

## **Effect of Predict-Observe-Explain Strategy on Secondary School Physics Students' Attitude in Simple Harmonic Motion in Ogun State**

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### **Abstract**

The study examined effect of Predict-Observe-Explain on secondary school Physics students' attitude in Simple Harmonic Motion in Ogun State. One hypothesis was formulated and tested at 0.05 levels of significance. The study adopted pre-test, post-test, control group, quasi-experimental design. A total of 166 SS2 Physics students in two senior secondary intact classes in Ogun State were selected through multi-stage sampling technique, participated in the study. One school was exposed to each of the Predict-Observe-explain and conventional method for 8 weeks. Physics Attitude Scale (PAS) with 20 items on a four-point Likert type scale ( $r=0.73$ ) was used for data collection. Data were analysed with descriptive and inferential statistics. There was a significant main effect of Predict-Observe-Explain strategy on students' attitude towards Physics ( $F_{(1,128)}=6.349, p<0.05, \eta^2=0.047$ ).

The study concluded that Predict-Observe-Explain is more effective instructional strategy than conventional method of teaching in

enhancing students' attitude towards Physics because every student participated in one activity or the other which enhanced conceptual understanding, creativity and critical thinking. Consequently, it was recommended that this strategy should be constantly used, while workshop and seminar should be organized for the teachers for effective use of the strategy.

**Keywords:** Predict-Observe-Explain, Attitude, Simple Harmonic Motion, Physics, Multi-stage Technique.

### **Introduction**

Science is primarily designed to transform the environment towards improving the general quality of life, thus making the world a better place. It is the foundation on which contemporary technological breakthroughs and advancement rest. Science systematically studies the nature of the materials and physical universe behaviour through observation, experimentation, measurement, and recording (Thomas, 2021). Science is considered to be a systematic, precise, and objective way to study the natural world (Arziqulogli & Ixomovich, 2022). Physics, Chemistry, Mathematics, and Biology constitute the fundamental disciplines of science (Selin & Kaya, 2020). In recent times, countries all over the world, especially developing ones like Nigeria, are striving hard to develop scientifically and technologically, since the world is a scientific and technological global village where all proper functioning of lives largely depends on science. Without the application of science, it would have been difficult for a man to explore the other planets of the universe. The development of any society is based on its technological level, and Physics education is a significant factor in enhancing technology development. Physics is a branch of Science that deals with the nature and properties of energy and matter. Physics is a pure Science subject with overwhelming impacts on this present globalised world. Physics is a Science of observation of the world around us (Al-Khalili, 2020). It is a core subject in Science and Technology since it studies the essence of natural phenomena and helps people understand the rapidly technological changing society (Edoja & Gbadamosi, 2020).

Physics is the natural development of experiments, observations, and theories to explain the fundamental structure of all we perceive

which is crucial for effective living in this jet age of Science and Technology (Novitra, 2021). Being fundamentally the study of various forms of energy interactions and inter-conversions with matter, Physics is the study of the nature of our environment and how different energies of nature can be produced, conserved, and changed to another form (Gulbin & Topsakal, 2021). The Nigeria Federal Ministry of education regards Physics as a crucial subject for effective living in the modern age of science and technology (Agbele, Oyelade & Oluwatuyi, 2020). This means that it is necessary that every student is given an opportunity to acquire some Physics concepts, theories, principles, and skills. These concepts, theories principles, and skills are clearly explained in the objectives of Physics education enshrined in the new Senior Secondary School Physics Curriculum (Soecharito et al., 2019). The objectives of Physics education are to provide a basic literacy in Physics for functional living in society; obtain elementary theories and principles of Physics as training for advanced studies; acquire essential scientific skills and attitudes as a preparation for the technological application of Physics, and stimulate and enhance creativity (Usman, Simvyap & Fasanya, 2019). Therefore, Physics is included in the Nigerian senior secondary school science curriculum to build a strong technological foundation for students. There are five concepts of Physics (Simeon, Samsudin & Yakubu, 2020). These include the concept of space, time, and motion, conservation principles, waves, fields, and Quanta. One important aspect of Physics is Mechanics. The importance attached to Mechanics topics in Physics as underscored by the Senior Secondary School Examination of West African Examinations Council (WAEC) and National Examination Council (NECO) indicated that more than 30 percent of senior secondary school Physics examination questions were from Mechanics and that the poor performance in Physics recorded on the concepts of Mechanics are mainly in the areas of Elasticity Properties of Solid, Kinetic Theory, Simple Harmonic Motion, Projectiles Motion, the Relative Density of a solid, Properties of Matter, equilibrium of forces and mechanical energy, simple mathematical computation, interpretation of expressions and equations affected students' performance in this aspect of Physics (Edoja & Gbadamosi, 2020; West African Examinations Council, 2019). Effective teaching of Science does not only depends on the teacher's knowledge of the methods but also

