Impact of Instructional Strategies: A Research-Based Pedagogy for Teaching Physics in Secondary Schools in Ekiti Nigeria

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Abstract: **- The study investigated the impacts of demonstration, programmed and projects instructional strategies on students' academic performance in secondary school Physics in Ekiti State. A quasi-experimental design, involving experimental and control groups plus pre-test and post-test were adopted. There were four strategies, three strategies in the experimental group (programmed, demonstration and project strategies) and traditional chalk and talk strategy in the control group. The samples consisted of 240 Physics Students (Male and Female) selected from eight secondary schools. The research instrument used for the study was physics Achievement Test (PAT). The instrument was administered as a pre-test before the treatment and as post-test after treatment for a period of six weeks. The data generated were computed using inferential statistical analysis of Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA). Three hypotheses were raised and tested at α=0.05 level of significance. The results generated from the study shows that students exposed to programmed strategy was the best if compared with demonstration, project and the traditional chalk and talk strategies. The study revealed that location of the school is helpful in enhancing academic performance in Secondary School Physics as most students in urban area performed better than those in rural areas. From the findings, it was recommended that programmed and demonstration strategies should be adopted as effective strategies of teaching Physics in secondary schools and that the government should ensure equal distributions of teachers to rural and urban secondary School.**

Keywords: **Demonstration, Programmed, Projects, Chalk and Talk, Academic Performance**

I. INTRODUCTION

Science and technology are two critical important factors that a nation needs for advancement. It brings about fundamental knowledge for the development of machineries and scientific equipment for economic enhancement of any nation. In the recent societies, science is increasingly a central aspect of our work and our everyday activities. Educators, policymakers, and researchers are focusing on ensuring that science education continues to help preparing future citizens scientifically literate and engaged prone to engage with science in their lives, allow the societies to meet and overcome the news challenges they are facing [1]. [2] opined that generally, the value of school based activities in science has engaged the attention of many science teachers. Science provides fundamental approach to every challenge encountered. Problem solving initiatives is also very key in development of a nation.

Physics happens to be a core subject of science; a compulsory subject for science students and a basic requirement for admission into tertiary institutions for science and engineering related courses. Despite the importance of Physics , it is unfortunate to discover that students' performance in both internal and external examination have not been encouraging and have been a source of concern to parents , teachers , curriculum planners and other stake others in education. There have been hues and cries over the poor level of mastery and proficiency in physics by learners. Due to the abstract nature and mathematical applications involved, physics learners viewed physics as a difficult subject. Lack of student's interest in physics can be attributed to preconceived idea and perception about the subject; this has affected the enrolment and performance of students. The trend in the enrolment and performance of secondary school students in science subjects, especially Physics assumed threatening and frightening in the recent times [3], [4], [5]. Teaching of science, especially Physics, and performance of students at the secondary school level have been the concern of government and parents [6]. Interest of secondary school students towards learning Physics can be influenced by several factors such as strategy of teaching, availability of instructional materials, scientific equipment and apparatus in the laboratories among others. The Interest and the performance of students is not solely in the hand of the teacher; however, the teacher plays a key role in ensuring that students get interest in the subject. Home background in terms of parental control seems to have effect on physics performance.

Research conducted by Physics Education Research (PER) have opined necessary suggestions about physics curriculum which are generally accepted and believed to increase the knowledge and elevate the horizon of understanding of physics by learners [7]. The unwavering poor performance in physics by students in secondary school substantiate the fact that physics teaching has not been properly understood [8] in[9] observed that in Nigeria, it is widely perceiving that most of the students in secondary schools have negative attitudes towards the learning of Sciences.

Over the years, the improper physics teaching has led to a vigorous search for a well appropriate teaching strategy that would be used to achieve the aims and objectives of physics teaching and thereby creating enhancement in students' performance. [10] in his own view sees Physics as a subject which involves a lot of abstract formulas for them to visualize. The instructional strategy engage by the teachers is also a dominant factor in attaining the stated educational objectives of the nation. Since the teachers are the life wire of all the educational enterprises, it is important for teachers to have direct or indirect impact on teaching process by varying various teaching strategies to meet the needs and interest of the students. Instructional strategy can be regarded as a significant factor in the quest for knowledge; it is the communication link between the teacher, students and the subject [11]. According to [9] for teaching and learning to be effective, the teacher must be skillful in the selection and utilization of appropriate instructional strategies. Instructional strategy occupies a significant position in the quest for knowledge; it is the communication link between the teacher, students and the subject.

