EFFECT OF PEER COLLABORATIVE LEARNING STRATEGY ON MOTIVATION AND ACADEMIC PERFORMANCE IN CHEMISTRY AMONG PUBLIC SENIOR SECONDARY SCHOOL STUDENTS IN KADUNA STATE, NIGERIA

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Abstract

This study investigated the effect of Peer Collaborative Learning Strategy (PCLS) on motivation and academic performance in Chemistry among public secondary school students in Kaduna State, Nigeria. Anchored in social constructivist and cooperative learning theories, the study employed a quasi-experimental pre-test, post-test control group design. A total of 84 SS II Chemistry students from two randomly selected public schools participated. The experimental group (n=46) received instruction through PCLS, while the control group (n=38) was taught using conventional methods. Data were collected using a validated 50-item Chemistry Performance Test (CPT) and Student Chemistry Motivation Questionnaire (SCLMG) with a reliability coefficient of 0.872 and 0.782 respectively. After a six-week intervention, data were analysed using descriptive statistics (Mean and standard deviation)to answer research questions and Analysis of Covariance (ANCOVA) to test the hypotheses at 0.05 level of significance. Findings revealed that the experimental group had a mean gain of 19.81 inmotivation and 14.65 inperformance, compared to 4.61 and 4.58 lower gains in the control group.ANCOVA confirmed significant effects of the PCLS on academic performance and motivation ($p = 0.000$) The study concludes that PCLS is an effective instructional strategy for enhancing Chemistry learning and student motivation and recommends its adoption by educators and support from psychologists and counselors.

Keywords: Peer Collaborative Learning Strategy, Academic Motivation, Chemistry Performance

Introduction

Traditional teacher-centered methods, such as lecture-based instruction, often result in passive learning, diminishing student motivation and engagement. This approach restricts active participation and fails to accommodate diverse learning needs (Samba & Eriba, 2012). Research suggests that student-centered strategies, such as peer collaborative learning, can enhance understanding and performance in chemistry (Eriba & Anchor, 2018). Peer collaborative learning is an interactive educational approach in which students work together to achieve common learning objectives. This method fosters engagement, social interaction, and the development of interpersonal skills (Lundahl, 2022). Studies indicate that collaborative learning enhances motivation, accountability, and knowledge retention, as students learn more effectively when they actively engage with peers (Lightbown & Spada, 2020). Moreover, peer interaction fosters a sense of responsibility and constructive competition, encouraging students to strive for academic excellence (Johnson et al., 2014).

Motivation is a key factor influencing academic performance, shaping students' engagement and persistence in learning (Kendra, 2023). It can be intrinsic, driven by personal satisfaction, or extrinsic, influenced by external rewards. Effective teaching approaches that promote autonomy, competence, and social interaction enhance motivation (Lundahl, 2022). Peer collaborative learning fosters

motivation through cooperative engagement, shared goals, and positive competition (Johnson et al., 2014). A meta-analysis by Johnson and Johnson (2014) affirms that collaborative learning positively influences academic performance, peer relationships, and knowledge retention, particularly in STEM education.

Academic performance in chemistry is shaped by instructional methods, motivation, and retention. Poor performance in chemistry can impede students' career aspirations in science-related fields (Freeman, 2014). Studies have identified ineffective teaching strategies, limited instructional resources, and inadequate teacher training as contributing factors to low achievement in chemistry (Ajayi, 2017b). Adopting student-centered approaches, such as peer collaborative learning, has the potential to improve students' understanding, motivation, and retention, leading to better academic outcomes.

Several studies suggest that peer collaborative learning strategies enhance students' academic performance and motivation across different subjects and educational levels. For example, Niyonsaba et al. (2022) examined the impact of collaborative learning on academic performance in chemistry among secondary school students in Rwanda. Using a quasi-experimental design, the study found that students taught with collaborative learning performed significantly better than those taught using traditional lecture methods. Christiana et al. (2018) also investigated the effects of peer collaboration on students' achievement in basic science in Benue State, Nigeria. The study employed a quasi-experimental design and revealed that peer collaborative learning improved students' academic achievement more than the demonstration method, with no significant gender differences in performance.

Similarly, Liu & Chen (2020) assessed the impact of peer learning on academic performance, motivation, and attitude among university students in Taiwan. Results showed that peer learning improved students' academic performance, motivation, and attitudes towards learning compared to lecture-based instruction. Furthermore, Hashmi et al. (2020) examined the effect of cooperative learning on students' achievement and motivation in computer science at the secondary level. The study found that students taught using cooperative learning performed better and were more motivated compared to those taught with traditional methods.

