



**EFFECT OF THINK-PAIR-SHARE INSTRUCTIONAL STRATEGY ON STUDENTS'
ACADEMIC PERFORMANCE IN CHEMICAL EQUILIBRIUM IN KARU
TOWNSHIP, NASARAWA STATE, NIGERIA**

Simon Achadu Ogbole

Department of Science, Technical and Mathematics Education (STME), Nasarawa State
University, Keffi.

Corresponding Author's Email: Sainsimon4real@yahoo.co.uk

Abstract

This study investigated that effect of Think-Pair-Share (TPS) instructional strategy on students' academic performance in chemical equilibrium in Karu Township, Nasarawa State. Two research questions and two null hypotheses guided the study. The study adopted a quasi-experimental design, specifically the non-equivalent, non-randomized, pre-test/post-test control group type. The population of the study comprised 1220 (710 males and 510 females) Senior Secondary II students in the 39 public schools that offered Chemistry in Karu township of Nasarawa State. The sample consisted of 76 (41 males and 35 females) students offering Chemistry. The study employed a multi-stage sampling procedure to select participants. Chemical Equilibrium Achievement Test (CEAT) questions adapted from past WAEC questions were used to collect data. The validated CEAT was tested for internal consistency using the Kuder-Richardson 20 (KR-20) formula, resulting in a coefficient of 0.74. Teaching of chemical equilibrium was done in the two intact classes by trained research assistants. The research questions were answered using descriptive statistics of mean and standard deviation, while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. The study revealed that students taught chemical equilibrium using the TPS instructional strategy performed significantly better than those taught using discussion method [$F(1,86) = 378.480$; $p = 0.000 < 0.05$]. However, there was no significant difference in the performance of male and female students taught with the TPS strategy [$F(1,33) = 1.069$; $p = 0.309 > 0.05$]. It was recommended among others that Chemistry teachers should use the TPS strategy to improve students' understanding and academic performance.

Key words: Think-pair-share, chemical equilibrium, instructional strategy, academic performance and gender.

Introduction

Chemistry is a field of science centered on the formation, characteristics, production, and practical applications of matter. According to Mills (2023), Chemistry

involves the study of matter and the transformations it undergoes, including the movement of energy during such changes. Chemistry significantly impacts human life through advancements in electronics,

construction materials, medicine and energy sources. Lumba (2020) categorized Chemistry into several branches, including Biochemistry, Geochemistry, Organic Chemistry, Physical Chemistry, Industrial Chemistry, Earth and Space Chemistry, Inorganic Chemistry, and Medicinal Chemistry. The core objective of teaching Chemistry in schools is to develop individuals capable of identifying and analyzing problems, drawing inferences, applying acquired knowledge and skills to solve real-world challenges (Obialor & Chukwuagu, 2020). However, achieving these goals is often hindered by teacher-related issues, such as ineffective teaching methods resulting in students' underperformance (Sagiru, 2015).

Students' academic performance is vital to national development. According to Nja, Cornelius-Ukpepi, Edoho, and Neji (2020), performance is typically assessed through internal and external examinations, continuous assessments such as tests, assignments, projects, debates, practical and term papers. Ogbaji, Achor, and Chianson (2022) define academic performance as the ability of students to learn, retain, and communicate knowledge effectively, either in written or oral form. Despite its importance, Chemistry remains a challenging subject for many students at the senior secondary level. Poor performance has been consistently reported in both internal and public assessments (WAEC, 2020–2023). The West African Examinations Council (WAEC, 2020-2023) Chief Examiners have attributed this to several difficult topics in Chemistry, including electrolysis, redox reactions, chemical kinetics, and chemical equilibrium.

