



Effect of Team-Pair-Solo Instructional Strategy on Students' Academic Performance in Physics Concept in Zaria Education Zone Kaduna State, Nigeria

¹Uwaisu M. Uwais, ²Musa Lukman, ³Lukman Samaila

^{1&2}Department Of Physics, Faculty Of Sciences And Science Education, Federal University Of Education, Zaria

³Department Of Physics, Federal University, Dutsin-Ma

ABSTRACT

This study investigated the effect of Team-Pair-Solo (TPS) instructional strategy on students' academic performance in Physics concepts in Zaria Education Zone, Kaduna State, Nigeria. The study was guided by two research questions and two null hypotheses tested at 0.05 level of significance. The study adopted a quasi-experimental research design, specifically the pre-test, post-test non-equivalent control group design. The population of the study comprised all Senior Secondary School II (SSS II) Physics students in public secondary schools in Zaria Education Zone. A sample of 123 SSS II Physics students was selected from two schools using multi-stage sampling technique. The experimental group consisting of 63 students was taught selected Physics concepts using Team-Pair-Solo instructional strategy, while the control group of 60 students was taught using the conventional lecture method for a period of six weeks. The instrument used for data collection was a 30-item Physics Performance Test (PPT) developed by the researcher based on the SSS II Physics syllabus. The instrument was validated by experts and a reliability coefficient of 0.82 was established using Kuder-Richardson formula 20. The PPT was administered as pre-test and post-test to both groups. Data collected were analysed using Mean, Standard Deviation and Analysis of Covariance (ANCOVA). The findings of the study revealed that students taught using Team-Pair-Solo instructional strategy performed significantly better in Physics concepts than those taught using conventional lecture method. The study also found no significant difference in the academic performance of male and female students taught using Team-Pair-Solo instructional strategy. Based on the findings, it was concluded that Team-Pair-Solo instructional strategy is effective in improving students' academic performance in Physics concepts and is gender friendly. It was recommended that Physics teachers should adopt Team-Pair-Solo instructional strategy, and that the Kaduna State Ministry of Education should organize workshops to train teachers on the use of cooperative learning strategies.

ARTICLE INFO

Article History

Received: February, 2026

Received in revised form: March, 2026

Accepted: May, 2026

Published online: June, 2026

KEYWORDS

Team-Pair-Solo, Instructional Strategy, Academic Performance, Physics Concepts, Gender

INTRODUCTION

Physics is one of the core science subjects in the Nigerian secondary school curriculum. It is fundamental to technological and industrial development of any nation (Federal

Republic of Nigeria (FRN), 2013). The concepts of Physics such as force, motion, energy, electricity and waves form the basis for engineering, medicine, and other applied sciences. Consequently, the performance of students in

Corresponding author: Uwaisu M. Uwais

muhduwais84@gmail.com

Department of Physics, Faculty of Sciences and Science Education, Federal University of Education, Zaria.

© 2026. Faculty of Technology Education. ATBU Bauchi. All rights reserved



Physics is often used as a yardstick for measuring the scientific and technological advancement of a country. Despite the importance of Physics, students' academic performance in the subject at both internal and external examinations in Nigeria has remained consistently poor over the years. Reports from the West African Examinations Council (WAEC) (2020-2025) Chief Examiners' Report indicated that students performed poorly in Physics, with particular weakness in the understanding and application of Physics concepts to solve problems. The report further attributed this poor performance to ineffective teaching methods, students' lack of interest, and inability to relate Physics concepts to real life situations.

In Zaria Education Zone of Kaduna State, the situation is not different. Teachers and education stakeholders have observed that many Senior Secondary School students develop negative attitude toward Physics and perceive it as abstract and difficult. This perception has led to low enrolment, poor participation in class, and consequently poor academic performance in Physics (Sani, 2022). One of the factors identified in literature as influencing students' academic performance is the instructional strategy adopted by the teacher (Adeleke, 2019).

