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Peer Tutoring Instructional Strategy and Academic Performance of Secondary School Students in Chemistry

***Wagbara, S.O.**
Department of Integrated Science, Ignatius Ajuru University of Education, Port Harcourt, Nigeria

***Corresponding author email**: samuel.wagbara@iaue.edu.ng

Abstract
This study investigated the effect of peer tutoring instructional strategy on the academic performance of senior secondary school students in Chemistry in Port Harcourt metropolis of Rivers State, Nigeria. Four research questions were used and 4 hypotheses, which were tested at the .05 level of significance, guided the study. The study adopted quasi quasi-experimental research design. A sample size of two hundred and forty (240) SS 2 Chemistry students participated in the study, comprising (140) males and (100) females. The purposive sampling technique was used to obtain 2 schools which 4 intact classes were selected, with 2 from each of the two schools that participated in the study. The Chemistry Performance Test (CPT) instrument was used to collect data for the study. The data collected were analysed by using mean and standard deviation to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at the .05 level of significance. The study found that, collaborative and think-pair-share peer instruction were better than discussion method, $P < .05$. The study also found that, gender had no significant effect in both collaborative and Think-pair-share peer instruction $P > .05$. Based on the findings, the following recommendations were made; collaborative and Think-pair-share peer instructional strategy should be used in schools as they are good innovative pedagogical strategies irrespective of the students' gender. The Ministry of Education should organise seminars and workshops for teachers to acquaint them with the knowledge of those innovative, centred strategies.

Keywords: Peer Tutoring, Instructional Strategy, Academic Performance, Secondary School Students, Chemistry.

Introduction

The indispensable importance of Chemistry in our society today stems from the fact that the study of Chemistry can enhance the scientific literacy of citizens, help their daily life and also uplift national development. Good knowledge of Chemistry will help the citizen to make informed decisions and a better understanding of many areas of life, such as making choices related to health, nutrition and environment, especially the constant challenges of environmental issues related to the planet and climate change (Wagbara & Ekwut, 2024). Scientific literacy ideas gained from Chemistry instil in us the understanding of our surroundings which influences our choice in many ways, such as the use of recycling and reuse in waste management to boost our economic status. It also empowers individuals with critical thinking to inquire, discover and give solutions to possible difficult problems around us. Chemistry is an essential subject for numerous sciences and technical-based specialised courses like medical science, pharmacy, engineering and many others (Chikendu et al., 2021).

The usefulness of Chemistry could be felt by the role it plays in economic and national development in various sectors such as: synthetic industry, textile technology, chemical industry, Engineering, Agricultural Science, Medical Science and Pharmacy, Printing technology, and Iron and Steel Industry (Gorcia-Gonzalez, 2019). Despite the immense importance of Chemistry as the pivot of modern technological activities and the careers available for people with good qualifications in Chemistry, the study of Chemistry in our secondary schools still has serious challenge of poor academic performance of students as a result of several factors which include; lack of interest, poor attitude of students and incessant use of non-innovative methods (Obikezie et al, 2021). There has been a decline in the academic performance of students in Chemistry in public examinations conducted by the West African Examination Council (WAEC) and National Examination Council (NECO) across the country over the years (Samuel & Obikezie, 2020). This was evidently shown in the WAEC Chief examiners' report of (2018), which asserted that Chemistry students had poor knowledge of acid, base and acid-base reactions and were unable

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to report results of acid-base titration experiments and were also unable to make calculations involving molar mass concentration. Chief examiners have also reported persistent candidates' weakness in Chemical bonding, which the failure rate was attributed to the use of teaching techniques as reported by (Ghukam et al, 2018).

