



Relative Efficacy of Think-Pair-Share and Peer-Tutoring Instructional Strategies on Students' Retention in Chemical Kinetics

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Abstract

The study investigated the relative efficacy of think-pair-share and peer-tutoring instructional strategies on senior secondary school students' retention in chemical kinetics. The study was carried out in Nsukka Education Zone of Enugu State. Three research questions and three null hypotheses guided the study. Post-test only quasi-experimental research design was adopted for the study. The population of the study comprised all the SS11 Chemistry students of 2023/2024 session in Nsukka Education Zone of Enugu State. The sample of the study consisted of 115 SS11 Chemistry students (31 male and 84 female students) in four intact classes. Multi-stage sampling technique was used for the study. The instruments for data collection were the Chemical Kinetics Achievement Test (CKAT) and the Chemical Kinetics Retention Test (CKRT). The instrument was developed by the researchers and was validated by three experts. The instrument was trial-tested on twenty SS11 Chemistry students in a secondary school outside the study population. The internal consistency reliability of the CKAT instrument was determined using Kuder-Richardson Formulas 20 (K-R₂₀) techniques and this resulted in reliability coefficient of 0.90. The score for temporal stability of retention test was 0.92. Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. From the results obtained, it was found that think-pair-share and peer-tutoring strategies enhanced students' retention in chemical kinetics. There was no significant difference on mean retention scores of students taught using think-pair-share and peer-tutoring strategies. The study also revealed that there was no significant influence of gender on the mean retention scores of students in chemical kinetics. The study also revealed that there was no significant interaction effects of strategy and gender on students' retention in chemical kinetics. Based on the findings of the study, the researchers recommended, among other things, that think-pair-share and peer-tutoring strategies should be adopted by chemistry teachers in the teaching and learning of Chemistry.

Keywords: Academic Achievement, Chemical Kinetics, Peer-Tutoring, Think-Pair-Share

Introduction

The study of Chemistry is very important in national development. The application of its principles contributes immensely to the advancement of modern technology and economic growth of a nation. Teaching and learning strategies that enhance students' retention in chemistry need to be explored. This could make the students apply the knowledge of Chemistry gained in the classroom to solve the problems in their daily lives and prepare them to face the challenges of a scientifically growing world. This study explored the use of think-pair-share and peer-tutoring strategies in enhancing the retention of students in Chemistry. Chemistry is the study of the nature and properties of all forms of matter as well as substances that make up our environment and the various changes, which these substances undergo in different conditions (Udu, 2017). Chemistry is required for a student to be given admission into an institution of higher learning to study any science

related course like engineering, pharmacy, nursing, geology, architecture, agriculture, food technology and the likes. The principles of Chemistry are very useful in the manufacture of many chemical products like soap, cement, fertilizers and chemical processes like mining oil refining and others, which make life easy and contribute to economic growth and national development.

Despite the importance of chemistry, it has been reported that students' retention in Chemistry had continued to be poor. Retention is the ability to retain and remember tasks or concepts learnt. Arua (2018) defined retention as an act of retaining or ability to recall or recognize what has been learnt or experienced over a long period of time. Okotcha (2018) defined retention as ability to retain and recall past experiences. The problem of students' poor retention capacity in chemistry is undoubtedly worrisome and has been a major concern to the

educationalists (Ajayi and Angura 2017). The study of Ajayi and Ogbeba (2017) revealed unimpressive students' retention rate at the senior secondary school level in Nigeria.

Several studies have attributed the observed students' poor retention capacity to the use of inappropriate and ineffective teaching methods such as lecture. Ajayi and Angura (2017) revealed that low retention rate of students particularly among sexes is as a result of instructional modality adopted by teachers. In this regard, inappropriate teaching methods used by chemistry teachers invariably translates to students' inability to retain and put into practice what is learnt in reality. This has become a major problem. One of the identified areas of students' difficulty in Chemistry is chemical kinetics. Zulkifli and Tesa (2017) reported that one of the concepts in Chemistry that is considered difficult is the chemical equilibrium. Gongden (2022) also identified chemical kinetics as a concept in Chemistry where students achieve poorly. Strategies that enhance students' retention in Chemistry and enable them to apply what was learnt in the classroom to real life situations should be explored. Think-pair-share and Peer-tutoring are examples of such strategies.

