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PROBLEM-BASED LEARNING STRATEGY AND SENIOR SECONDARY SCHOOL PHYSICS STUDENTS' ACADEMIC PERFORMANCE IN OBIO AKPOR LOCAL GOVERNMENT AREA OF RIVERS STATE

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ABSTRACT

The study examined Problem-based learning Strategy on senior secondary school two (SS11) physics students' academic performance in Obio Akpor Local Government Area. In line with the aim of the study, four objectives, four research questions and four hypotheses were formulated to guide the study. The study adopted quasi experimental design. The population of the study consists of 240 senior secondary school two (SS11) physics students. Stratified random sampling techniques was used to select a sample size of 110 senior secondary school two (SS11) physics students to represent the entire population. The instrument for data collection was Physics Performance Test (PPT)the instrument was validated by the researcher's supervisor and two other research expects from the department of Curriculum Studies and Instructional Technology, the reliability coefficient of 0.85 was derived using Pearson Product Moment Correlation and regarded to be adequate and acceptable for the study. Mean (x) and standard Deviation (SD) were used to answer the research questions while Analysis of Covariance (ANCOVA) statistics was used to test the hypotheses at 0.05 level of significance. The findings of the study showed that there was a significant difference between the mean achievement scores of SS11 physics students taught using PBLS and those taught using lecture method. Based on the findings, the study recommended that Seminars and workshop should be organized by school administrators and other educational stakeholders on how to use Problem-based learning strategy especially for physics teachers.

Textbook writers should incorporate problem related to the topics in the text for teachers to conduct classroom exercise and for personal evaluation for students.

KEYWORDS: Problem-based, Learning Strategy, Physics Education.

INTRODUCTION

Education is the primary instrument for public development and social change, facilitating the acquisition of knowledge, skills, values, and habits (Abdu-Raheem, 2012). Educational systems equip students with knowledge and skills to contribute meaningfully to societal problem-solving, with classroom learning expected to translate into real-world application (Asuzu & Okoli, 2019).

Nigeria's development, like that of other nations, depends heavily on science and technology, making science education critical. Among science subjects at the secondary school level, physics described as "the soul of science and technology" (Ilo, 2022) governs the laws that determine the structure of the universe in terms of matter and energy (Nnaji, 2021). Its principles form the foundation of technological advancement, making it a key requirement for science-related courses in Nigerian higher institutions. The objectives of teaching physics in senior secondary schools include providing basic literacy, building foundational scientific skills, and stimulating creativity (FRN, 2014). However, these objectives remain largely unrealized, as students' achievement in physics has consistently declined, particularly in WASSCE results (Aina, 2022).

A significant factor behind this poor performance is the adoption of inappropriate teaching methods by science teachers, who tend to favour conventional approaches like lectures and demonstrations over innovative strategies (Aremu, 1999; Jimoh, 2003; Ezeoba, 2010). Problem-Based Learning (PBL) is one such innovative strategy. It is a student-centred, collaborative approach in which students actively engage in solving real-world problems using prior knowledge and independently acquired information (Tarhan & Ayyıldız, 2015). PBL fosters critical thinking, self-directed learning, higher-order reasoning, and interpersonal skills (Azer, 2014; Sungur et al., 2013), and has gained wide acceptance across medical, science, mathematics, and engineering education (Hung, Jonassen, & Liu, 2016). Its effective use has the potential to improve students' academic performance in both teacher-made and standardised assessments such as WAEC, NECO, and NABTEB (Omeodu & Utuh, 2016). Against this backdrop, this study investigates the effect of Problem-Based Learning on senior secondary school physics students' academic performance in Rivers State.

Statement of the Problem

In spite of the perceived significance of material science training in cultivating decisive reasoning, critical thinking abilities, and logical education among senior optional school understudies, there stays a relentless test in regards to the poor scholastic exhibition of understudies in this subject. In Obio Akpor Neighborhood Government Region, comparable worries exist, as proven by the exhibition patterns saw in the Senior School Interior Fake Assessment results as displayed in supplement B.

Conventional educational techniques may not adequately draw in understudies or sufficiently set them up to handle the intricacies of material science ideas in functional settings. This prompts the requirement for investigating elective educational methodologies, for example, Issue Based Learning (PBL), to address the noticed lacks in scholastic accomplishment. Consequently, the essential worry of this exposition is to examine the impact of Issue Put together Learning methodology with respect to the scholastic exhibition of senior optional school material science understudies in Obio Akpor Nearby Government Region, with an emphasis on improving reasonable comprehension, critical thinking skills, and by and large scholarly accomplishment in physical science.