on his/her ability to use the appropriate method or combination of methods. Attitude as a variable, continues to receive considerable attention from researchers in different subjects' areas because attitude is an integral part of learning. Attitude is a social psychological construct representing an individual's evaluation of attitude objects. Attitudes are essential determinants of human behaviour. Thus, attitudes, when acquired, could influence student's likes and dislikes of a particular subject, attitudes are formed by people as a result of some kinds of learning experiences and if the experience is favourable, a positive attitude is formed and vice versa. Furthermore, the attitude people hold can frequently influence the way they act and respond to situations. However, an interesting result was observed from a study which posit that the students' science attitudes do influence their actual achievement in Science and their Science achievement does not necessary influence their attitudes (Mao et al., 2021). Thus, although positive attitudes can increase the students' Science achievement, a high Science achievement does not necessarily create positive attitudes towards Science by the students. Finding shows that high achievement could serve to predict a positive attitude but a positive attitude alone could not predict stronger achievement (Geisler, Rach & Rolka, 2023). Negative attitude towards a certain subject makes learning difficult (Wakhata, Mutarutinya & Balimuttajjo, 2023). Attitude of both teachers and students have become one of the most important issues in Science education because it has strong influence on performance. The reason why many students have not been opting to study Science further and not progressing to scientific careers over the years has been partly related to low levels of interest and negative attitude developed quite early in life. Students achieve better when they are interested in whatever they are doing (Wigfield, 2023). It was argued that emotional attitudes can have profound effects on learning efficiency (Tan et al., 2021). The kind of attitude one holds in learning situation therefore is of great significance. Students' attitude toward Physics plays vital roles in the teaching-learning process. This is because whatever attitude students have in Physics will affect their achievement. The way science is taught, both at high school and college level also plays a major role in shaping students attitude toward science. Students' attitudes towards rapidly changing technological environment will influence their ability to cope with it emotionally, as well as in

material ways. Therefore, an investigation on students' attitudes towards Physics and recommendations on ways of improving their attitudes towards Physics, enrolment in Physics and their performance in the subject matter is important. Understanding students' attitudes towards Physics are fundamental in sourcing a practical approach to enhancing students' performance and motivation in Physics. Science should be taught in such a way that students will be allowed to experiment and discuss in groups as they make meaning of tasks and set out to solve challenging problems. Activity based and student-centred instructional strategies can attract and retain students in Physics classes by making lessons active, relevant, student oriented and participatory. One of these activity based and students-centered instructional strategies is Predict-Observe-Explain Instructional Strategy (POEIS) which is being investigated in this study. Predict-Observe-Explain Instructional Strategy is based on the philosophy of practical activities which involves learning by doing. Here, learners perform three different tasks; predict, observe and explain.

The POEIS works best with demonstrations which allow immediate observations. It was asserted that the POEIS procedure is based on the classic model of research where a hypothesis is stated and reasons are given for why this may be true, relevant data are gathered and results are discussed (Alfiyanti, Jatmiko & Wasis, 2020). Predict-Observe-Explain instructional strategy is based on the philosophy of practical activities which involves learning by doing. It involves students predicting the result of a demonstration and discussing the reasons for their predictions; carrying out and observing the demonstration and finally explaining any discrepancies between their predictions and observations. Predict-Observe-Explain (POE) strategy is one of the methods suitable for constructivist approach and aims to identify and eliminate students' misconceptions and increase the comprehension level of them (Jasvi, 2020).