Think-pair-share is an instructional strategy that promotes thinking and construction of knowledge among students. It is a collaborative learning strategy where students work together to solve a problem or answer a question about an assigned reading (Akanmu, 2019). Researchers like Akanmu (2019), Lawal and Hamman (2021); Sunday, Nyakno and Assan (2023) worked on the effect of think-pair-share strategy on the achievement and retention of students in Mathematics, Economics and Chemistry respectively. The findings showed that there was a statistical differences in grades of students in favour of the experimental group. Other strategy to be explored that enhance collaboration of students and interaction among peers, is peer-tutoring.

Peer tutoring is an instructional strategy in which one student teaches one or more fellow students. Peer-tutoring is described by Okoye (2016) as an instructional strategy in which students in their groups, under the guidance of a teacher, work together through a given instructional assignment with brilliant student as a peer tutor, providing assistance and instruction to others. The student who instructs is called the tutor, while the student who receives instruction is called the tutee. This strategy links high achieving students with low achieving students. Some researchers have worked on peer-tutoring strategy. Azeez, Omananyi, Kwasi and Abuh (2022); Aftab, Tehsain and Bagum (2022) revealed

that peer-tutoring instructional strategy has positive significant effect on students' academic achievement and in Chemistry. Juweto (2018) found that Biology students taught using small-group strategy achieved higher than those taught using peer-tutoring, but those taught using lecture method had higher retention scores. Oloyede, Bamidele and Oladipupo (2020) worked on the effects of peer tutoring and think-pair-share instructional strategies in improving students' academic performance in Chemistry and found that think-pair-share significantly improved students' achievement more than peer-tutoring strategy. In the midst of these inconsistencies, peer-tutoring need to be explored further. Teaching strategies that favour both male and female students should be encouraged. This is because the achievement and retention of students in Chemistry may be influenced by gender.

Gender is a variable which plays a very important role in learning process. Gender is a stereotyped socially constructed roles assigned to individuals as males and females. Okeke (2018) defined gender as a socially constructed role and socially learned behaviours and expectations associated with males and females. The studies of Semerzier (2020), Okorie and Ezech (2016) and Okeke (2018) showed inconsistent results on male and female students' achievement and retention in Chemistry. Hence the academic achievement and retention of students in Chemistry need to be further investigated.

The studies on think-pair-share and peer-tutoring were carried out in different subjects such as Mathematics, Economics, e.t.c. The studies done in Chemistry were not done in chemical kinetics. Others were conducted using primary school pupils and outside Nigeria which may have different background and dispositions with students in secondary schools in Nigeria. Hence the need for this study, to investigate the relative efficacies of think-pair-share and peer-tutoring instructional strategies on students' retention in chemical kinetics. The study also investigated the influence of gender on students' retention in chemical kinetics

Research Questions

The following research questions were posed to guide the study.

1. What are the mean retention scores of students taught chemical kinetics using think-pair-share strategy and those taught using peer-tutoring strategy?
2. What are the mean retention scores of male and female students in chemical kinetics?

3. What is the interaction effect of strategies and gender on students' mean retention scores in chemical kinetics?

Hypotheses

The following null hypotheses (H_0) were formulated to further guide the study and was tested at 0.05 level of significance:

- Ho1: There is no significant difference in the mean retention scores of students taught chemical kinetics using think- pair- share strategy and those taught using peer-tutoring strategy.
- Ho2: There is no significant difference in the mean retention scores of male and female students in chemical kinetics.
- Ho3: There is no significant interaction effect of strategies and gender on students' mean retention scores in chemical kinetics.