Aim and Objectives of the Study

The aim of this study is to investigate the influence of problem-based learning strategy on senior secondary school physics students' academic performance in Obio Akpor Local Government Area. Specifically, the study sought to:

1. Determine the difference between the mean achievement scores of SS11 Physics students taught using problem-based learning strategy and those taught using lecture method in Obio Akpor Local Government Area of Rivers State.
2. Examine the difference between the mean achievement scores of male and female SS11Physics students taught using problem-based learning strategy in Obio Akpor Local Government Area of Rivers State.

1.4 Research Questions

The following research questions were formulated to guide the study.

1. is there any difference between the mean achievement scores of SS11 Physics students taught using problem-based learning strategy and those taught using lecture method in Obio Akpor Local Government Area?

2. What is the difference between the mean achievement scores of male and female SS11Physicsstudents taught using problem-based learning strategy in Obio Akpor Local Government Area?

1.5 Hypotheses

The following hypotheses were formulated to guide the study

H_{01}: There is no significant difference in the mean performance scores of SS1 Physics students taught using problem-based learning strategy and those taught using lecture method

H_{02}: There is no significant difference in the mean performance of male and female SS11

METHODOLOGY

The study adopted quasi experimental research design. Specifically, the equivalent control design. Ali (2011) stated that in the non-equivalent control group design, the treatment groups and the comparison group were compared using pretest and posttest measures. The design according to Ali (2012) is considered appropriate because it establishes a cause effect relationship between the independent variable (strategies) and the dependent variables (performance). This design was adopted because it was not possible to have a complete randomization of the subjects. These intact classes are experimental and control groups, since it is not possible to disrupt existing classes in a school.

Below is the illustration of the design:

Group.	**Pretest.**	**Treatment.**	**Posttest**
E1.	Q1.	X1.	O2
E2.	Q1.	X2.	O2

Where:

E1 and E2 represents experimental and control groups

O2 and O1 represents pretest and posttest observation in Physics performance test.

X1 and X2 represents treatment.

The population of study consists of 240 senior secondary two (SSll) physics students from two (2) co-educational secondary schools, one (1) private senior secondary school and one (1) single sex senior secondary school located strategically in the area of study.

Name of School	School Type	M	F	Total
Triumphant Latter rain Academy	Private	30	50	80
CSS, Mgbosimini	Co-edu	25	35	60
GGSS, Rumueme	Single sex	-	40	40
CSS Rumuolumeni	Co-edu	21	39	60
Total	**76**	**164**	**240**	

Source: Planning, Research & Statistics Department RSSSSB 2023

The sample for the study consists of One Hundred and Ten (110) senior secondary school physics students. This was derived using stratified random sampling techniques, all physics students in the four selected schools in their intact classes consisting of 110 students which constituted the sample for the study,

Co-Educational	Private school	Single Sex School	Total
50	15	20	85
25			25
			110

The instrument used for data collection was Physics Performance Test (PPT). The instrument has four options ranging from A, B, C, D in a way that only one of the options is correct. It also consists of twenty multiple choice items. Immediately after the administration of the instrument, the researcher scored it by giving each option chosen one mark and any wrong option zero, making a minimum of zero mark and a maximum of 20 marks. The topic that the instrument covers are concept of projectile, The instruments are divided into two sections, section A consist of bio-data of the students while section B consist of 20 items multiple choice questions.

The instrument for this study was subjected to face and content validity. The Physics Performance Test (PPT) was validated by three experts from the department of curriculum and instructional technology, the project supervisor and two other physics teachers from the selected schools for the purpose of appropriateness of expressional standard, language, suitability, arrangement, sequencing and other. For the content validity, a test blue print was constructed and to validate for weighing of sub-topics in accordance with the suggested instructional periods in the instructional objectives and their frequency.

Table of Test Blue Print for the Physics Performance (PPT)

A test blue print on Physics Performance Test for Senior Secondary Two Students (SS 2).