Multiple studies (Obialor & Chukwuagwu, 2022; Ezeanya & Egbutu, 2023) have attributed this poor performance to various factors, including a weak foundational understanding, incomplete

syllabus coverage, unfamiliar exam formats, poor study habits, lack of motivation, psychological and emotional challenges, shortage of qualified teachers, inadequate instructional resources, negative student attitudes, and ineffective teaching strategies. Additional challenges such as weak mathematical skills, limited practice, and difficulty with laboratory tools and chemical calculations further hinder students' understanding, especially in topics like chemical equilibrium. Furthermore, Mitchell, Hampton and Mambwe (2022) identified shortage of qualified teachers, limited teaching resources, students' negative attitudes and ineffective teaching methods as some of the factors responsible for underdevelopment in Chemistry.

To address these challenges, Chemistry teachers must adopt more effective instructional strategies. Achor, Ejeh, and Odaudu (2018) noted that over-reliance on traditional teaching methods, such as whole-class discussion, often limits student engagement and understanding. These methods can lead to passive learning, rote memorization, and unequal participation during lessons. As an alternative, innovative strategies like the Think-Pair-Share (TPS) instructional strategy could improve academic outcomes. Originally developed by Lyman in 1981, Gillies (2016) view the Think-Pair-Share as a cooperative learning strategy that structures classroom activity into three phases: individual thinking, paired discussion, and whole-class sharing. It encourages students to reflect individually on a problem, share ideas with a partner, and then present their findings to a larger group. This process fosters deeper understanding through collaborative reasoning and active participation (Achor, Chianson-Akaa, & Ogbaji, 2022). The strategy promotes personal engagement with content, reduces bias, and facilitates the development of critical thinking and communication skills

(Akanmu, 2019). Moreover, TPS strengthens students' ability to recall information, supports collaborative learning, and enhances classroom interaction. By increasing "wait time" for thinking and peer discussion, TPS helps students explore a wider range of ideas and refine their responses. This could encourage equitable participation, interest and performance across different student groups irrespective of gender.

Gender is another critical factor in science education. It is a socio-cultural construct that distinguishes the roles, expectations, and behaviors of males and females in society (Ayua & Eriba, 2023). Gender-related issues in science learning have been widely studied (Nworgu & Eke, 2020; Okwo & Otuba, 2018). Brown and Soinyo (2019) and Okeke and Dikeocha (2022) reported no significant gender-based difference in academic achievement among students. However, Abuh (2021) found significant impact of gender on the mean performance scores of students in science. Yet there is limited research specifically examining how gender influences performance in Chemistry, particularly in complex topics like chemical equilibrium in the study area. In light of these concerns, this study examined the effect of the think-pair-share instructional strategy on students' academic performance in chemical equilibrium in Karu Township, Nasarawa State, Nigeria.

Statement of the Problem

Chemistry is a vital science subject that equips learners with problem-solving skills and prepares them for real-life challenges. Despite its importance, students' performance in Chemistry at the senior secondary level has remained consistently poor, as reported by the West African Examinations Council (WAEC, 2020–2023). Chief Examiners have highlighted persistent

difficulties in mastering abstract concepts such as electrolysis, redox reactions, chemical kinetics, and particularly chemical equilibrium. This recurring underperformance hampers both students' academic growth and national development, considering the crucial role of chemistry in socio-economic and technological progress. Research has linked this poor performance to factors such as ineffective teaching methods, inadequate resources, weak foundational knowledge, and limited practical engagement (Sagiru, 2015; Obialor & Chukwuagwu, 2022; Mitchell, Hampton & Mambwe, 2022). Traditional lecture-based approaches dominate Nigerian classrooms, often encouraging rote learning rather than critical thinking and active participation. The Think-Pair-Share (TPS) strategy has shown promise in improving engagement and achievement by fostering reflection, collaboration, and idea-sharing. However, its application in teaching complex Chemistry concepts like chemical equilibrium remains underexplored. Also, gender differences in science achievement present mixed findings, with limited evidence on how gender interacts with innovative instructional strategies like TPS. This gap underscores the need to investigate the effect of TPS on students' performance in chemical equilibrium in Karu Township, Nasarawa State, Nigeria.