Method

The study adopted the post-test only quasi-experimental research design. The population of the study comprised all the 1529 Senior Secondary two (SS11) Chemistry students in the 61 Senior Secondary Schools in Nsukka Education Zone of Enugu State in the 2023/2024 academic session. The sample size for this study consisted of 115 (SS11) Chemistry students made up of 31 males and 84 females drawn from four intact classes from two schools. Simple random sampling technique using balloting with replacement was employed to select two out of the three local government areas in Nsukka. Purposive sampling technique was used to select two co- educational schools, one from each of the two local government areas selected since gender is a moderating variable. Two science classes were used as intact classes in each school selected. With a toss of coin, the classes were assigned to think-pair-share group and peer-tutoring groups. The instrument used for data collection was the Chemical Kinetic Achievement Test (CKAT), which was reshuffled after two weeks and re-administered to the students as the Chemical Kinetic Retention Test (CKRT). The

instrument comprised 25 multiple choice test items compiled by the researcher using WAEC past question papers in Chemistry which was subjected to content validity by the use of table of specification. The instrument was validated by three experts, two from Chemistry Education and one in Measurement and Evaluation, all from the Department of Science Education, University of Nigeria, Nsukka. The reliability coefficient of the chemical kinetic achievement test (CKAT) was determined using Kuder-Richardson Formula 20 (K-R 20) resulting in internal consistency estimate of 0.90. The score of temporal stability for the retention test was 0.92.

Experimental Procedure

This study involved two groups of non-equivalent subjects. These are the think-pair-share strategy experimental group and peer-tutoring strategy experimental group. The study involved two intact classes in each school for think-pair-share experimental group and peer-tutoring experimental group respectively. The regular chemistry teachers of the schools were trained as research assistants by the researchers based on the objectives of the study and using the lesson plan as a guide. The experiment lasted for four weeks. At the end of the teaching exercise, the CKAT was administered to the students in the two groups for post-test. After two weeks, the chemical kinetics retention test (CKRT) was administered to the research subjects to measure the extent to which they retained what was learnt. The data obtained from the post-test and retention test were analysed using mean and standard deviation to answer the research questions. The analysis of covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. The null hypothesis is not rejected if the p-value is greater than 0.05 level of significance. To control Hawthorne effect, the students were taught by their regular Chemistry teachers and the teachers were trained on how to use the lesson notes to ensure uniformity of standard of teaching.

Results.

Table 1: Mean analysis of the retention scores of students taught chemical kinetics using think-pair-share strategy and those taught using peer-tutoring strategy

Treatment	n	Posttest		Retention		Mean Difference
		Mean	Std. Deviation	Mean	Std. Deviation	
Experimental Group 1 (TPS)	59	60.88	18.60	60.27	16.47	57.13
Experimental Group 2 (PT)	56	53.29	13.41	53.29	12.61	56.92

Result in Table 1 indicates that the students taught chemical kinetics using think-pair-share strategy had post-test and retention mean scores of ($M = 60.88$, $SD = 18.60$) and ($M = 60.27$, $SD = 16.47$), while the students taught chemical kinetics using peer-tutoring strategy had post-test and retention mean scores of ($M = 53.29$, $SD = 13.41$) and ($M = 53.29$, $SD = 12.61$). The adjusted mean scores of 57.13 and 56.92 for the students taught using think-pair-share strategy and those taught using peer-

tutoring strategy respectively show that the students taught using think-pair-share strategy had higher retention mean score than those taught using peer-tutoring strategy. However, the posttest standard deviations of 16.47 and 12.61 for the two groups respectively, indicate that the individual retention scores of the students taught using think-pair-share strategy varied more from their group mean than those taught using peer-tutoring strategy.