Content	knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	Total
The concepts of scalar	1		1		2		**4 20%**
The concepts of vectors		1	1	2		1	**5 25%**
Resolution of vectors, components	1				1	2	**4 20%**
The concept of projectile motion		1		1		1	**3 15%**
Range, times of light and max. Height	1		1			2	**4 20%**
Total	**3 15%**	**2 10%**	**3 15%**	**3 15%**	**3 15%**	**6 60%**	**20 100%**

(percentage = Total number inn each column or roll x 100/20)

In order to ascertain the reliability of the instruments, the trail testing was used to ascertain the reliability of physics performance test. Copies of the Physics Performances Test were administered to 10 SS II class that is not part of the group under investigation. Scores of the Physics Performance Test (PPT) obtained from Test-retest approach was used to estimate the reliability co-efficient of the instruments using Pearson product moment correlation. The reliability coefficient index of 0.85 was obtained.

The researcher used intact classes for the experimental groups and control group, in the four (4) selected schools. A pre-test was administered to the groups before the commencement of the teaching. The scores obtained from the result were referred to as pre-test scores. The researcher and research assistance taught group A and B for a period of four weeks. The researcher taught group A with lecture method and group B which is the experimental class were taught with problem-based learning method. The administration of the instrument was done by the researcher according to the following steps.

Step I: Pre-test Administration

Pre-test were administered to the experimental and control groups. All the tests and the teaching instruments were administered by the researcher and research assistants.

Step II: Post-test Administration

After treatment, the study groups were served with post-test. The teaching exercise continued until the last lesson, for four weeks. In conclusion of the experiment, all the students in all the group were given a post-test, which yielded the post-test scores that was analyzed.

The data were collected through the pre-test and post-test administered to the senior secondary II physics students and were analyzed using SPSS. Mean and standard deviations were used to answer the research questions while Analysis of Covariance (ANCOVA) statistics were used to test the hypotheses at 0.05 level of significance.

RESULT

Research Question 1: What is the difference between the mean achievements scores of students taught Physics using problem-based learning strategy (PBLS) and those taught using lecture method (LM)

Table 1: Mean Achievement Scores, Standard deviation and mean difference for experimental and control group of SS11 Physics Students taught using Problem-Based Learning Approach (PBLS) and Lecture method. (LM)

Test: Achievement	Pre-test			Post-Test			Mean Difference
Group	N	$\bar{X}$	SD	N	$\bar{X}$	SD	$\bar{X}$
Experimental	70	28.86	8.98	70	70.13	17.40	41.27
Control	40	30.27	9.38	40	50.23	11.89	19.96

Table 1showsthat the students taught Physics using PBLS has pretest mean achievement score of 28.86 and standard deviation of 8.98with posttest mean achievement score of 70.13 with gained mean achievement score of 41.27, while those in the control group taught with lecture method has pretest mean achievement score of 30.27 and posttest mean score of 50.23 with gained mean 19.96.

Students taught Physics using PBLS had less homogeneous scores in their posttest (17.40) than those taught using LM (11.89). The difference between the mean gained achievement scores of the students is 21.32 in favour of PBLS. This reveals that SS11 Physics students taught using PBLS performs better than those taught using lecture method.

Research Question 2: What is the difference between the mean achievement scores of male and female SS11 Physics students taught using problem-based learning strategy?

Table 2: Mean performance score, standard deviation and mean difference of Male and Female SS11 Physics Students taught using PBLS.

Method	Gender	N	Pretest $\bar{X}$	SD	Posttest $\bar{X}$	SD	Mean Difference
PBLS	Male	56	28.20	6.779	74.12	14.245	45.92
PBLS	Female	54 **110**	15.83	5.866	52.22	5.470	21.39

Table 2 showsthat the male Physics students taught using PBLS has pretest mean achievement score of 28.20 and posttest mean achievement score of 74.12 with a mean difference of 45.92 while thefemale Physics students have pretest mean achievement score of 15.83 and posttest mean achievement score of 52.22 with a Mean difference of 21.39. Table 2 also reveals that the male Physics students taught using PBLS performs better than the female counterparts taught using the same PBLS.

Hypothesis

Hypothesis 1: There is no significant difference between the mean achievement scores of students taught Physics using problem-based learning approach (PBLS) and those taught using lecture method (LM).