Conventional instructional strategies such as lecture method, which is teacher-centred, dominate Physics classrooms in Nigeria. This method places the teacher as the sole source of knowledge while students remain passive listeners. Such an approach does not encourage interaction, collaboration, or critical thinking among students (Yusuf, 2020). In response to the limitations of conventional methods, educators have advocated for the use of cooperative and collaborative instructional strategies. One of such strategies is the Team-Pair-Solo (TPS) instructional strategy.

Team-Pair-Solo is a three-phase cooperative learning strategy developed to promote students' participation, peer learning, and independent problem-solving skills (Bruner, 1966). In the Team phase, students work in small groups to solve problems and share ideas. In the Pair phase, students work with a partner to

compare solutions and explain concepts to each other. In the Solo phase, students work independently to demonstrate their understanding without assistance. This strategy is rooted in Bruner's theory of instruction and Vygotsky's social constructivism, which emphasize the role of social interaction in learning (Bruner, 1966).

Studies have shown that Team-Pair-Solo instructional strategy can improve students' academic performance, retention, and interest in subjects like Mathematics and Basic Science (Musa, 2017; Olorode, 2018). However, there is paucity of empirical research on the effect of Team-Pair-Solo instructional strategy on students' academic performance in Physics concepts, particularly in Zaria Education Zone. It is against this background that this study seeks to investigate the effect of Team-Pair-Solo instructional strategy on students' academic performance in Physics concepts in Zaria Education Zone, Kaduna State, Nigeria.

Academic performance refers to the extent to which a student, teacher or institution has achieved their educational goals. It is commonly measured through examinations, class tests, assignments and continuous assessment (Adeleke, 2019). In Physics, academic performance reflects students' ability to understand concepts, apply principles to solve problems, and interpret scientific phenomena. Poor academic performance in Physics has been linked to abstract nature of the subject, poor teaching methods, and lack of instructional materials (WAEC, 2025).

Physics concepts are the fundamental ideas and principles that explain natural phenomena. At the Senior Secondary School level, key concepts include force, motion, work, energy, power, electricity, and waves (FRN, 2013). Mastery of these concepts is important because they form the foundation for engineering, technology and other applied sciences. However, students often find Physics concepts difficult due to their mathematical nature and lack of practical application (Sani, 2022).

Gender is a social and cultural construct that distinguishes between male and female roles in society (WHO, 2020). It goes beyond biological



differences to include expectations, norms, and behaviours associated with being male or female. In education, gender has been identified as one of the variables that may influence students' learning outcomes, particularly in science subjects like Physics (Olorode, 2018). Historically, Physics has been perceived as a "male-dominated" subject, and this perception has affected the interest and performance of female students (Yusuf, 2020).

Some studies have reported that male students outperform females in Physics, while other studies found no significant gender difference when learner-centred strategies are used (Adeleke, 2019). Team-Pair-Solo instructional strategy provides equal opportunity for both male and female students to interact, explain ideas to peers, and build confidence before working independently. This makes it important to investigate whether gender has any effect on students' performance when taught using TPS. Hence, gender is included as a moderating variable in this study.

STATEMENT OF THE PROBLEM

The persistent poor academic performance of secondary school students in Physics in Nigeria and specifically in Zaria Education Zone has become a source of concern to educators, parents, and government. Despite various curriculum reforms and teacher training programs, students continue to perform below average in Physics, especially in topics that require conceptual understanding and problem-solving skills. Preliminary observations and WAEC (2020-2025) results in Zaria Education Zone reveal that a large proportion of students score low grades in Physics. This has been attributed to the continued use of teacher-centred lecture methods which do not engage students actively in the learning process.

Students are rarely given opportunity to discuss, collaborate, or solve problems independently, which are essential skills for mastering Physics concepts. While Team-Pair-Solo instructional strategy has been found effective in improving performance in other subjects, its effect on students' academic performance in Physics concepts in Zaria

Education Zone has not been adequately investigated. Therefore, there is a need to determine whether the adoption of Team-Pair-Solo instructional strategy could lead to improved academic performance of students in Physics concepts in Zaria Education Zone, Kaduna State, Nigeria. This is the problem this study intends to address.

