physics practical. In the other way the lower the students' attitude to Physics practical, the lower the understanding of the concept of Physics practical. The cause of the negative perception of students towards Physics was identified by Adedayo (2008) to include the fear of the mathematical skills involved, harsh teacher-students' relationship, students' unreadiness to study, preconceived bad information that Physics is a difficult subject and poor method of teaching. Olusola and Rotimi (2012) supported this claim that Physics is perceived as a difficult subject for students from secondary school to university and also for adult in graduate education. This impression greatly affects students' readiness and interest to study the subject. However, the reality on ground demands steering up students' attitude towards Physics practical in secondary schools. It is therefore necessary for teachers to help the students to develop right attitude towards Physics practical.

Attitude of the students towards Physics practical has a great impact on their performance in the subject. The availability, readiness and interactive manner of the students in Physics practical class is a function of their attitude towards practical activities. Thus right attitude towards Physics practical is imperative for optimal performance of the students in Physics examinations like WAEC and NECO.

Statement of the Problem

There has been growing concern about low achievement of secondary school students in science subjects. Poor performance in Physics has been a major concern for Physics educators, parents, guardians, curriculum planners, researchers and government. The implication of the persistent failure in Physics is grievous on the society as there may be shortage of manpower in science and technology related disciplines.

One of the Nigeria newspapers, The Punch, under editorial for Tuesday April 28, 2020 reported that “patients outnumber doctors at a ratio of 1:3500. This is against the 1:600 doctor per patient ratio recommended by the World Health Organization. The shortage of trained personnel is exacerbated by the brain drain syndrome” this is one of the long run effects of persistent failure in Physics in secondary schools on the society. Studying medicine in any of the Nigeria universities, the students must have at least a credit pass in Physics as one of the requirements.

Based on the allocation of marks to essay and practical aspects of Physics in external examinations like WAEC and NECO, it is discovered that it may be difficulty for students to make a credit pass in the subject if they performed poorly in practical aspect which is being assessed separately as an integral part of the subject carrying substantial weight in grading the students’ performance.

It is also discovered that the methods adopted by teachers to teach Physics practical have not solved the problem of poor performance in the subject, probably because those methods have not actually focused on learners as constructors of their own knowledge and also damp their interest and invariably affecting their attitude towards practical activities making the students not to develop appropriate practical skills needed to perform well in their external examinations.

In view of the aforementioned, the need to adopt activity-based instructional strategies in teaching Physics practical in secondary schools with a view to helping students to develop positive attitude towards Physics practical and improve their performance in Physics practical necessitated this study. This study, therefore, sought to examine and compare the effects of two activity-based instructional strategies (POEIS and VLIS) on secondary school students’ attitudes towards Physics practical.

Research Question

What is the attitude of the students towards Physics practical in the three groups before and after treatment?

Research Hypotheses

The following null hypotheses were generated for the study:

- H₀₁:** there is no significant difference in the pre-test mean scores of students’ attitude towards Physics practical in the three groups before treatment.
- H₀₂:** there is no significant difference in the post-test mean scores of students’ attitude towards Physics practical in the three groups after treatment.

Methodology

Research Design

This study adopted quasi-experimental design of the pre-test, post-test and control group. There were three groups altogether: two experimental groups (corresponding to the use of predict-observe-explain instructional strategy and virtual laboratory instructional strategy) and the third (conventional) group served as the control group. The teacher-centered instructional strategy was used as the conventional laboratory strategy of teaching Physics practical. The design is represented schematically as follows:

G ₁ :	O ₁	x ₁	O ₂
G ₂ :	O ₃	x ₂	O ₄
G ₃ :	O ₅	x ₃	O ₆

Where

G₁ - Experimental group 1

G₂ - Experimental group 2

G₃ - Control group

O₁, O₃ and O₅ are the pre-test observations

O₂, O₄ and O₆ are the post-test observations

x₁-Treatment for group 1 (Predict-Observe-Explain-Instructional Strategy)

x₂ - Treatment for group 2 (Virtual Laboratory Instructional Strategy)

x₃ - Treatment for control group (Conventional laboratory Strategy)

Population, Sample and Sampling Technique

The population for this study consisted of all Senior Secondary two (SS II) Physics students in the three Senatorial Districts of Osun State. The Senior Secondary two (SS II) students were considered appropriate for this study because they would have been exposed to a considerable knowledge of Physics in Senior Secondary one (SS I). The sample for the study consisted of 74 Physics students of Senior Secondary two (SS II) in three co-educational senior secondary schools in the state. The multistage sampling procedure was used to select the sample. Stage one involved the selection of one Local Government Area from each of the three Senatorial Districts in the state using simple random sampling by balloting. The second stage involved the use of purposive sampling technique to select one secondary school with relatively-equipped Physics laboratory from each Local Government Area selected, and the third stage involved the use of students in an intact class of an arm randomly selected from each school considered.