Although the research effort of some scholars recommends the use of some strategies like the Demonstration method by Ogologo and Wagbara (2013), Problem solving by Wagbara (2024) and concept mapping by Wagbara and Mark (2024) to improve students' academic performance in Chemistry, which have not yielded any notable improvement. This could be due to ineffective teaching, as it is obvious that, if the teachers taught and learning did not take place, it means the teaching was not effective. This could be as a result of those factors that can hinder effective learning, which include; the learner, the content, the intention, the method and the environment. Above all, in order to curb this ugly trend of poor academic performance in Chemistry, an innovative strategy, such as a peer tutoring instructional strategy that can tackle those factors that could hinder effective learning wholistically, can be used by Chemistry teachers. Peer instructional strategy is an approach which involves students actively engaging in the teaching and learning process by collaborating with their peers in structured activities (Mark, 2024). Peer tutoring as a pedagogical practice can reduce stress on teachers who teach a large group of multi-age and diverse learners (Wolfe, 2018). Peers are people who share similar or common abilities. In the classroom setting, students' peers are other members of the class. For this study, the peer tutoring instructional strategy is that which students support other students in the learning process, while the act of initiating instruction in any skill or topic is done by the teacher. Students can help in providing support, reinforcement or modelling for a variety of academic topics. Collaborative peer instruction and think-pair-share peer instruction are used for this study out of several types of peer tutoring instructional strategies. Collaborative peer tutoring involves students working together in pairs or small groups to discover course concepts or find solutions to problem. This kind of activity is useful if enough time is given to groups to explain their conclusion to the rest of the class, thus reinforcing their own understanding. Think-pair-share peer instruction gives opportunity for students to consider a question on their own and to discuss it in pairs and finally together as a class. Peer tutoring instruction helps the students to gain peer assistance in building their cognitive strength and conceptual understanding of the topic.

Gender of the students may also affect their understanding of the set topics or activities carried out by students in a peer tutoring instruction. Many socio-cultural factors jointly or separately depress female interest, participation and performance in science at all levels of education (Njoku, 2001). Obviously, gender can affect students' participation in peer tutoring instruction in Chemistry due to the fact that men and women choose professions and occupations that are appreciated by the society. Hence, relatively few female students may venture into male-dominated subjects, such as Chemistry, Physics, Further Mathematics and at the higher institution level, disciplines like science, Technology and Engineering (Okoli, 2012). The fact is that peer tutoring instructional strategy provides critical reasoning and engages the learners in enjoyable motivational activities (Ajeyami & Owoyemi, 2014). Above all, peer tutoring inspires students, assists them to concentrate, organise materials for understanding and mastery, monitor and evaluate learning, stimulate self-monitoring and self-correction and provide instruments for reflecting on and evaluating individual learning (Nurhidayat et al., 2021). Hence, it becomes necessary to investigate the effect of the peer tutoring instructional strategy on the academic performance of students in Chemistry.

Statement of the Problem

The problem of this study borders on the negative attitude and poor academic performance of students in Chemistry in public examinations like WASC and NECO. A situation which was ascribed to ineffective teaching methods. In response to the above situation, several teaching methods have been suggested by science educators to uplift students' academic performance in Chemistry. Chemistry is a human endeavour that requires basic training qualities like creativity, insightful reasoning, and the skill of well-structured content that can make it activity-oriented as well as student-centred. In modern times, there is a paradigm shift as the instructional process has shifted from teacher teacher-centred to student student-centred approach. Hence, eminent scholars suggest that the teaching of science should be more activity-oriented for maximum self-development and fulfilment of the learners. In line with the above ideas, the peer tutoring instructional strategy that makes students to gain peer assistance in building their cognitive strength and the understanding of content and concepts of set topics or activities becomes necessary as it can boost students' academic performance and retention in Chemistry.