Table 5: Summary of ANCOVA analysisof difference between the mean difference for experimental and control group of SS11 Physics Students taught using Problem-Based Learning Strategy (PBLS) and Lecture method. (LM)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Decision
Corrected Model	14339.235[a]	4	3584.809	16.180	.000	
Intercept	38303.302	1	38303.302	172.883	.000	
Pretest	.009	1	.009	.000	.995	
Method	11722.483	1	11722.483	52.910	.000	Sig.
Error	27029.820	1	221.556			
Total	519442.000	110				
Corrected Total	41369.055	110				

P-Value at 0.05 level of Significance

Table 5 shows that there is a significant main effect of the treatment on students' achievement in Physics, F (1, 122) = 52.910, P = 0.000 < 0.05. Therefore, the null hypothesis was rejected meaning that there is a significant difference between the mean achievement scores of Physics students taught using problem-based learning approach (PBLS) and those taught using lecture method in favour of PBLS.

Hypothesis 2: There is no significance difference in the mean performance of male and female SS11Physicsstudents taught using problem-based learning strategy

Table 6: Summary of ANCOVA analysis of difference between the achievement scores of male and female SS11 Physics students taught using problem-based learning strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10468.845[a]	2	5234.423	66484.446	.000
Intercept	14898.011	1	14898.011	189225.454	.000
Pre-test	10454.017	1	10454.017	132780.550	.000
Gender	.004	1	.004	.003	.001
Error	21.021	1	.079		
Total	1305084.000	110			
Corrected Total	10489.867	110			

P-Value at 0.05 level of Significance

Table 6 shows that there is a significant main influence of gender on students' achievement in Physics, F (1, 122) = 7.522, P = 0.007 < 0.05. Therefore, the null hypothesis was rejected meaning that there is a significant difference between the mean achievement scores of male and female students taught Physics using PBLS.

DISCUSSION OF FINDINGS

The findings of the study showed that there was a significant difference between the mean achievement scores of physics students taught using PBLS and those taught using lecture method in favour of PBLS. The observed findings of the study are attributed to the fact that PBLS promotes the development of critical thinking skills, problem-solving abilities, and communication skills. It allows a student to demonstrate their capabilities while working independently. It also developed in the students the ability to apply acquired problem skills in the solution to related problems. The adoption of PBLS made the learning materials more understandable and properly integrated with previous knowledge, thereby avoiding rote

learning. Again, getting to solve related problems boosted the student's belief in their ability learn the materials and solve related problems.

Working in groups during problem-based learning developed in student's ability to collaborate, solve problems, think clearly and connect prior knowledge to a problem. The approach helped students develop effective way of learning from one another and communicating their weaknesses where they needed help. Activities carried out with groups of students, typically in a tutorial or presentation setting also served as a motivation for the students to be more actively engaged in the learning process. PBLS also fostered self-directed learning where study search for related questions on what they are taught and evaluate themselves by solving such related questions. They thereafter learn about the ones they could not solve from their group and in the process continue to improve on their academic achievement.

CONCLUSION

In conclusion, the study's findings indicate a significant difference in the mean achievement scores of students taught physics using Problem-Based Learning Strategy (PBLS) compared to those taught using the traditional lecture method, with the lecture method showing superior results. Despite this, PBLS offers numerous educational benefits, including fostering critical thinking, problem-solving abilities, and effective communication skills. It encourages independent learning, enhances the understanding and integration of new material with prior knowledge, and reduces reliance on rote memorization. Furthermore, PBLS enhances students 'confidence in their ability to learn and solve related problems by providing opportunities to tackle real-world issues collaboratively.

Group work within PBLS settings promotes collaboration, clear thinking, and the application of previously acquired knowledge to new problems. This collaborative environment also encourages students to learn from each other and address areas of weakness, thereby fostering a more engaging and active learning process. PBLS also supports self-directed learning, motivating students to seek out additional information and continuously improve their academic performance through peer feedback and self-assessment.

The study's findings align with previous research, such as Jegede and Fatoke (2014) and Anyafulude (2014), which highlighted the effectiveness of problem-based strategies in enhancing student achievement. Additionally, the study found a significant gender influence on student achievement, favoring female students, although no significant interaction effect between gender and teaching method was observed. This gender difference may stem from

societal biases and stereotypes regarding the perception of science subjects like physics, while the lecture method demonstrated higher mean achievement scores, PBLS's holistic benefits in developing essential academic and life skills suggest its value in educational settings. Future research could explore ways to optimize PBLS to enhance its effectiveness further, potentially leading to improved student outcomes across diverse demographics.