Objectives of the Study

The main purpose of this study is to determine the effect of Team-Pair-Solo instructional strategy on students' academic performance in Physics concepts in Zaria Education Zone, Kaduna State, Nigeria. Specifically, the study seeks to:

1. Determine the effect of Team-Pair-Solo instructional strategy on students' academic performance in Physics concepts.
2. Compare the academic performance of male and female students taught Physics concepts using Team-Pair-Solo instructional strategy.

Research Questions

The following research questions guided the study:

1. What is the effect of Team-Pair-Solo instructional strategy on students' academic performance in Physics concepts?
2. What is the difference in the academic performance of male and female students taught Physics concepts using Team-Pair-Solo instructional strategy?

Null Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

- H₀₁:** There is no significant difference in the academic performance of students taught Physics concepts using Team-Pair-Solo instructional strategy and those taught using conventional lecture method.
- H₀₂:** There is no significant difference in the academic performance of male and female students taught Physics concepts using



Team-Pair-Solo instructional strategy in Kaduna State.

Finally, the study would add to the existing body of literature on cooperative learning strategies in Nigeria. This study is delimited to Senior Secondary School II Physics students in public secondary schools in Zaria Education Zone, Kaduna State, Nigeria. The study will focus on selected Physics concepts in Mechanics and Electricity. The effect of Team-Pair-Solo instructional strategy will be examined in terms of students' academic performance using a Physics Performance Test.

Theoretical Framework

Bruner's Theory of Instruction: Jerome Bruner (1966) proposed that learning occurs best when students are actively involved in constructing knowledge. He identified three stages of representation: enactive, iconic, and symbolic. Team-Pair-Solo aligns with this theory because students first manipulate ideas in groups enactive, then discuss with a partner iconic, and finally represent knowledge independently symbolic and

Vygotsky's Social Constructivism Theory: Lev Vygotsky (1978) emphasized the role of social interaction in cognitive development. According to Vygotsky, learning occurs within the "Zone of Proximal Development" where students can achieve more with peer guidance than alone. The Team and Pair stages of TPS provide this peer scaffolding before students move to Solo work.

Several studies have investigated the effect of cooperative learning strategies on students' academic performance. Musa (2017) examined the effect of cooperative learning on Mathematics achievement of secondary school students in Kaduna State. The study found that students taught with cooperative strategies performed significantly better than those taught with lecture method. The study also reported that both male and female students benefited equally. Olorode (2018) investigated the effect of cooperative learning on Basic Science achievement in Oyo State. Results showed that

students in the cooperative group had higher post-test scores and better retention than the control group. The author concluded that cooperative learning promotes active participation. Adeleke (2019) compared lecture method and collaborative learning in Physics in Lagos State. The findings revealed that students taught with collaborative strategies had better conceptual understanding and problem-solving skills. Gender was not a significant factor in performance. However, few studies have specifically examined Team-Pair-Solo in Physics in Northern Nigeria. Sani (2022) recommended that more research should be done on student-centred strategies in Zaria Education Zone due to persistent poor performance in Physics.

The literature reviewed shows that academic performance in Physics in Nigeria is generally poor due to instructional and attitudinal factors. Team-Pair-Solo instructional strategy is a cooperative learning approach grounded in Bruner and Vygotsky's theories. Empirical evidence from Mathematics and Basic Science suggests that cooperative strategies improve students' performance. However, there is a gap in literature regarding the effect of Team-Pair-Solo specifically on Physics concepts in Zaria Education Zone. This study therefore seeks to fill this gap by investigating the effect of Team-Pair-Solo instructional strategy on students' academic performance in Physics concepts in the study area.

METHODOLOGY

The study adopted a quasi-experimental research design, specifically the pre-test, post-test non-equivalent control group design. This design was considered appropriate because the study aimed to determine the effect of Team-Pair-Solo instructional strategy on students' academic performance in Physics concepts. The design involved two groups: an experimental group taught using Team-Pair-Solo instructional strategy and a control group taught using conventional lecture method. Both groups were given a pre-test before treatment and a post-test after treatment. The population of this study consisted of all Senior Secondary School II (SSS



II) Physics students in public secondary schools in Zaria Education Zone, Kaduna State, Nigeria. According to the Kaduna State Ministry of Education (2025), there are 87 public secondary schools in Zaria Education Zone with a total of 4,620 SSS II Physics students.