A study investigated the effects of predict-observe-explain strategy on students' academic achievement, scientific process skills and attitude towards science (Arslan & Irfan, 2020). The results revealed that students in the experimental group had significantly higher scores than the students in the control group in terms of academic achievement and scientific process skills. However, no difference was observed in their attitude

towards science. Another study investigated, the effect of the prediction-observation-explanation (POE) method on learning of image formation by a plane mirror and pre-service teachers' opinions (Gernale, Arañes & Duad, 2015). It was found that the POE method is effective in the learning of image formation by a plane mirror. Thirteen (65%) pre-service teachers expressed only positive opinions about making a plane mirror by using glass and mirror-effect spray paint; seven (35%) pre-service teachers expressed both positive and negative opinions.

Also, a research was carried out on the effects of POE Learning Model and Achievement Motivation on the Spiritual & Social Competence of Madrasah Tsanawiyah (MTs) Students in Social Studies (Mauniyati & Basuki, 2019). The results of the hypothesis study show: 1) that the significance value that follows the POE and DI learning model is 0.785, which means that it is non-significant. This shows that there is no difference in the competence of students' spiritual and social attitudes between those who follow the POE learning model and the DI learning model; 2) a significance value of 0.169 means non-significant. This shows that there is no difference in the competence of students' spiritual and social attitudes between those who have low achievement motivation and those who have high achievement motivation; and 3) significance value of 0.494 means non-significant. The study of the effects of a laboratory instruction, based on POE, on the pre-service science teachers' conceptual understanding of photosynthesis and respiration in plants as well as pre-service science teachers' attitudes towards general Biology laboratory (Bilen & Aydogdu, 2010). The findings showed that laboratory instruction designed based on POE strategy was an effective way of promoting the conceptual understanding and improving attitudes toward Biology laboratory positively.

A study investigated the effects of activities, based on POE, about growth and development in plant on pre-service science teachers' attitudes toward science teaching (Bilen, & Kose, 2012). The results showed that there were significant differences between the experimental and the control groups' attitudes toward science teaching in favour of the experimental group. Moreover, the pre-service science teachers said that POE activities were effective, they were happy, they felt themselves better, their self-confidence increased and they would use these activities in their lessons. A POE activity named as "Water can be boiled with ice"

was developed (Koseoglu, Tumay & Kavak, 2002). According to the results, it was found that POE activity was effective in promoting the preservice science teachers' attitudes toward chemistry, their interest and motivation. An extensive study has also been done (Yavuz, & Celik, 2013). It was found that POE was an effective way of promoting the pre-service elementary teachers' achievement, conceptual understanding on gases subject and their attitude toward Chemistry.

A study on Predict-Observe-Explain tasks in Chemistry Laboratory Pre-Service elementary teachers' understanding and attitudes (Mutlu & Şeşen, 2016). The results indicated that the pre-service elementary teachers who were trained using laboratory activities based on predict observe- explain task had significantly higher scores in terms of achievement and attitude toward Chemistry lesson and laboratory than those taught by the traditional approach. The effect of Prediction, Observation, and Explanation Supported Project-Based Environmental Education on the levels of attitude and behavior toward the environment was investigated (Duygu & Halil, 2020). The study found that the POESPBE provided a significant development on students' attitude and behavior; however, teacher centered environmental education could not provide a significant development on the students. A study carried out suggests that the POE strategy positively influenced the academic performance and attitude of the students towards Physics (Venida & Sigma, 2020). The findings of the study showed a significant difference in the achievement scores of the two groups in the posttest. It was further revealed that the experimental group performed better in the posttest than the control group and registered a significant change in attitude towards Physics from neutral to positive while the control group maintained a neutral attitude.