RECOMMENDATIONS

Based on the findings of the study and the conclusion, the following recommendations are made:

1. Seminars and workshop should be organized by school administrators and other educational stakeholders on how to use Problem-based learning strategy especially for teaching physics.
2. Textbook writers should incorporate problems related to the topics in the text for teachers to conduct classroom exercise and for personal evaluation for students.

REFERENCES

1. Abu, Y.P. (2021). Gender and assessment of physics students' academic performance in secondary school SS3 in Olamaboro local government area of Kogi state. AJSTME, 6(2); 1-9.
2. Aina, J.K. (2022). Analysis of gender performance in physics in Colleges of Education, Nigeria. *https://www.researchgate.net/publication/263651908_Analysis_of_Gender_*
3. Akachukwu, E.E. & Okoli, J.N. (2021). Effects of interpretation construction based instructional strategy on students' achievement in ecological concepts in Onitsha education zone. *International Journal of Education and Evaluation*, 7(1); 10-18.
4. Aloa, A.A. (2010). Gender and academic performance of college physics students: A case study of department of physics/computer science education, Federal College of Education (Technical) Omoku, Nigeria. *Journal of Research in Education and Society*, 1(1); 129-138.
5. Anyafulude, J. (2014). Effect of problem-based learning strategy on students' achievement in senior secondary schools chemistry in Enugu State. IOSR *Journal of Research & Method in Education (IOSR-JRME)*, 4(3); 27-31.
6. Asuzu, I.J. & Okoli, J.N. (2019) Effect of multimedia integrated instruction and demonstration on secondary school students' achievement in ecological concepts in Udi education zone. *Unizik Journal of STEM Education,* 3(1); 179-191.
7. Barasa, J.O., Changeiywo, J. & Okere, M.I.O. (2015). Influence of gender on physics students' achievement in secondary schools *Journal of Research in Education and Society*, 2(1); 29-38.

8. Efendioglu, A. (2015). Problem-based learning environment in basic computer course: preservice teachers' achievement and key and key factors of learning. *Journal of International Education Research*, 3(1); 205-216.
9. Ejej, C.I. & Akudolu, L.R. (2021). Discovery learning and problem-based instructional approaches:Effect on secondary school students' interest in Biology. *International Journal of Research and Scientific Innovation*, (IJRSI), 8(5); 1-7.
10. Emerhiona, F., Ajaja, O. P., Pius, P. O., Nwanze, A. C. & Izuegbuna, A. G. (2018). Effects of problem and discovery-based instructional strategies on students' academic achievement inchemistry. *International Journal of Innovative Research and Advanced Studies (IJIRAS)*, 5(6); 209-214.
11. Ilo, U.C. (2022). Effect of blended learning instructural strategy on secondary school students' academic achievement in physics. *International Journal of Research Publication and Review*, 2(22); 34-41.
12. Jegede, S. A. & Fatoke, A. O. (2014).The effects of problem-based instructional strategy, three modes of instruction and gender on learning outcomes in chemistry. *Journal of Education and practice,* 5(23); 23-29.
13. Konyefa, B.I. & Okigbo, E.C. (2021). Effect of ethnochemistry instructional approach on secondary school students' interest in chemistry in Bayelsa state. IOSR *Journal of Research and Method in Education*, 11(5); 12-19.
14. Nekang, F. N. (2013). Effect of rusbult's problem solving strategy on secondary school students' achievement in Trigonometry. *Journal of Mathematics Education*, 6(1); 38-55.
15. Nilson, L.B. (2016). Teaching at its best: A research-based resource for college instructors. New York: John Wiley & sons.
16. Nnaji, I.J. (2021). Relationship between self-regulated learning strategies and academic achievement of physics students in secondary school in Enugu state. Unpublished Masters Thesis, Nnamdi Azikiwe University, Awak.
17. Santyasa, I.W., SukraWarpala, I.W. & Sudama, I.K. (2018). The power of group investigation model on student's critical thinking, attitude and character in learing physics. Advances in Social Science, Education and Humanities Research, 274, 101106.
18. Tracey, D.H. & Morrow, L.M. (2017). Lenses on reading: an introduction to theories and models. New York: Guilford Press.
19. Udegbe, S. I. & Okoli, J.N. (2022). Self-efficacy, study habit and attribution style as predictors of senior secondary school students' achievement in biology in Ogidi education zone. *African Journal of Science, Technology and Mathematics Education*, 8(1), 91-98.