The sample for this study comprised 123 SSS II Physics students drawn from two public secondary schools in Zaria Education Zone. A multi-stage sampling technique was used in the selection process. One intact class of SSS II Physics was selected from each school. Two schools were assigned to the experimental group and one to the control group. The sample size of 123 was considered adequate for a quasi-experimental study (Fraenkel & Wallen, 2019). The instrument used for data collection was the Physics Performance Test (PPT).

The PPT was developed by the researcher based on the SSS II Physics syllabus. It consisted of 30 multiple-choice objective questions drawn from two topics: Mechanics and Electricity. Each correct answer attracted 1 mark, giving a total of 30 marks. The PPT was used as both pre-test and post-test. Different but equivalent forms were used to avoid test-wise effect. Face and content validity of the PPT was established by three experts of which two Physics educators from Ahmadu Bello University, Zaria and one experienced SSS II Physics teacher. The experts assessed the items in terms of clarity, relevance to the syllabus, and coverage of content. Their corrections and suggestions were incorporated to produce the final version of the instrument.

The reliability of the PPT was determined using a trial test. The instrument was administered to 30 SSS II Physics students in a school outside the study area but with similar characteristics. The data obtained was analysed using Kuder-Richardson formula 20 (KR-20) because the items were dichotomously scored. A

reliability coefficient of 0.82 was obtained, which indicated that the instrument was reliable for the study. The study lasted for six weeks. Before the commencement of treatment, the PPT was administered to both groups as pre-test. For the Experimental Group: Students were taught selected Physics concepts using Team-Pair-Solo instructional strategy. Lessons followed the three stages:

Stage 1: Team: Students in groups of 4 discussed and solved problems together.

Step 2: Pair: Students worked with a partner to compare answers and explain to each other.

Stage 3: Solo: Students solved problems individually without assistance.

For the Control Group: Students were taught the same concepts using the conventional lecture method. The teacher explained concepts while students listened and took notes. At the end of the six weeks, the post-test was administered to both groups. Data were collected by the researcher with the help of research assistants who were regular Physics teachers in the selected schools. The assistants were trained for two days on how to administer the PPT and implement the treatment faithfully. The pre-test and post-test scripts were collected, marked and scored by the researcher. The research questions were answered using descriptive statistic of Mean and Standard Deviation while inferential statistic of Analysis of Covariance (ANCOVA) was to test the null hypotheses at 0.05 level of significance. ANCOVA was used to control for initial differences by using pre-test scores as covariate. All analyses were done using SPSS version 26.

RESULTS

Research Question One

What is the effect of Team-Pair-Solo instructional strategy on students' academic performance in Physics concepts?

Table 1: Mean and Standard Deviation on Students Performance Taught Physics Concept Using Team-Pair-Solo Instructional Strategy and Conventional method

Groups	Test	N	Mean	St. Div.
Experimental	Pre-test	63	15.70	6.44
	Post-test	63	24.92	2.34

Corresponding author: Uwaisu M. Uwais

muhduwais84@gmail.com

Department of Physics, Faculty of Sciences and Science Education, Federal University of Education, Zaria.

© 2026. Faculty of Technology Education. ATBU Bauchi. All rights reserved



Groups	Test	N	Mean	St. Div.
Control	Pre-test	60	13.83	6.23
	Post-test	60	14.45	4.92

Table 4.1 shows that, the pre-test and post-test mean and standard deviation of mean performance scores of students taught physics concept using Team-Pair-Solo Strategy are (N= 63, Mean = 15.70, Std. Div. = 6.44) and (N= 63, Mean = 24.92, Std. Div. = 2.34) the pre-test and post-test mean and standard deviation of students' performance scores of students' taught physics concept using conventional method are (N= 60,

Mean = 13.83, Std. Div. = 6.23) and (N= 60, Mean = 14.45, Std. Div. = 4.92) respectively.