### **Statement of the Problem**

In Nigeria, students' attitude in secondary school Physics has not been encouraging and in spite of the desire for technological development, which needs Physics education, there is persistent poor attitude of students in the subject. So many factors can be attributed to students' poor attitude in Physics; they include teachers' use of inappropriate instructional approaches, lack of adequate laboratory facilities, poor organization of laboratory activities, lack of commitment to laboratory

work by both teachers and students, partial or total absence of laboratory, lack of qualified Physics teachers and mode of laboratory activities that are used in Physics laboratory. Studies have shown that teachers use mostly teacher-centred approaches in carrying out laboratory activities. The inappropriate instructional approaches used by secondary school Physics teachers, tend to raise doubts about the possibility of realizing the objectives of Physics education in Nigerian secondary schools as stated in the National Policy on Education. Most instructional approaches such as lecture and demonstration used in teaching Physics in the classroom or laboratory, promote rote learning and lack of opportunity for students to manipulate materials and reflect on what they do during teaching and learning processes. Students' interaction during practical activities in the laboratory could play a key role towards concretizing learning. It is against this background that, the study investigated the effects of Predict-Observe-Explain Instructional Strategy on secondary school Physics students' attitude in Simple Harmonic Motion in Ogun State, Nigeria.

### **Hypothesis**

There is no significant main effect of Predict-Observe-Explain strategy on students' attitude in Simple Harmonic Motion in Physics in secondary school in Ogun State.

### **Methodology**

The study adopted a pre-test, post-test, control group, quasi-experimental design. The target population for this study was all the SSII students offering Physics in public schools of Ogun Central Senatorial district of Ogun State. The sample consisted of only two public senior secondary schools which are government owned (for purpose of uniform standard) and which offer Physics up to the Senior Secondary School Certificate (SSSC) level, using multi-stage sampling technique. A total of one hundred and sixty-two (166) students offering Physics (seventy-five (75) in the experimental group and ninety-one (91) in the control group participated in the study. Three research instruments were developed and used for the study. These are: The Physics Attitude Scale (PAS) with the reliability coefficient of 0.73 using Cronbach alpha coefficient, Instructional guide on Predict-Observe-Explain Strategy and Instructional guide on Conventional Method. The Physics Attitude Scale (PAS) from



Fennema-Sherman attitude scale was adapted for use by the researcher. It consisted of 20 items for measuring student's attitude towards Simple Harmonic Motion (SHM) in Physics. The questionnaire contains two sections A and B. Section A contained personal information and section B contains twenty attitude items towards Simple Harmonic Motion (SHM) which the participant responded to. It is made of 20-items on a 4-point Likert scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) to which respondents indicated their degree of Agreement or otherwise to the 20-items on the scale. These guides were given to the experts in the Physics department, Science Educators in Science and Technology Education department and practicing two senior secondary school Physics teachers for the corrections and observations. These guides consisted of notes of lesson in which the major roles of individuals participating in the study (Teacher and Students) were clearly stated. Specific in the notes of lesson are the following items: subject, class, topic, instructional materials, objectives to be achieved, previous, knowledge, presentation and assessment. The following time schedule was adopted for the process:

- a) The first week for the training of research assistant.
- b) One week for pre-test.
- c) Five weeks for carrying out the treatment.
- d) One week for post-test.

The hypothesis formulated was analyzed using Analysis of Covariance (ANCOVA) with pre-test scores as covariates. The analysis was done at a 0.05 level of significance.

## Demographic Data Analysis

The below are the socio-demographic characteristics of the participants.

**Table 1: Distribution of the Participants by Sex**

Sex	Frequency	Percent
Male	70	42.2
Female	96	57.8
Total	166	100.0

**Source:** *Field Survey, 2024*

Table 1 reveals that seventy (70) (42.5%) of the participants were males, while ninety-six (96) (57.8%) were females. This means that, most of the participants were females.