Research Instruments

Physics Practical Attitude Scale (PPAS) was the instrument used to collect relevant data for this study. The Physics Practical Attitude Scale (PPAS) was developed to measure the attitude of students towards Physics

practical. The PPAS had two sections A and B. Section A consisted of students' personal bio-data such as name of school, gender, age range and class while section B consisted of 40 items-questionnaire intended to measure students' attitude towards Physics practical. The PPAS was structured in 4-points Likert scale: Strongly Agree (SA) – 4 points, Agree (A) – 3 points, Disagree (D) – 2 points and Strongly Disagree (SD) – 1 point. The face and content validity of the instrument were carried out by experts. The reliability coefficient of 0.73 was obtained for PPAS using Cronbach's Alpha. The value was considered high enough to be used for the study.

Data Analysis

The data collected were collated and analyzed. The question raised was answered using descriptive statistics of mean, standard deviation and bar chart. The hypotheses generated were analyzed using Analysis of Variance (ANOVA), Scheffe Posthoc Analysis and Multiple Classification Analysis (MCA). Decisions were taken at 0.05 level of significance.

Result

Question

What is the attitude of the students towards Physics practical in the three groups before and after treatment?

In order to answer the question, mean scores of attitude of the students towards Physics practical in the three groups before and after treatment were computed and compared. The result is presented in Table 1.

Table 1: Students' attitude towards Physics practical in the three groups before and after treatment

<i>Group</i>	<i>N</i>	<i>Pre-test</i>		<i>Post-test</i>		<i>Mean Difference</i>
		<i>Mean</i>	<i>SD</i>	<i>Mean</i>	<i>SD</i>	
Predict-Observe-Explain	24	62.37	4.14	135.73	4.59	73.36
Virtual Laboratory	20	63.20	4.77	132.56	9.04	69.36
Control	30	64.21	6.08	90.10	8.77	25.89
Total	74					

The attitude of students towards Physics practical in the three groups before and after the treatment is further depicted in Figure 2.

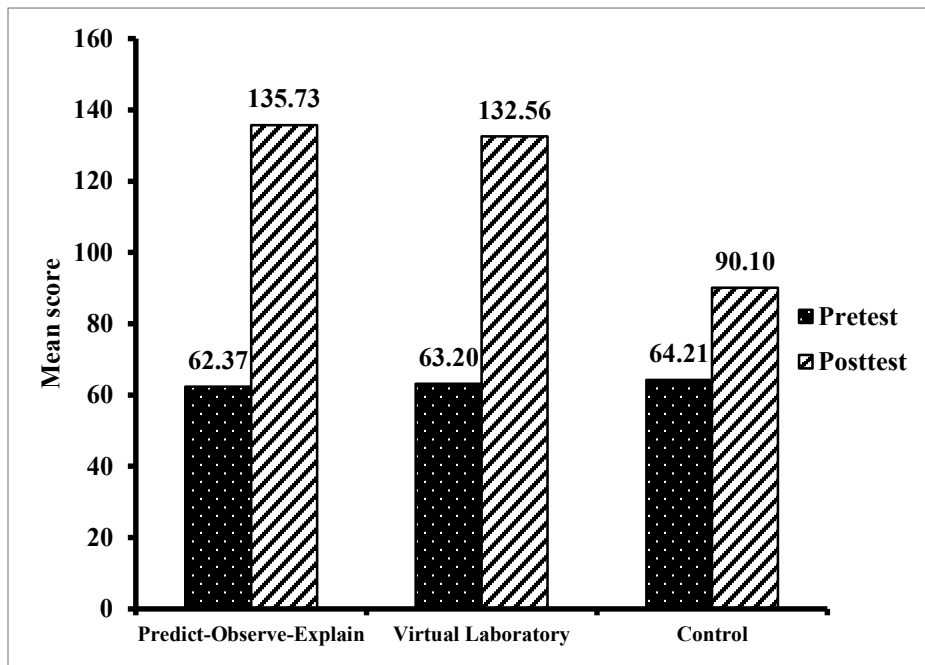


Figure 2: Bar chart showing attitude of the students towards Physics practical in the three groups before and after treatment

Testing of Hypotheses

H₀₁: There is no significant difference in the pre-test mean scores of students’ attitude towards Physics practical in the three groups before treatment.