Null Hypothesis One:

There is no significant difference in the mean performance scores of students taught physics concepts using Team-Pair-Solo Strategy and those taught using conventional method.

Table 2: Result of ANCOVA Analysis on Students Performance Scores of Experimental and Control Groups

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4929.490 ^a	2	2464.745	182.657	.000
Intercept	5678.871	1	5678.871	420.850	.000
PRETEST	150.196	1	150.196	11.131	.001
METHODS	4689.552	1	4689.552	347.534	.000
Error	1619.257	120	13.494		
Total	50195.000	123			
Corrected Total	6548.748	122			

Table 2 showed that, there is significance different between the means performance scores of students when exposed to TPS strategy and Conventional method. The value of $F(1,120) = 347.534$ is obtained with associate exact probability value of 0.000. Since the associated probability value is less than alpha value of 0.05 level of significance. Therefore, for p-value observed is less then alpha value, it

means the difference is significant. Therefore, the null hypothesis one is hereby rejected.

Research Question Two:

What is the difference in the academic performance of male and female students taught Physics concepts using Team-Pair-Solo instructional strategy?

Table 3: Mean and Standard Deviation on Performance Scores of Male and Female Students Taught Team-Pair-Solo Instructional Strategy

Gender	Type of Test	N	Mean	Std. Div
Male	Pre-test	32	15.69	6.09
	Post-test	32	24.94	2.35
Female	Pre-test	31	16.01	6.73
	Post-test	31	24.92	2.36

Table 3 shows the results of pre-test and post-test mean performance scores and standard deviation of male students' taught physics concepts using Team-Pair-solo Strategy

are (N = 32, Mean = 15.69, Std. Div. = 6.09) and (N = 32, Mean = 24.94, Std. Div. = 2.35), while pre-test and post-test mean performance scores and standard deviation of female students' taught

Corresponding author: Uwaisu M. Uwais

muhduwais84@gmail.com

Department of Physics, Faculty of Sciences and Science Education, Federal University of Education, Zaria.

© 2026. Faculty of Technology Education. ATBU Bauchi. All rights reserved



physics concepts using TPS Strategy are ($N = 31$, Mean = 16.02, Std. Div. = 6.73) and ($N = 31$, Mean = 24.92, Std. Div. = 2.36) respectively.

Null Hypothesis Three:

There is no significant difference in the mean performance scores of male and female students taught physics concepts using TPS Strategy.

Table 4: Result of ANCOVA Analysis on Performance Scores of Male and Female Students Taught using TPS Strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	31.565 ^a	2	15.782	3.084	.053
Intercept	7696.183	1	7696.183	1503.952	.000
PRETEST	31.546	1	31.546	6.165	.016
GENDER	.812	1	.812	.159	.692
Error	307.038	60	5.117		
Total	39464.000	63			
Corrected Total	338.603	62			

Table 4 showed that, there is no significance different on the means performance scores of male and female students taught physics concepts TPS Strategy. The value of $F_{(1,60)} = .159$ is obtained with associate exact probability value of 0.692. Since the associated probability value is greater than alpha value of 0.05 level of significance. Then, the p-value observed is greater than alpha value it means the difference is not significant. Therefore, the null hypothesis two is hereby retained.

DISCUSSION OF FINDINGS

The findings of this study revealed that, Students taught using Team-Pair-Solo instructional strategy performed better in Physics concepts than those taught using conventional lecture method. This finding agrees with Musa (2017) and Olorode (2018) who reported that cooperative learning strategies enhance students' academic performance. The improvement may be due to the interactive nature of TPS which allows peer explanation and independent practice. Although students taught with lecture method also improved, the gain was lower. This supports Yusuf (2020) who stated that lecture method promotes passive learning. Gender Difference:

The study found no significant difference in the performance of male and female students taught with Team-Pair-Solo. This is in line with Adeleke (2019) who found that

cooperative learning benefits both genders equally. In conclusion, Team-Pair-Solo instructional strategy is effective in improving students' academic performance in Physics concepts in Zaria Education Zone.