Literatures on effects of gender on secondary school student's performance in science (physics inclusive) contain contradictory results. It is the contention of many science educators that education generally is in favour of male as against female. The poor performance physics is no gender exception it cut across both male and female but it is very important to find out the level of failure between male and female so as to proffer adequate solution to it. Effect of gender on school science cannot be overemphasized as observed by [12] that gender difference is characterized by female underrepresentation and underachievement in science [13] concluded that male and female students learn differently from each other. [14] found that male students usually do better in sciences than female students; but in contrary, did not find either gender performing better. [15] concluded that there are paucity of girls and women in science and technology, since the percentage of female students in science and technology is less than their male counterpart. There are so many teaching strategies as there are teachers. In other words, instructional strategies are many and varied. [16] classified teaching strategies into five; they are heuristic, creative, in directive, behavioral, and task analytic strategies. [16], further stated that the first three Heuristic, creature and indirect methods were seen as having the same attributes because the teacher who use them are likely to lay emphasis on the development of self-initiated, self-directed and intrinsic instructional characteristic in the learner

Instructional strategies for teaching science are methods that can be used to deliver a variety of content objectives; or how the content of curriculum of science should be taught. [17] reveal that students centered science instruction tends to have more long terms value than teachers centered instruction. The instructional strategies employed by science teachers probably covers the entire range between direct instruction, teacher-centered approaches, and students centered approaches in which the students take and active role in learning activities and may exercise some control over the nature and decision of the activities. It has been observed that when the teacher uses active or collaborative strategies that are student centred, students think as they learn, activate their prior knowledge and link new concepts to related ones in their schema; hence they tend to be more effective in developing deeper understanding than peers who were taught using the teacher - centred strategies, [18]; [19]). The study tends to look at effectiveness of instructional strategies such as programmed strategy, project strategy and demonstration strategy. Programmed strategy can be expressed as a self based strategy of teaching that entails a process in which the response of the learner is guided by the programmed questions. The primary aim of this strategy is to enhance desirable change in cognitive domain of the learners. [20] opined that programmed strategy is a type of individualized instruction; it is designed in such a way that the learners are assisted through the learning task by either a book or a machine design for that purpose. Programmed instruction also enables students to answer questions about a unit of study at their own rate, checking the own answer and advancing only after answering correctly [21]. Demonstration strategy is often used to support other strategies of teaching. It is usually used by teachers to show case a particular skill or technique, in some cases it could be performed by students either in small groups or individuals. Demonstration strategy is a strategy quite often abused because many teachers use it in place of the more preferred laboratory based method [20]. [22] reveals that project strategy as a child- centered strategy of teaching; which can be employed by science teachers to individualized instructions. Project strategy also requires a bit of originality, for example; students are allowed to look for problems, which are of special interest to them and the solution to the problem, which must be unknown to the students. Since the teachers are the life wire of all the educational enterprises, it is important for teachers to have direct or indirect influence on teaching process by varying various teaching strategies to meet the needs and interest of the students.

II. THEORETICAL FRAMEWORK

Since the primary purpose of teaching at any level of education is to bring a fundamental change in the learner [23], the use of Instructional Strategies in teaching can be traced to the constructivist teaching and learning theory. Therefore, the theory adopted is based on constructivist theory and cognitive learning theory because it involves mental process in which knowledge will be acquired with changes in human behavior.

The constructivist theory emanated from John Dewey, Jean Piaget, Vygotsky and Brunner and the underlying premise is that knowledge is not given but constructed based on the learners' prior knowledge [24].Therefore, children learn best when they are allowed to construct a personal understanding based on their experience of things and reflection on those

experiences. In the constructivist classroom, students work primarily in groups and learning is interactive and dynamic using resources which engage all their senses and using multiple intelligences [19]. This forms the basis for the use of Instructional Strategies in teaching as it is manipulative and appeals to all the senses. The constructivist approaches emphasis social interaction and communication skills, as well as collaboration and exchange of ideas and these have been given a great push by the use of digital communication tools in teaching and learning. Another related theory that supports the use of instructional strategies is the Situated learning theory by in [19], which reinforces the social constructivists theory by Brunner but holds that learning occurs when students participate in activities that are ideally situated in authentic contexts, or those that approximate as closely as possible to the contexts in which the knowledge will later be required.

III. STATEMENT OF THE PROBLEM

Over the years, challenges about the quality of strategy used by teachers in secondary schools especially Physics teachers has been a major concern. The decline in performance of students in physics examinations and enrolment contributed as major challenges to physics educators. This issue has attracted the attention of researchers and science educators. Several factors have been attributed to be responsible for these problems. These include the strategy of instruction used in teaching science (physics inclusive) which does not have positive impact on the academic performance of physics students. According to [19] the strategies used by teachers determine whether learners will be active or passive during teaching and learning process. In most secondary schools' teachers use mainly the chalk and talk strategy which is a teacher centred strategy and the implication is that learners are passive and learning tend to be superficial.