Purpose of the Study

The main purpose of this study was to investigate the effect of the peer tutoring instructional strategy on the academic performance of senior secondary school students in Chemistry. Specifically, the study sought to:

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1. Investigate how the academic performance mean scores of students taught Chemistry by the use of collaborative peer tutoring instructional strategy differ from those of those taught using the discussion method in Rivers State.
2. Determine how the academic performance mean scores of students taught Chemistry with the think-pair-share instructional strategy differ from those of those taught with the discussion method in Rivers State.
3. Examine the difference in academic performance mean scores of male and female students taught Chemistry with collaborative peer tutoring instructional strategy in Rivers State.
4. Evaluate the difference in academic performance mean scores of male and female students taught Chemistry by the use of the think-pair-share peer instructional strategy in Rivers State.

Research Questions

1. What is the academic performance mean scores difference of students taught Chemistry by the use of collaborative peer instructional strategy and those taught with the discussion method in Rivers State?
2. What is the difference in the academic performance mean scores of students taught Chemistry with the think-pair-share peer instructional strategy and those taught with the discussion method in Rivers State?
3. What is the difference in the academic performance mean scores of the male and female students taught Chemistry by the use of a collaborative instructional strategy in Rivers State?
4. What is the difference in the academic performance mean scores of male and female students taught Chemistry by the use of the think-pair-share instructional strategy in Rivers State?

Hypotheses

The following null hypotheses, which were tested at .05 level of significance, guided the study.

Ho_1: There is no significant difference in the academic performance mean scores of students taught Chemistry by the use of collaborative peer instructional strategy and those taught by the use of the discussion method in Rivers State.

Ho_2: There is no significant difference mean scores of students taught Chemistry by the use of the think-pair-share instructional strategy and those taught by the use of the discussion method in Rivers State.

Ho_3: There is no significant difference in the academic performance mean scores of male and female students taught Chemistry by the use of collaborative peer instructional strategy in Rivers State.

Ho_4: There is no significant difference in the academic performance mean scores of male and female students taught Chemistry with the think-pair-share instructional strategy in Rivers State.

Methodology

Quasi quasi-experimental research design was adopted for this study. The study was carried out in Port Harcourt metropolis of Rivers State. Port Harcourt metropolis is made up of eight (8) Local Government areas out of the twenty-three (23) Local Government Areas in Rivers State, Nigeria. The purposive sampling technique was used to select Obio/Akpor out of the eight(8) Local Government Areas in Port Harcourt metropolis. Simple random sampling by balloting was used to select two (2) senior secondary schools out of the sixteen (16) senior secondary schools in Obio/Akpor. The non-randomised sampling was used to obtain a sample size of two hundred and forty (240) SS2 Chemistry students, comprising (140) males and (100) females, who participated in the study. Chemistry Performance Test (CPT) was used to collect data for the study. The data collected were analyzed by using mean and standard deviation to answer all the research questions, while Analysis of Covariance was used to test the hypotheses at the .05 level of significance.

Results

Research Question I: What is the mean academic performance score difference of students taught Chemistry by the use of collaborative peer instructional strategy and those taught with the discussion method in Rivers State?

Table I: Mean and standard deviation of academic performance mean scores of students taught Chemistry by the use of collaborative peer instructional strategy and those taught by the use of the Discussion method.

Teaching method	**N**	**Pretest**		**Posttest**		**Mean**
		$\overline{X}$	**SD**	$\overline{X}$	**SD**	**Gain**
Experimental	60	31.00	10.58	96.00	11.87	65.00
Control	60	5.75	9.49	56.50	7.27	30.75
Mean Diff.						34.25

Table I shows that the mean score of the collaborative peer instructional strategy in the pretest group was 31.00 with a standard deviation of 10.58, while in the posttest group, the students had a mean score of 96.00 with a

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standard deviation of 11.87 and a mean gain of 65.00 was obtained. The mean score of the discussion method group students in the pretest was 25.75 with a standard deviation of 9.49, and in the posttest group mean score of 56.50 was obtained with a mean gain of 30.75. The collaborative peer instructional collaborative peer instructional experimental group students had a higher mean gain than the discussion method group students, with mean difference of 34.25.