Summary

This study investigated the effect of Team-Pair-Solo instructional strategy on students' academic performance in Physics concepts in Zaria Education Zone, Kaduna State, Nigeria. The findings revealed that Team-Pair-Solo instructional strategy significantly improved students' academic performance in Physics concepts compared to conventional lecture method. The strategy was also found to be effective for both male and female students. It was therefore recommended that Physics teachers should adopt Team-Pair-Solo instructional strategy in teaching Physics to enhance students' performance.

Major Findings of the Study

Students taught using Team-Pair-Solo instructional strategy had higher mean gain in academic performance in Physics concepts than those taught using conventional lecture method. There was a significant difference in the academic performance of students taught Physics concepts using Team-Pair-Solo instructional strategy and those taught using conventional lecture method in

Corresponding author: Uwaisu M. Uwais

muhduwais84@gmail.com

Department of Physics, Faculty of Sciences and Science Education, Federal University of Education, Zaria.

© 2026. Faculty of Technology Education. ATBU Bauchi. All rights reserved



Favor of Team-Pair-Solo group. There was no significant difference in the academic performance of male and female students taught Physics concepts using Team-Pair-Solo instructional strategy.

CONCLUSION

Based on the findings of this study, it was concluded that, Team-Pair-Solo instructional strategy is an effective instructional strategy for teaching Physics concepts in Senior Secondary Schools in Zaria Education Zone. The use of Team-Pair-Solo instructional strategy leads to better academic performance of students in Physics than the conventional lecture method. Team-Pair-Solo instructional strategy is gender friendly as both male and female students benefited equally from its use. Therefore, Team-Pair-Solo instructional strategy should be adopted by Physics teachers to enhance students' understanding and performance in Physics concepts.

RECOMMENDATIONS

Based on the findings and conclusion of this study, the following recommendations are made Physics teachers in secondary schools should adopt Team-Pair-Solo instructional strategy in teaching Physics concepts. This will make students active participants and improve their performance.

1. The Kaduna State Ministry of Education and Zaria Education Zone should organize workshops and seminars to train Physics teachers on the use of Team-Pair-Solo and other cooperative learning strategies.
2. Curriculum planners and textbook authors should incorporate cooperative learning activities like Team-Pair-Solo into the Physics curriculum and textbooks.
3. School principals should encourage teachers to move away from teacher-centred lecture method and adopt student-centred methods. They should also provide necessary materials to support group work.
4. Parents and PTA should support the use of innovative teaching strategies in schools by

providing resources needed for group activities.

REFERENCES

- Adeleke, M. A. (2019). Effect of instructional strategies on students' academic performance in science subjects. *Journal of Educational Research and Development*, 12(2), 45-52.
- Bruner, J. S. (1966). *Toward a theory of instruction*. Harvard University Press.
- Federal Republic of Nigeria. (2013). *National policy on education* (6th ed.). NERDC Press.
- Fraenkel, J. R., & Wallen, N. E. (2019). *How to design and evaluate research in education* (10th ed.). McGraw-Hill Education.
- Kaduna State Ministry of Education. (2024). *Annual school census report*. Kaduna State Government Press.
- Musa, A. (2017). Effect of cooperative learning strategies on students' performance in Mathematics. *ABACUS: The Journal of the Mathematical Association of Nigeria*, 42(1), 112-118.
- Olorode, O. (2018). Cooperative learning and students' achievement in Basic Science. *Journal of Curriculum and Instruction*, 15(3), 67-74.
- Sani, R. (2022). Students' attitude and performance in Physics in Kaduna State secondary schools. *Katsina Journal of Education*, 5(2), 89-95.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- West African Examinations Council. (2019-2025). *Chief examiners' report on West African Senior School Certificate Examination*. WAEC Press.
- Yusuf, H. (2020). Lecture method and students' achievement in Physics. *Kaduna Journal of Educational Research*, 10(1), 34-41.
- Zaria Education Zone Quality Assurance Unit. (2023). *Report on students' academic performance in SSCE*. Kaduna State Ministry of Education.