This study is grounded in Vygotsky's Social Development Theory and Self-Determination Theory (SDT) to explain the impact of peer collaborative learning strategy on students' motivation and academic performance in chemistry. Vygotsky's theory highlights the Zone of Proximal Development (ZPD), where learners benefit from peer interactions, enabling them to acquire knowledge beyond their independent capabilities. Through scaffolding and social constructivism, peer collaboration enhances conceptual understanding, critical thinking, and retention.

Self-Determination Theory (SDT) further supports the effectiveness of peer learning by emphasizing autonomy, competence, and relatedness as key drivers of motivation. In collaborative settings, students experience greater control over their learning (autonomy), gain confidence through peer support (competence), and develop a sense of belonging (relatedness), all of which enhance their engagement and academic performance.

Data from the West African Examination Council (WAEC) between 2020 and 2024 indicate fluctuating performance in chemistry among students in Kaduna State. In 2020, the pass rate stood at 46%, improved to 51% in 2021, but later declined, with an average performance of 44% in 2024. Such inconsistencies in academic achievement hinder students' overall educational progress and national development. Freeman (2024) asserts that poor chemistry performance can negatively impact comprehension of other science subjects, leading to broader academic difficulties. Furthermore, struggling in chemistry can weaken critical thinking and problem-solving abilities, which are essential for both personal and professional success. Contributing factors such as overcrowded classrooms, insufficient resources, and an overreliance on traditional instructional methods have been identified as key challenges affecting chemistry performance in Kaduna State (Federal Ministry of Education, 2020). Kaduna State, a vital educational center in Northern Nigeria, faces significant hurdles, including limited teaching resources, large class sizes, and ineffective pedagogical strategies. Given the critical role of

chemistry in national development, it is imperative to explore innovative instructional approaches. International research suggests that peer collaborative learning strategies enhance student engagement, motivation, and knowledge retention (Roschelle et al., 2010; Slavin, 2014). Integrating these strategies into chemistry instruction in Kaduna's secondary schools could help bridge the academic performance gap and advance the country's educational goals.

Despite the well-documented benefits of peer collaborative learning, research gaps remain, particularly in African contexts such as Nigeria (Okoye et al., 2020). Limited studies have specifically explored the impact of peer collaboration on students' motivation and academic performance in Chemistry. This study addresses these gaps by investigating the effect of peer collaborative learning on motivation and academic performance in Chemistry among public senior secondary school students in Kaduna State.

Objectives of the Study

1. To investigate the effect of Peer Collaborative Learning Strategy on Motivation in Chemistry among senior secondary school students in Kaduna state.
2. To examine the effect of Peer Collaborative Learning Strategy on Academic Performance in Chemistry among senior secondary school students in Kaduna state.

Research Questions

The following research questions guided the study:

1. What is the effect of Peer Collaborative Learning Strategy on Motivation in Chemistry among senior secondary school students in Kaduna state?
2. What is the effect of Peer Collaborative Learning Strategy on Academic Performance in Chemistry among senior secondary school students in Kaduna state?

Hypotheses

The following hypotheses were tested at 0.05 level of significance

H_{O1}:There is no significant effect of Peer Collaborative Learning Strategy on Motivation in Chemistry among senior secondary school students in Kaduna state.

H_{O2}:There is no significant effect of Peer Collaborative Learning Strategy on Academic Performance in Chemistry among senior secondary school students in Kaduna state.

Methodology

This study adopted a quasi-experimental pre-test, post-test control group design using intact classes to minimize disruptions. The population comprised 62,072 SS II Chemistry students from public secondary schools in Kaduna State. SS II students were selected due to their academic stability. Two schools were randomly chosen: Government Secondary School Dakace (experimental group, 46 students) and Government Senior Secondary School Tudun Wada (control group, 38 students).

Two instruments were used: a 50-item Chemistry Performance Test (CPT), adapted from WAEC past questions (2021–2024), to assess academic performance, and Student Chemistry Motivation Questionnaire (SCLMG) to measure motivation levels under PCLS. Expert validation ensured content validity, and reliability testing using Cronbach's Alpha yielded a coefficient of 0.872 for Chemistry Performance and 0.782 for SCLMQ, indicating high internal consistency. Two chemistry teachers assisted with the six-week intervention. A pre-test established baseline scores for motivation and academic performance, followed by four weeks of instruction peer collaborative learning for the experimental group and conventional teaching for the control group. A post-test and motivation questionnaire and academic performance were then administered.