Research Questions

The following research questions guided the study:

1. What is the difference between the mean performance scores of students taught chemical equilibrium using think-pair-share instructional strategy and those taught using discussion method?
2. What is the difference between the mean performance scores of male and female students taught chemical

equilibrium using Think-Pair-Share instructional strategy?

Hypotheses

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

1. There is no significant difference between the mean performance scores of students taught chemical equilibrium using Think-Pair-Share instructional strategy and those taught using discussion method.
2. There is no significant difference between the mean performance scores of male and female students taught chemical equilibrium using Think-Pair-Share instructional strategy.

Research Design

The study adopted a quasi-experimental design, specifically the non-equivalent, non-randomized, pre-test/post-test control group type. According to Emaikwu (2019), quasi-experimental designs are appropriate in educational research where randomization is not feasible, as they enable the researcher to compare the effects of an intervention on different groups while maintaining control over key variables.

The population of the study comprised 1220 comprising of (710 males and 510 females) Senior Secondary II students in the 39 public senior secondary schools that offered Chemistry in Karu township of Nasarawa State. The sample for this study consisted of 76 (41 males and 35 females) students offering Chemistry in two intact classes in Karu township. The study employed a multi-stage sampling to select participants. In the first stage, purposive sampling technique was selected two coeducational schools to take care of the gender variable. In the second stage, the two school were randomly assigned to experimental and control groups while in the

third stage one intact class was also randomly selected and used in each school since all the schools had more than one arm. There were 37 students in the experimental group and 39 in the control group.

One instrument was used for the study. This was the Chemical Equilibrium Achievement Test (CEAT). The test was adapted from West African Examination Council (WAEC) past questions papers for the duration of 2020 – 2023 Chemistry examinations because the content of the questions consists of the major areas to be covered in the research such as Le chatelier's principle, factors affecting equilibrium position, law of mass action, equilibrium constant, homogeneous and heterogeneous equilibrium and application of chemical equilibrium. Also, the instrument consists of twenty-five (30) multiple choice test item.

The validation process focused on the content validity, clarity and relevance, difficulty level, and face validity. Based on the feedback provided by three experts in Department of Science, Technical and Mathematics Education, Nasarawa State University Keffi, which included spelling errors, sentence structure and ambiguity of words, necessary modifications were made to improve the clarity, relevance, and effectiveness of the instruments before their final administration. Additionally, the internal consistency of the CEAT was measured using the Kuder-Richardson 20 (KR-20) formula, resulting in a coefficient of 0.74, indicating an acceptable level of reliability. Teaching of chemical equilibrium was done in the two intact classes by research assistants trained for a week under the supervision of the researcher. The Think-Pair-Share (TPS) strategy began with the teacher presenting a question or problem for students to reflect on individually. Students then pair up to discuss their ideas, compare answers, and refine their understanding. Finally, the pairs share their responses with

the whole class, promoting active participation, collaboration, and deeper learning of chemical equilibrium. In the discussion method group, the teacher introducing a topic or problem and guiding students to share their ideas, experiences, and perspectives in an interactive way. Students actively participate by asking and answering questions, debating viewpoints, and connecting concepts, while the teacher moderates to keep the discussion focused and meaningful. Pre-test and post-test were administered at first and sixth weeks respectively to collect data. The research questions were answered using descriptive statistics of mean and standard deviation, while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. The ANCOVA method

is suitable because it measured the effect of an independent variable on a dependent variable while controlling for the influence of covariates like pre-test scores or prior knowledge.

Results

The result of data analysis and interpretation are presented according to the research questions and hypotheses formulated for the study.

Research Question 1

What is the difference between the mean performance scores of students taught chemical equilibrium using Think-Pair-Share instructional strategy and those taught using discussion method?