The deteriorating conditions of learners is quite worrisome especially the performance of physics students. physics which happens to be a core course of study that needs to be well understood by the science students because wrong use of strategy for teaching and wrong implementation of physics curriculum by teacher will lead to total failure of the teaching process. Development and adequate preparation of physics students constitutes an important element for quality and efficiency in science. However, enabling physics students to develop the needed knowledge, skills and adequate understanding of physics concepts after completion of senior secondary school examination requires specialist training and attention by the teacher. Researchers strongly relate academic performance of students to strategies used by the teacher [25], [26], [2]. The study therefore consider imperative to use empirical data in investigating the problems associated with programmed, demonstration and projects strategies in teaching physics which may contribute to reduction in students' enrolment, affect scientific growth, and also educational output of our nation

IV. PURPOSE OF THE STUDY

The primary motive of this study is aimed at discovering experimentally the effects of selected instructional strategies, such as Programmed, Demonstration, Project strategies on students' academic performance in secondary school physics in Ekiti State and also to evaluate these strategies on the account of gender and location of the learners.

V. RESEARCH HYPOTHESES

The following hypotheses were generated for the study:

1. There is no significant difference between the pre-test and post-test means scores of students exposed to Demonstration, Project and Programmed strategies of teaching physics.
2. There is no significant difference between performance of students in rural and urban area exposed to Demonstration, Projects and Programmed strategies of teaching physics.
3. There is no significant difference between the performance of male and female students exposed to Demonstration, Projects and Programmed strategies of teaching physics.

VI. SIGNIFICANCE OF THE STUDY

The importance of this study is to engender more interest in the study of physics in secondary school, enhance scientific growth of the nation, help the teacher to know the appropriate strategy to be used and also make stakeholders in curriculum development to organize physics curriculum along side with strategies, so as to allow effective teaching and learning.

VII. METHODOLOGY

The research employed the quasi -experimental design, a non-randomized pre-test and post-test control group design. Four groups were selected, three experimental and one control. The first, second and third groups A B C were chosen as experimental group which were taught with Demonstration, Project and Programmed instructional strategies while the fourth group D that is the control group was taught with traditional chalk and talk Strategy.

Schematically, it can be given as follows:

$O_1\ X_1\ O_2$	Experimental Group A
$O_3\ X_2\ O_4$	Experimental Group B
$O_5\ X_3\ O_6$	Experimental Group C
$O_7\ Xc\ O_8$	Control Group D

From above, O_1, O_3 O_5 O_7 are pre-test and O_2 O_4 O_6O_8 are pre-test are post test while x_1 x_2 x_3 are treatments for experimental group and X_C is the treatment for control group. The samples consisted of 240 SS2 Physics Students (Male and Female) selected from eight Senior Secondary. The multistage random sampling technique was adopted in selecting the needed sample for the study. At the first stage, stratified

random technique was used to select eight Local Government Areas across the three senatorial districts in Ekiti –State. The second stage involved selection of one school from each of the selected Local Government Areas through stratified random sampling techniques putting into consideration the locations (rural and urban) of the schools. The third stage also involved the use of simple random and purposive sampling technique to select 30 students (15 males and 15 females) from each of the eight schools. The students were therefore assigned to experimental and control groups

The research instrument used to collect data for this study was Physics Achievement Test (PAT).The test consisted of 30 objectives questions constructed based on the topics taught during the study, from which the respondents are to choose the correct options. An instructional package of Programmed textbook was also used to facilitate teaching with programmed strategy. The study established the instrument (PAT) on Secondary School students in senior class 2 outside the sample. To obtain the reliability of coefficient of the instrument split half method was adopted. The items were divided into two (odd numbers versus even numbers) the scores obtained from the students were correlated using Pearson Product Moment Correlation Analysis. (PPMCA). To get the half length of the test Spearman-Brown Prophecy Formula was adopted in order to obtain the correlation coefficient for the full length of the test. A value of 0.69 was obtained as the reliability coefficient of the instrument and it was high enough to adjudge the instrument being reliable.

VIII. TESTING OF HYPOTHESES

Hypothesis 1

There is significant differences between in the pre-test and post- test mean scores of students exposed to demonstration, programmed, project and chalk and talk strategies of teaching physics.

TABLE 1**:** Analysis of Covariance Variance (ANCOVA) was applied to analyze the pre-test and post-test mean scores.

Nature of instruction	Sum of Square	Df	Mean square	Fcal	F tab
Corrected Model	8091.522	4	2022.88	139.56	.000
Groups	4281.895	3	1427.298	98.475	2.60
Error	3406.062	235	14.494		
Corrected Total	11497.583	239			
Total	89618.000	240			

From the table 1 above, F cal 98.475 is greater than F tab 2.60.Therefore, the null hypothesis is hereby rejected at α=0.05level of significance, therefore there is a significant difference between the pre-test and post test mean score of students exposed to demonstration, project, programmed and chalk and talk strategies of teaching physics. Since there is a significant difference between in the performance, mean scores of the three strategies, Post-hoc Scheffe's test was used to compare performance mean scores for this significant F. ratio.