Descriptive statistics (Mean & Standard Deviation) were used to answer research questions, while Analysis of Covariance (ANCOVA) tested hypotheses at a 0.05 significance level. ANCOVA was chosen to adjust for pre-test differences, ensuring a precise evaluation of the intervention's effect.

Results

Answers to Research Questions

1. What is the effect of Peer Collaborative Learning Strategy on Motivation in Chemistry among senior secondary school students in Kaduna state?

Table 1: Mean and Standard Deviation of Experimental and Control Group on the effect of Peer Collaborative Learning Strategy on Motivation in Chemistry

Group	Pretest		Posttest		Mean Gain
	N	M	SD	M	SD	
Experimental Group	46	47.00	8.64	61.65	9.80	14.65
Control Group	38	48.26	9.16	52.89	10.85	4.63

Table 1 shows that the Experimental Group (PCLS) had a pre-test motivation score of 47.00 (SD = 8.64), while the Control Group had 48.26 (SD = 9.16), indicating similar initial motivation levels. After the intervention, the Experimental Group's post-test score increased to 61.65, while the Control Group's rose to 52.89. The Experimental Group achieved a mean gain of 14.65, suggesting that Peer Collaborative Learning Strategy positively impacted students' motivation in Chemistry.

2. What is the effect of Peer Collaborative Learning Strategy on Academic Performance in Chemistry among senior secondary school students in Kaduna state?

Table 2: Mean and Standard Deviation of Experimental and Control Group on the effect of Peer Collaborative Learning Strategy on Academic Performance in Chemistry

Group	Pretest		Posttest		Mean Gain
	N	M	SD	M	SD	
Experimental Group	46	49.02	9.49	68.83	10.87	19.81
Control Group	38	46.68	9.44	51.26	11.28	4.58

Table 2 indicates that the Experimental Group (PCLS) had a pre-test mean score of 49.02 (SD = 9.49), while the Control Group (Conventional Method) had 46.68 (SD = 9.44), suggesting similar baseline knowledge. After the intervention, the Experimental Group's mean post-test score increased to 68.83, while the Control Group's rose to 51.26. The Experimental Group showed a mean gain of 19.81, compared to 4.58 for the Control Group, highlighting the positive impact of Peer Collaborative Learning Strategy on academic performance.

Testing of Hypotheses

The hypotheses were tested using Analysis of Covariate (ANCOVA) at 0.05 alpha level of significance.

H_{O1}: There is no significant effect of Peer Collaborative Learning Strategy on Motivation in Chemistry among senior secondary school students in Kaduna state.

Table 3: Results of ANCOVA Analysis on effect of Peer Collaborative Learning Strategy on Motivation in Chemistry

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	7674.519[a]	2	3837.260	119.388	.000	.747
Intercept	337.721	1	337.721	10.507	.002	.115
TREATMENT	**2063.118**	**1**	**2063.118**	**64.189**	**.000**	**.442**
Pretest	6078.581	1	6078.581	189.121	.000	.700
Error	2603.433	81	32.141			
Total	289846.000	84				
Corrected Total	10277.952	83				

a. R Squared = .747 (Adjusted R Squared = .740)

Table 3 ANCOVA analysis showed the effect of Treatment (PCLS on Motivation Posttest Scores). The result revealed that the effect of Treatment (Peer Collaborative Learning Strategy) on students' motivation is statistically significant $F(1,81) = 64.189$, $p = .000$, Partial Eta Squared (η^2) = .442. Since

$p < 0.05$ and the effect size ($\eta^2 = .442$) is large, we reject the hypothesis (H_{O1}). This means that Peer Collaborative Learning Strategy has a significant effect on students' motivation in Chemistry. The Partial Eta Squared (0.442) suggests that 44.2% of the variance in posttest motivation scores is due to the PCLS treatment. The corresponding research question 2 also indicated that the experimental group had mean gain of 14.64 in favor of the PCLS.

H_{O2}: There is no significant effect of Peer Collaborative Learning Strategy (PCLS) on Academic Performance in Chemistry among senior secondary school students in Kaduna state.