Ho_1: There is no significant difference between the academic performance mean scores of students taught Chemistry by the use of collaborative peer instructional strategy and those taught by the use of the discussion method.

Table 2: Analysis of Covariance (ANCOVA) of students' academic performance mean scores in Chemistry of the students taught by the use of collaborative peer instructional strategy and those taught by the use of the discussion method.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	15802.515[a]	2	7801.257	78.330	.000
Intercept	247068.885	1	247068.885	248.618	.000
Pretest	.015	1	.015	.000	.990
Method	14550.996	1	1450.996	146.103	.000
Error	3684.996	117	99.54		
Total	257850.000	120			
Corrected Total	19287.500	119			

a. R Squared = 809 (Adjusted R Squared = 7.99)

Table 2 result was used to determine whether the students' academic performance mean scores in chemistry significantly differ between those taught by the use of collaborative peer instructional strategy and those taught by the use of discussion method. Table 2 shows that, an f-ratio of 146.10 with associated probability value of .00 was obtained. The probability value of .00 was compared with .05 and it was found to be significant as .00 was less than .05 ($p < .05$). Hence, the hypothesis one, ho1, was therefore rejected and inference difference between the academic performance mean score of students taught chemistry by the use of collaborative peer instructional strategy and those taught by the use of discussion method.

Research Question 2: What is the difference between the academic performance mean score of students taught Chemistry by the use of the think-pair-share peer instructional strategy and those taught by the use of the discussion method?

Table 3: Mean and standard deviation scores of students taught Chemistry by the use of the think-pair-share peer instructional strategy and those taught by the use of the discussion method.

Teaching method	N	Pretest		Posttest		Mean
		$\overline{X}$	SD	$\overline{X}$	SD	Gain
Experimental	60	28.50	6.90	86.50	17.5	58.00
Control	60	26.25	9.70	56.50	7.27	30.25
Mean Diff.						27.75

Table 3 shows that, in the pretest, the think-pair-share instructional strategy had a mean score of 28.50 with a standard deviation of 6.90, while in the posttest, the group had a mean score of 86.50 with a standard deviation of 17.5 and a mean gain of 58.00 was obtained. Also, the pretest group of the discussion method had a mean score of 26.25 with a standard deviation of 9.70, while in the posttest, they had a mean score of 56.50 with a standard deviation of 7.27 and a mean gain of 30.25 was obtained. A mean difference of 27.75 was obtained in favour of the experimental group (think-pair-share).

Ho_2: There is no significant difference in the academic performance mean scores of students taught Chemistry by the use of the think-pair-share peer instructional strategy and those taught by the use of the discussion method.

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Table 4: Analysis of Covariance (ANCOVA) of students' academic performance mean scores in Chemistry of those taught by the use of the think-pair-share peer instructional strategy and those taught by the use of the discussion method.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5024.509[a]	2	4512285	24.425	.000
Intercept	15678.440	1	15698.440	84.867	.000
Pretest	24.5691	1	24.5691	133	.717
Method	8708.295	1	8708.295	47.138	.000
Error	6835.431	117	184.741		
Total	220350.000	120			
Corrected Total	19287.500	119			

a. RSquared = 809 (Adjusted RSquared = 7.99)

The result in Table 4 was used to determine whether there is a significant difference in the academic performance mean scores of students taught Chemistry by the use of the think-pair-share peer instructional strategy and those taught by the use of the discussion method. Table 4 shows that an F-ratio of 47.13 with an associated probability value of .00 was obtained. The probability value of .00 was compared with .05 and it was found to be significant as .00 was less than .05 ($P < .05$). Hence, hypothesis two, Ho2 was rejected and inference drawn that, there is significant different between the academic performance mean scores of the students taught Chemistry by the use of think-pair-share peer instructional strategy and those taught by use of discussion method.

Research Question 3: What is the difference in the academic performance mean scores of the male and female students taught Chemistry using a collaborative instructional strategy in Rivers State?