In testing the hypothesis, pre-test mean scores of students’ attitude towards Physics practical in the three groups before treatment were computed and compared for statistical significance using Analysis of Variance (ANOVA) at 0.05 level of significance. The result is presented in Table 2 below.

Table 2: ANOVA showing attitude mean scores of students in the three group before treatment

Source	SS	Df	MS	F	P
Between Groups	46.010	2	23.005	0.861	0.427
Within Groups	1896.208	71	26.707		
Total	1942.218	73			

p>0.05

The result in table 2 above shows that the computed F-value (0.861) obtained for the groups with a p value > 0.05 was not statistically significant at 0.05 level. The null hypothesis is not rejected; implying that there is no significant differences in the pre-test mean scores of students' attitude towards Physics practical in the three groups before treatment.

H₀₂: There is no significant difference in the post-test mean scores of students' attitude towards Physics practical in the three groups after treatment.

In order to test the hypothesis, post-test mean scores of the students' attitude towards Physics practical in the three groups were computed and compared for statistical significance using Analysis of Variance (ANOVA) at 0.05 level of significance. The result is presented in Table 3.

Table 3: ANOVA showing post-test attitude mean score of students by treatment

Source	SS	Df	MS	F	P
Between Groups	34944.235	2	17472.117	290.509*	0.000
Within Groups	4270.161	71	60.143		
Total	39214.396	73			

* $p < 0.05$

The result in table 3 above showed that the computed F-value (290.509) obtained for the groups with a p value < 0.05 was statistically significant at 0.05 level. The null hypothesis is rejected; implying that there is significant difference in the post-test attitude mean scores of the students in the three groups.

In order to locate the sources of pairwise significant difference among the groups, Scheffe Posthoc test was carried out. The result is presented in Table 4 below.

Table 4: Scheffe Posthoc analysis of students' attitude towards Physics practical by treatment

Group	1	2	3	N	Mean
Predict-Observe-Explain (1)			*	24	135.73
Virtual Laboratory (2)			*	20	132.56
Control (3)				30	90.10

* $p < 0.05$

Table 4 above showed that there is significant difference between the attitude of students exposed to predict-observe-explain instructional strategy and conventional laboratory strategy at 0.05 level. Similarly, the mean difference between the attitude of students exposed to virtual laboratory instructional strategy and conventional strategy is statistically significant at 0.05 level. However, there was no significant difference between the attitude of students exposed to predict-observe-explain instructional strategy and virtual laboratory instructional strategy at 0.05 level.

In order to determine the effectiveness of the treatment (instructional strategies) at enhancing students' attitude towards Physics practical, Multiple Classification Analysis (MCA) was used. The result is presented in Table 5.

Table 5: Multiple Classification Analysis (MCA) of students' attitude towards Physics practical by treatment

Grand mean=116.38							
Variable Category	+	N	Unadjusted Devn'	Eta²	Adjusted For Independent Covariate	+	Beta
Predict-Observe-Explain		24	19.35	0.90	19.21		-.03
Virtual Laboratory		20	16.18		16.16		
Conventional		30	-26.28		-26.15		
Multiple R							0.033
Multiple R ²							0.001

Table 5 revealed that students exposed to predict-observe-explain instructional strategy had the highest adjusted mean score of 135.59 (116.38+19.21) on attitude towards Physics practical. This was closely followed by those taught using virtual laboratory instructional strategy with an adjusted mean score of 132.54 (116.38+16.16) while the students in the conventional laboratory strategy group had the least adjusted mean score of 90.23(116.38+(-26.15)). This implies that virtual laboratory and predict-observe-explain constitute effective instructional strategies for enhancing students' attitude towards Physics practical.