Table 1: Mean and Standard Deviation of performance scores of students taught chemical equilibrium using Think-Pair-Share instructional strategy and discussion method

Group	Pre-Test			Post-Test		Mean Gain
	n	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$
Think-Pair-Share Strategy	36	12.92	3.84	24.53	3.23	11.61
Discussion Method	53	12.81	3.75	16.06	3.43	3.25
Mean Difference		0.11		8.47		8.36

Table 1 reveals the mean performance scores of students taught chemical equilibrium using Think-Pair-Share instructional strategy is 12.92 and 24.53 in pre-test and post-test with standard deviation of 3.84 and 3.23 respectively. Students taught chemical equilibrium using discussion method have mean performance scores of 12.81 and 16.06 in pre-test and post-test with

standard deviation of 3.75 and 3.43 respectively. Result further shows that students taught using Think-Pair-Share instructional strategy have mean gain of 11.61 while those taught using discussion method have mean gain of 3.25 with mean gain difference of 8.36 in favour of students taught using Think-Pair-Share instructional strategy.

Research Question 2

What is the difference between the mean performance scores of male and female

students taught chemical equilibrium using Think-Pair-Share instructional strategy?

Table 2: Mean and Standard Deviation of performance scores of male and female students taught chemical equilibrium using Think-Pair-Share instructional strategy

Group	Pre-Test		Post-Test		Mean Gain
	n	$\bar{x}$	SD	$\bar{x}$	SD
Male	19	12.26	3.74	24.26	3.74
Female	17	13.65	3.94	24.82	2.63
Mean Difference		1.39		0.56	
					0.83

Table 2 shows the pre-test and post-test mean performance scores of male students taught chemical equilibrium using Think-Pair-Share instructional strategy as 12.26 and 24.26 with standard deviation of 3.74 and 3.74 respectively. Female students taught chemical equilibrium using Think-Pair-Share instructional strategy have mean performance scores of 13.65 and 24.82 in pre-test and post-test with standard deviation of 3.94 and 2.63 respectively. Results further show that male students taught using Think-

Pair-Share instructional strategy have a mean gain of 12.00, while their female counterparts have a mean gain of 11.17, with a mean gain difference of 0.83 in favor of female students.

Hypothesis 1

There is no significant difference between the mean performance scores of students taught chemical equilibrium using Think-Pair-Share instructional strategy and those taught using discussion method.

Table 3: Summary of ANCOVA Result of the Difference in the mean performance scores of students taught chemical equilibrium using Think-Pair-Share instructional strategy and those taught with discussion method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2172.892 ^a	2	1086.446	272.139	.000
Intercept	858.198	1	858.198	214.966	.000
Pre-Performance	634.470	1	634.470	158.926	.000
Group	1510.983	1	1510.983	378.480	.000
Error	343.333	86	3.992		
Total	36300.000	89			
Corrected Total	2516.225	88			

a. R Squared = .864 (Adjusted R Squared = .860)

Table 3 indicated F value for strategy as $F(1,86) = 378.480$; $p = 0.000 < 0.05$. Since the probability level (0.000) is less than the specified alpha level of 0.05, the null hypothesis is rejected. Thus, it implies that, there is significant difference between the mean performance scores of students taught chemical equilibrium using Think-Pair-Share

instructional strategy and those taught using discussion method.

Hypothesis 2

There is no significant difference between the mean performance scores of male and female students taught chemical equilibrium using Think-Pair-Share instructional strategy.

Table 4: Summary of ANCOVA Result of the Difference in the mean performance scores of male and female students taught chemical equilibrium using Think-Pair-Share instructional strategy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	297.410 ^a	2	148.705	72.633	.000
Intercept	585.478	1	585.478	285.968	.000
Pre-Performance	294.592	1	294.592	143.890	.000
Gender	2.189	1	2.189	1.069	.309
Error	67.563	33	2.047		
Total	22023.000	36			
Corrected Total	364.972	35			

a. R Squared = .815 (Adjusted R Squared = .804)

Table 4 shows F value for strategy as $F(1,33) = 1.069$; $p = 0.309 > 0.05$. Since the probability level (0.309) is greater than the specified alpha level of 0.05, the null hypothesis is not rejected. It implies that, there is no significant difference between the mean performance scores of male and female students taught chemical equilibrium using Think-Pair-Share instructional strategy.