Table 5: Mean and standard deviation –scores of male and female students taught Chemistry by the use of a collaborative peer instructional strategy.

Gender	N	Pretest		Posttest		Mean Gain
		$\overline{X}$	SD	$\overline{X}$	SD	
Male	35	28.00	9.94	86.57	18.7	58.7
Female	25	27.60	9.26	88.00	19.5	60.40
Mean Diff.						1.83

Table 5 shows that the males in the pretest group had a mean score of 28.00 with a standard deviation of 9.94. While in the posttest group, the males had a mean score of 86.57 with a standard deviation of 18.7. Also, in the pretest group, the females had a mean score of 27.60 with a standard deviation of 9.26, whereas in the posttest, they had a mean score of 88.00 with a standard deviation of 19.5. The males had a mean gain of 58.57, while the females had a mean gain of 60.40. A mean difference of 1.83 was obtained in favour of the females.

Ho_3: There is no significant difference in the academic performance mean scores of male and female students taught Chemistry by the use of collaborative peer instructional strategy in Rivers State.

Table 6: Analysis of covariance (ANCOVA) of significance difference in the academic performance mean scores of male and female students taught Chemistry by the use of collaborative peer instructional strategy in Rivers State.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	573.703[a]	2	286.851	.792	.458
Intercept	54756.430	1	54756.430	157.138	.000
Pretest	543.940	1	543.940	1.502	.225
Gender	24.540	1	24.540	.068	.767

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Error	20644.63	57	362.187
Total	47100.000	60	
Corrected Total	21218.333	59	

Q. RSquared = .027 (Adjusted RSquared = .007)

The result of Table 6 was used to determine whether there is a significant difference in the academic performance mean score of the male and female students taught Chemistry using a collaborative peer instructional strategy. Table 6 shows that an F-ratio of .068 with a probability value of .76 was obtained. The probability value of .76 was compared with .05, and it was found to be greater than .05 (P > .05). Hence, the null hypothesis, Ho3, was accepted, and inference drawn that there is no significant difference in the academic performance mean score of the male and female students taught Chemistry by the use of collaborative peer instructional strategy.

Research Question 4: What is the difference in the academic performance mean scores of the male and female students taught Chemistry by using the think-pair-share instructional strategy in Rivers State?

Table 7: Mean and standard deviation scores of males and females taught by the use of the think-pair-share peer instructional strategy.

Gender	N	Pretest		Posttest		Mean
		$\overline{X}$	SD	$\overline{X}$	SD	Gain
Male	35	28.34	9.54	86.43	14.37	57.09
Female	25	25.00	8.16	86.40	12.12	61.40
Mean Diff.						4.13

Table 7 shows that the male students had a mean score of 28.34 with a standard deviation of 9.54 in the pretest group, while in the posttest group, they had a mean score of 85.43 with a standard deviation of 14.57. Also, in the pretest group of the females had a mean score of 25.00 with an associated standard deviation of 8.16, whereas in the posttest group, they had a mean score of 86.40 with standard deviation of 12.12. The male had a mean gain of 57.09 while the female had a mean gain of 61.40. A mean difference of 4.13 was obtained in favour of the females.

Ho_4: There is no significant difference in the academic performance mean score of male and female students taught Chemistry by the use of the think-pair-share peer instructional strategy in Rivers State.

Table 8: Analysis of Covariance (ANCOVA) of significant difference in the academic performance mean score of male and female students taught Chemistry with the think-pair-share peer instructional strategy.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	508.891a	2	252.446	1.415	.251
Intercept	53059.003	1	53059.003	295.081	.000
Pretest	495.1229	1	495.1229	2.754	.103
Gender	.183	1	.183	.001	.975
Error	10249.442	57	179.814		
Total	452800.000	60			
Corrected Total	10758.333	59			

a. RSquared = 658 (Adjusted RSquared = 640)

The result of Table 8 was used to determine whether there is a significant difference in the academic performance mean scores of male and female students taught Chemistry by the use of the think-pair-share peer instructional strategy. Table 8 shows that an F-ratio of .001 and a probability value of .975 were obtained. The probability value of .975 was compared with .05, and it was found to be greater than .05 (P > .05). Hence, the null hypothesis four, Ho_4, was accepted, and inference drawn that there is no significant difference in the academic performance mean score of male and female students taught Chemistry by the use of the think-pair-share instructional strategy.