Discussion

Table 1 revealed that Physics students in the predict-observe-explain instructional strategy group had mean score of 62.37 while those exposed to virtual laboratory instructional strategy and conventional laboratory strategy had mean scores of 63.20 and 64.21 respectively prior to treatment. This implies that the attitude of the students towards Physics practical in the three groups before treatment was unsatisfactory. On exposure to treatment, students taught using predict-observe-explain instructional strategy had the highest mean score of 135.73, closely followed by those exposed to virtual laboratory instructional strategy with a mean score of 132.56 while the students in the conventional laboratory strategy group had the least mean score of 90.10. This implies that the attitude of the students towards Physics practical in the three groups after treatment was high.

Figure 2 showed the students' attitude mean scores towards Physics practical in the three groups before and after treatment. The Bar Chart showed that students taught using predict-observe-explain instructional strategy had the highest post-test attitude mean score, closely followed by those exposed to virtual laboratory instructional strategy while the students exposed to conventional laboratory strategy had the least attitude mean score. The comparison between the pre-test and post-test attitude mean scores in the three groups showed that the post-test attitude mean scores are higher than the pre-test attitude mean scores. This implies that the treatment had positive effect on students' attitude towards Physics practical. The Bar Chart further showed that predict-observe-explain is the most effective strategy for enhancing students' attitude towards Physics practical. This is in agreement with the finding of Gernale, Duad and Aranes (2015) that there was an improvement in the attitude of the students exposed to predict-observe-explain approach. It was further elicited that the attitude of the students was significantly enhanced since the activities were basically learner-centered.

Table 2 showed that there was no significant difference in the pre-test attitude mean scores of the student in the three groups. It could therefore be said that the attitude of the students towards Physics practical before the commencement of the treatment is homogenous.

Table 3 indicated that there was significant difference in the post-test attitude mean scores of the students in the three groups. This implies that the attitude of students towards Physics practical in the experimental groups (Predict-Observe-Explain Instructional Strategy and Virtual Laboratory Instructional Strategy) was significantly higher than their counterparts in control group (Conventional laboratory Strategy). It shows that the treatment influenced the attitude of the students positively towards Physics practical.

Table 4 further showed that there was significant difference between the attitude of students exposed to predict-observe-explain instructional

strategy and control group. Similarly, there was significant difference between the attitude of students exposed to virtual laboratory instructional strategy and control group. However, there was no significant difference between the attitude of students exposed to predict-observe-explain instructional strategy and virtual laboratory instructional strategy. This is in line with the report of Teerasong et al (2010) who reported positive attitude of students using predict-observe-explain strategy. It is also in support of Tuysuz (2010) who discovered that virtual laboratory applications made positive effects on students' achievements and attitudes when compared to traditional teaching methods. Likewise, Asiksoy and Islek (2017) found that virtual laboratory experiences made positive effects on students' attitudes.

Table 5 showed the effectiveness of the treatment at enhancing students' attitude towards Physics practical. The treatment accounted for about 90% ($\eta^2=0.90$) of the observed variance in students' attitude towards Physics practical.

The results showed that predict-observe-explain and virtual laboratory instructional strategies are both effective instructional strategies for enhancing students' attitude towards Physics practical. The interactive and manipulative effects of Physics apparatus encapsulate in activity-based instructional strategies improve students' attitude towards Physics practical works. Students tend to learn better in activity-based class where they manipulate apparatus, think and act in scientific manner to gain insight into the concepts of Physics practical. These strategies that make students the central figure of learning activities enhance students' experience, understanding, skills and motivate them to develop positive attitude towards practical works in Physics. This finding provides empirical support to earlier finding of Gambari, Falode, Fagbemi, and Idris (2013) who reported that the application of the virtual laboratory had positive effects on students' attitudes when compared to physical laboratory method. It is also in agreement with Pyatt and Sims (2012) who asserted that using virtual laboratory increases motivation and desire for lesson and laboratory in the process of learning. Likewise, the finding is in line with Bilen and Kose (2012) who reported that predict-observe-explain instructional strategy had positive effects on pre-service science teachers' attitudes toward science teaching.

Conclusion

This study shows that the treatment influenced the attitude of the students positively towards Physics practical and there was no significant difference between the attitude of students exposed to predict-observe-explain instructional strategy and virtual laboratory instructional strategy. This implies that predict-observe-explain and virtual laboratory instructional strategies are both effective instructional strategies for enhancing students' attitude towards Physics practical.

Recommendations

Based on the finding of this study, it was recommended that Physics teachers should be enlightened and encouraged to employ predict-observe-explain and virtual laboratory instructional strategies to cultivate positive attitude of students towards Physics practical in secondary schools.

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