Discussion of Findings

The findings of this study revealed a significant difference between the mean performance scores of students taught chemical equilibrium using the Think-Pair-Share (TPS) instructional strategy and those taught using the traditional discussion method. This result aligns with that of Ogunyebi (2018) and Ogbaji, Achor and Chianson (2022), who reported a significant difference in the mean scores of students

exposed to the TPS strategy compared to those taught with conventional methods. Similarly, it corroborates the findings of Okeke and Dikeocha (2022), who found a significant improvement in academic achievement among students taught using the jigsaw teaching strategy compared to the conventional approach. The TPS strategy led to higher mean performance scores, indicating enhanced understanding and knowledge acquisition of chemical equilibrium concepts. This suggests that TPS is a more effective instructional approach for teaching chemical equilibrium, as it promotes deeper conceptual understanding and improved academic performance.

The study also found no significant difference between the mean performance scores of male and female students taught chemical equilibrium using the TPS strategy.

This finding agrees with Yusuf, Owede and Bello (2018) who found no significant effect of think-pair-share instructional strategy on secondary school students' achievement based on gender. Moreso, Ibe, Ezeliora and Okafor (2024) found that there was no significant difference in the mean achievement scores of male and female students taught Chemistry using think-pair-share instructional strategy. This finding supports the findings of Brown and Soinyo (2019), which showed that the jigsaw instructional strategy's effectiveness is not gender-dependent. Likewise, Okeke and Dikeocha (2022) reported no significant gender-based difference in academic achievement among students taught with the jigsaw strategy. The likely explanation for this is that the TPS strategy fosters equal participation among students regardless of gender, offering a bias-free, inclusive learning environment. This approach encourages both male and female students to engage actively and equitably in the learning process, thereby promoting similar levels of academic performance. This finding however, is not consistent with previous research by Abuh (2021) who found significant impact of gender on the mean performance scores of students in science. Also, the finding disagrees with that of Nnoli (2024) who found a significant difference in achievement scores between male and female students taught with TPS. The likely explanations for the variation may be attributed to differences in the subject focus within science, as well as contextual or cultural differences.

The findings of this study have important implications for science education in Nigerian secondary schools. The demonstrated effectiveness of the TPS strategy highlights the need to prioritize interactive and cooperative instructional methods that actively engage students, enhance understanding, and increase interest

in complex scientific topics such as chemical equilibrium. Furthermore, the absence of gender disparity in performance outcomes underscores the inclusive nature of the TPS strategy, suggesting its potential to bridge gender gaps and foster equity in Chemistry classrooms in terms of students' performance in chemical equilibrium.

Conclusion

This study has demonstrated that the Think-Pair-Share (TPS) instructional strategy significantly enhances students' academic performance in chemical equilibrium compared to the traditional discussion method. The higher mean scores achieved by students taught with TPS indicate that the strategy effectively promotes deeper understanding, active engagement, and knowledge retention. Additionally, the study revealed no significant difference in the performance of male and female students taught using TPS, suggesting that the strategy is gender-inclusive and provides an equitable learning environment for all students. This reinforces the idea that interactive and cooperative learning methods like TPS can bridge performance gaps based on gender

Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. Chemistry teachers, particularly those teaching chemical equilibrium topics, should adopt the Think-Pair-Share instructional strategy to enhance students' understanding and academic performance.
2. Since Think-Pair-Share instructional strategy has been shown to be gender-neutral in its impact, teachers should be encouraged by school administrators to adopt it as a means of fostering inclusive classrooms that provide equal learning opportunities for both male and female students.



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