Discussion

The result of Analysis of Covariance which was used to test hypothesis one, Ho_1, as shown in Table 2, yielded an F-ratio of 146.10 with probability value of .00. The result showed that P < .05 which means that there is significant difference in the academic performance mean scores of students taught Chemistry by the use of collaborative peer instructional strategy and that of those taught with discussion method. The findings of this study agree with the findings of Olalekan (2016), who found that, when students receive essential peer support, they are more likely to achieve and exceed their capabilities, focus more on their studies and perform well in academic tasks. The

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findings of this study are also in line with those of Irgan et al. (2019), as they asserted that peer tutoring greatly improved experimental group students' academic performance when compared with the control group. This study has confirmed that collaborative peer instructional strategies have a significant effect on students' academic performance in Chemistry. The result of Table 4 of the Analysis of Covariance used to test hypothesis two, $Ho_{2,}$ shows an F-ratio of 47.13 with associated probability value of .00. The result showed that $P < .05$ which means that, there is significant difference in the academic performance mean scores of students taught Chemistry by the use of Think-pair-share peer instructional strategy and those taught with discussion method. The findings of this study are in line with the findings of Lumberg et al. (2022), who found that, peer tutoring and teacher-led instruction were more constructive in increasing students' spelling abilities. The findings of Agu and Samuel (2019) also agree with the findings of this study, as they found that peer instructional strategy has a good impact on performance in science and technology. This study has confirmed that, think-pair-share peer instructional strategy has a significant effect on students' academic performance in Chemistry.

Table 6 shows that an F-ratio of 0.68 with an associated probability value of .76 were obtained. The result showed that gender does not have a significant mean scores of students taught Chemistry by the use of a collaborative peer instructional strategy. The findings of this study agree with the findings of Abdulahi (2018), who noted that students taught using a peer instructional strategy outperformed those taught with the lecture method and that students' scores were unaffected by gender. This study has confirmed that there is no significant difference in the academic performance of male and female students taught Chemistry by the use of collaborative peer instructional strategy.

Table 8 shows that an F-ratio of .001 with a probability value of .975 was obtained. The result of Table 8 shows that gender does not have a significant effect on students taught Chemistry by the use of the Think-pair-share peer instructional strategy, as $p > .05$. Hence, the null hypothesis four, $Ho_{4,}$ was accepted. The findings of this study agree with the findings of Sani (2015), who asserted that peer-assisted learning benefited students of all genders. This study has confirmed that there is no significant difference in the academic performance of male and female students taught Chemistry by the use of the think-pair-share peer instructional strategy.

Conclusion

First, the result of this study has shown that there is a significant difference between the academic performance mean scores of students taught Chemistry by the use of a collaborative peer instructional strategy and those taught with the discussion method. Secondly, the result of the study found that there is a significant difference between the academic performance mean scores of students taught Chemistry by the use of the Think-pair-share peer instructional strategy and those taught by the use of the demonstration method. Thirdly, gender does not have a significant effect on the academic performance mean scores of students taught by the use of both collaborative and think-pair-share peer instructional strategies.

Recommendations

1. Chemistry teachers should adopt the strategy of the use of peer tutoring instruction in the teaching of their students, as it is an activity-based and student-centred approach that makes lessons real and explicit.
2. All the students should be exposed to the peer tutoring instructional strategy regardless of gender. Both males and females can learn Chemistry optimally by the use of the peer tutoring instructional strategy.

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