TABLE 2: Summary of Post hoc Scheffe's test analysis showing difference in post –test mean scores between Experimental group (Demonstration, Programmed and Project strategies) and control group (chalk and talk strategies).

Strategy	**Mean**	**Programmed**	**Demonstration**	**Project**	**Chalk and Talk**
Program-med	23.15			*	*
Demonstration	22.63			*	*
Project	16.70				*
Chalk and talk	9.68				

Note * Denotes pairs of strategies significantly different at α< 0.05

The data in table 2 above showed that the mean sores of the students in programmed, demonstration, project and chalk and talk strategies of teaching physics were 23.15, 22.63, 16.70 and 9.68 respectively. It showed that the mean score of programmed strategy is significantly higher than the demonstration, project and chalk and talk strategies. Therefore, there is no significant difference between the performance of students exposed to Programmed and Demonstration Strategies of teaching Physics. However, there is a significant difference between the performance of students exposed to programmed, project and Chalk and Talk strategies. This implies that both Programmed and Demonstration strategies are effective in teaching Physics in secondary schools.

Hypothesis 2

There is a significant difference in the performance of students in rural and urban area exposed demonstration, project and programmed strategies of teaching physics.

TABLE 3: Summary of analysis of variance (ANOVA) showing performance of students in rural and urban area exposed to demonstration, project and programmed strategies of teaching physics.

Nature of Instruction	**Sum of square**	**Df**	**Mean score**	**Fcal**	**Ftab**
Corrected model	1621.228	5	324.246	16.829	.000
Groups	1541.478	2	770.739	40.003	.000
Town	70	1	70.939	3.682	3.00
Groups * town	8.811	2	4.406	.229	.796
Error	3352.433	174	19.267		
Corrected total	4973.661	179			
Total	83057.000	180			

Significant at 0.05 α level F cal = 3.682 >f tab= 3.00

The table 3 revealed that F cal 3.682 is greater than P 3.00. The result revealed that there is a significant difference

between the performance of students in rural and urban areas exposed to demonstration, project and programmed strategies of teaching physics. Therefore, the null hypothesis is hereby rejected.

Hypothesis 3

There is no significant difference in the performance of male and female students exposed demonstration, programmed and project instructional strategies of teaching physics.

*TABLE 4:*Summary of 2way ANOVA on the post test Mean Scores of Male and Female Students.

Nature of instruction	Sum of square	Df	Mean square	Fcal	Ftab
Corrected model	1934.224	5	386.849	4.12	.001
Groups	1343.511	2	671.756	7.15	.000
Sex	118.422	1	118.422	1.26	3.00
Groups * sex	472.311	2	236.156	2.516	.084
Errors	16329.533	174	93.848		
Corrected Total	18263.778	179			
Total	104506.00	180			

Significant at 0.05 α level F cal =1.26 <F tab 3.00

The table 4 revealed that the F cal is 1.26 and it is less than F tab which is 3.00. The result revealed that there is no significant difference in the performance of male and female students exposed to demonstration, programmed and project instructional strategies therefore, the null hypothesis is hereby not rejected.

IX DISCUSSIONS

Findings of the study showed that there was a significant difference between the pre test and post -test mean scores of students exposed to Demonstration, Programmed, Project and chalk and talk strategies of teaching, in favour of post test scores. This implies that the three strategies are effective in teaching of physics. The result is in agreement with [27] that there is significant difference between the pre test and posttest mean scores of students exposed to treatment groups and control group. The students performed best in post test than pre test, thus the three strategies are effective in teaching physics. The study also reveals that there was a significant difference between the performances of students in rural and urban areas exposed to Demonstration, Programmed and Project strategies of teaching physics in favour of students in urban areas; this can be attributed to availability of science equipments and qualified teachers as most teachers prefers to work in urban areas, this is in contrary to [28] that there is no significant difference between performance of students in rural and urban areas. Furthermore, the study also shows that there was no significant difference between the performances of male and female students exposed to Demonstration, Programmed and Project strategies of teaching physics. This implies that male and female students performed equally in learning of physics it's in agreement with [29] that there is no significant difference in the performance of male and female secondary school students in sciences(physics inclusive). However, the study is contrary to [30], [31] which opined that male students perform better than female secondary school students in sciences.

X. CONCLUSION

In conclusion, it can be inferred from the study that there was a significant difference in pre test and post test of the performance of students. The students in urban areas are better than their counterparts in the rural areas. It can also be seen that gender has no effects on students' academic performance in physics. It is however recommended that Physics teachers should endeavor to use instructional strategies that are student centered; government should employ more qualified physics teachers and ensure equal distributions of teachers to rural and urban secondary schools. Physics laboratories should be equipped in all the senior secondary schools.

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