Table 4: Results of ANCOVA Analysis on effect of Peer Collaborative Learning Strategy (PCLS) on Academic Performance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	14564.585[a]	2	7282.293	313.388	.000	.886
Intercept	289.637	1	289.637	12.464	.001	.133
TREATMENT	**4674.166**	**1**	**4674.166**	**201.149**	**.000**	**.713**
Pretest	8145.753	1	8145.753	350.546	.000	.812
Error	1882.224	81	23.237			
Total	327792.000	84				
Corrected Total	16446.810	83				

a. R Squared = .886 (Adjusted R Squared = .883)

Table 4 ANCOVA analysis revealed that the effect of Treatment (Peer Collaborative Learning Strategy) PCLS on academic performance is statistically significant ($F(1,81) = 201.149$, $p = .000$) Partial Eta Squared (η^2) = .713 (which indicates a very large effect size). Since $p < 0.05$, we reject the hypothesis (HO2) and conclude that Peer Collaborative Learning Strategy significantly affects students' academic performance in Chemistry. The high Partial Eta Squared (0.713) suggests that 71.3% of the variance in posttest scores is explained by the PCLS treatment. The corresponding research question indicated that the experimental group had mean gain of 19.80 in favor of Peer Collaborative Learning Strategy.

Discussion of Findings

The findings of this study demonstrate a significant and positive effect of the Peer Collaborative Learning Strategy (PCLS) on both motivation and academic performance in Chemistry among senior secondary school students in Kaduna State, Nigeria.

The results of the first hypothesis testing revealed a significant positive impact of PCLS on students' motivation. ANCOVA results indicated $F(1,81) = 64.189$, $p < .000$, with an effect size of $\eta^2 = .442$, suggesting that 44.2% of the variance in post-test motivation scores was due to the PCLS intervention. Descriptive data revealed a mean gain of 14.65 in the experimental group, compared to just 4.63 in the control group. This increase in motivation aligns with studies such as those by Liu and Chen (2020), who found that students exposed to peer learning exhibited improved motivation and more positive attitudes toward learning. Likewise, Hashmi et al. (2020) reported increased motivation in students learning computer science through cooperative learning strategies. These results are also in line with Self-Determination Theory (SDT), which explains how autonomy, competence, and relatedness contribute to intrinsic motivation. In the context of this study, PCLS fostered autonomy by allowing students to take responsibility for their learning, built competence by enabling success through peer support, and enhanced relatedness by promoting a sense of belonging and collaboration within learning groups. These psychological benefits collectively contributed to heightened student engagement and motivation in learning Chemistry.

The results of the second hypothesis testing also revealed a statistically significant effect of PCLS on academic performance, with $F(1,81) = 201.149$, $p < .000$, and a large effect size of $\eta^2 = .713$. This indicates that 71.3% of the variance in students' post-test scores was attributable to the PCLS intervention. The descriptive statistics further confirmed this outcome, showing that students in the

experimental group improved from a pre-test mean score of 49.02 to a post-test mean of 68.83, reflecting a mean gain of 19.80. In contrast, the control group recorded a modest gain of only 4.58. This substantial improvement in academic performance is consistent with findings from Niyonsaba et al. (2022), whose study in Rwanda demonstrated that collaborative learning significantly enhanced Chemistry performance. Similarly, Christiana et al. (2018) reported higher student achievement in Basic Science through peer collaboration compared to traditional teaching methods. Further support comes from the work of Hashmi et al. (2020) and Liu and Chen (2020), both of whom found that cooperative and peer learning strategies significantly improved academic outcomes across various subjects. These findings resonate with Vygotsky's concept of the Zone of Proximal Development (ZPD), which posits that learners achieve greater academic success through social interaction and collaborative engagement than they would through individual effort alone. While this study showed a significant positive impact of peer collaborative learning on academic performance, motivation, and retention, a study by Eze (2024) in Nasarawa State, Nigeria, reported inconsistent outcomes. The effectiveness of peer collaboration was found to depend on factors such as students' prior knowledge, self-regulation skills, and proper guidance from instructors. Without these conditions, peer collaboration yielded minimal improvements in student achievement.

Conclusion

The results of this study strongly support the effectiveness of Peer Collaborative Learning Strategy in enhancing both academic performance and motivation in Chemistry among senior secondary school students. The findings are not only statistically significant but also practically meaningful, with large effect sizes indicating the substantial role PCLS plays in improving learning outcomes.

Recommendations

Based on the findings, the following recommendations are proposed:

1. Teachers and Schools and adopt peer collaborative and personalized learning strategies to improve student engagement, performance, and retention, especially in science subjects.
2. Educational psychologists and counsellors should provide support by addressing students' cognitive, emotional, and motivational needs, and guide teachers on best practices.
3. Students and Parents should encourage students to actively participate in group learning and sensitize parents to support and monitor their children's academic activities at home.
4. School Management and Policymakers should develop supportive policies and provide resources to ensure the effective implementation of peer collaborative and personalized learning strategies

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