**Table 2: Distribution of the Participants by Class**

Class	Frequency	Percent
SS2	166	100.0

**Source:** *Field Survey, 2024*

Table 2 reveals that one hundred and sixty-six (166) (100.0%) participants were in SS 2. This means that all the participants were in SS 2.

**Table 3: Distribution of the Participants by Age**

Age	Frequency	Percent
12-14 years	59	35.5
15-16 years	94	56.6
17 years and above	13	7.8
<b>Total</b>	<b>166</b>	<b>100.0</b>

**Source:** *Field Survey, 2024*

Table 3 reveals that Fifty-nine (59) (35.5%) of the participants were in the age range of 12-14 years, ninety-four (94) (56.6%) were between

15-16 years, while thirteen (13) (7.8%) were 17 years and above. This means that, most of the participants were in the age range of 15-16 years, while the participants who were over 17 years were the least.

**Table 4: Distribution of the Participants by Groups**

Treatment Groups	Percent
Predict-Observe-Explain (Experimental Group )	30.5
Control Group	69.5
<b>Total</b>	<b>100.0</b>

**Source:** *Field Survey, 2024*

Table 4 reveals that 30.5% of the participants were in the Predict-Observe-Explain (Experimental Group), while 69.5% were in the control group. This means that, more of the participants were in the control group.

## Results

**Table 5: Analysis of Covariance of Main Effect of Predict-Observe-Explain Strategy on Students' Attitude towards Simple Harmonic Motion in Physics.**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	272.067	2	136.034	3.485	0.034	0.052
Intercept	5097.099	1	5097.099	130.574	0.000	0.505
Pretest	13.492	1	13.492	0.346	0.558	0.003
Treatment	247.822	1	247.822	6.349	0.013	0.047
Error	4996.635	128	39.036			
Total	423171.000	131				
Corrected Total	5268.702	130				

**Source:** *Field Survey, 2024*

The table shows that there was a significant main effect of Predict-Observe-Explain strategy (treatment) on students' attitude towards Simple Harmonic Motion in Physics in secondary school in Ogun State ( $F_{(1,128)}=6.349$ ,  $p<0.05$ ,  $\eta^2=0.047$ ). The null hypothesis was therefore rejected. This implies that the treatment was effective on students' attitude towards Simple Harmonic Motion in Physics in secondary school in Ogun State. Also, the eta square value of 0.047 shows the contributing effect size of 4.7%.

### **Discussion of Findings**

The finding showed significant main effect of Predict-Observe-Explain strategy on students' attitude towards Physics. This finding is not surprising, given the fact that POE strategy is a learner-centered instructional strategy and the students were involved in active learning. Students learn best when they are interested in whatever they are doing. The use of Predict-Observe-Explain Strategy falls within the domain of active learning of constructivists where learners are actively involved in the process of teaching and learning. Interactive experiences increase attitude and attitude increase performance (Thomas, 2021). Attitude as an individual attribute can be developed, influence and changed over time. The finding is in consonance with a study investigated the effects of activities, based on POE, about growth and development in plant on pre-service science teachers' attitudes toward science teaching and the effect of Predict-Observe-Explain (POE) Strategy on students' achievement and attitude towards Physics (Selin & Kaya, 2020; Arziqulogli & Iliomovich, 2022). The finding however negates earlier finding of the study which investigated the effects of predict-observe-explain strategy on students' academic achievement, scientific process skills and attitude towards science where no difference was observed in their attitude towards science (Al-Khalili, 2020)

### **Conclusion**

This study investigated the effect of Predict-Observe-Explain instructional strategy on secondary school Physics students' attitude in Simple Harmonic Motion in Ogun State. The instructional strategy that was employed in this study emphasized the participation and active intellectual involvement of students. This learner centered activity based

strategy proved better than the conventional method. The result of the study revealed that there was significant main effect of instructional strategy (Predict-Observe-Explain) on students' attitude towards Physics.

### **Recommendation**

Based on the finding of this study, it was recommended that: Physics teachers should be trained on the use of Predict-Observe-Explain to improve the teaching of Physics in secondary schools.

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