Table 2: Analysis of covariance of the effect of learning strategy on students' retention in chemical kinetics

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	22932.087 ^a	4	5733.022	213.849	.000	.886
Intercept	587.708	1	587.708	21.922	.000	.166
Posttest	21350.559	1	21350.559	796.404	.000	.879
Treatment	.963	1	.963	.036	.850	.000
Gender	13.238	1	13.238	.494	.484	.004
Treatment * Gender	12.488	1	12.488	.466	.496	.004
Error	2948.956	110	26.809			
Total	397808.000	115				
Corrected Total	25881.043	114				

Table2 reveals that there is no significant difference in the mean retention scores of students taught chemical kinetics using think-pair-share strategy and those taught using peer-tutoring strategy,

$F(1, 110) = .036$, $p = .850$. Therefore, the null hypothesis is not rejected since the associated probability value of .850 is greater than the .05 level of significance.

Table 3: Mean analysis of the retention scores of male and female students in chemical kinetics

Gender	n	Posttest		Retention		Mean Difference
		Mean	Std. Deviation	Mean	Std. Deviation	
Male	31	57.03	16.33	57.29	15.71	57.41
Female	84	57.24	16.87	56.71	14.92	56.64

Table 3 shows that male students had post-test and retention mean scores of ($M = 57.03$, $SD = 16.33$) and ($M = 57.29$, $SD = 15.71$), while female students had post-test and retention mean scores of ($M = 57.24$, $SD = 16.87$) and ($M = 56.71$, $SD = 14.92$). The adjusted retention mean scores of 57.41 and 56.64 for the male and female students respectively show that the male students had higher retention mean score than female students. However, the post-test standard deviations of 15.71 and 14.92 for the two groups respectively, indicate that the individual retention scores of the male students varied more from their group mean than those of the female students.

H₀₂: There is no significant difference in the mean retention scores of male and female students in chemical kinetics.

Table2 reveals that there is no significant difference in the mean retention scores of male and female students in chemical kinetics, $F(1, 110) = .494$, $p = .484$. Thus, the null hypothesis is not rejected since the associated probability value of .484 is greater than the .05 level of significance. This implies that gender does not influence the retention of students in chemical kinetics.

Table 4: Mean analysis for the interaction effect of strategy and gender on students' retention scores in chemical kinetics

Treatment	Gender	n	Posttest		Retention	
			Mean	Std. Deviation	Mean	Std. Deviation
Experimental Group 1 (TPS)	Male	15	64.00	18.64	62.93	18.17
	Female	44	59.82	18.68	59.36	15.98
Experimental Group 2 (PT)	Male	16	50.50	10.72	52.00	11.12
	Female	40	54.40	14.32	53.80	13.25

Table 4 indicates that the male students taught chemical kinetics using think-pair-share strategy had posttest and retention mean scores of ($M = 64.00$, $SD = 18.64$) and ($M = 62.93$, $SD = 18.17$), while the male students taught chemical kinetics using peer-tutoring strategy had posttest and retention mean scores of ($M = 50.50$, $SD = 10.72$) and ($M = 52.00$, $SD = 11.12$). Similarly, the female students taught chemical kinetics using think-pair-share strategy had posttest and retention mean scores of ($M = 59.82$, $SD = 18.68$) and ($M = 59.36$, $SD = 15.98$), while the female students taught chemical kinetics using peer-tutoring strategy had posttest and retention mean scores of ($M = 54.40$, $SD = 14.32$) and ($M = 53.80$, $SD = 13.25$). This implies that while male students taught chemical kinetics using think-pair-share strategy had higher mean retention score than the female students of the same group, the female students taught chemical kinetics using peer-tutoring strategy had higher mean retention score than the male students of the same group.

H₀₃: There is no significant interaction effect of strategy and gender on students' mean retention scores in chemical kinetics.

Table 2 reveals that there is no significant interaction effect of strategy and gender on students' mean retention scores in chemical kinetics, $F(1, 110) = .466$, $p = .496$. Thus, the null hypothesis is not rejected since the associated probability value of .496 is greater than the .05 level of significance. This implies that retention scores of the students in chemical kinetics as a result of their exposure to think-pair-share and peer tutoring are not dependent on their gender.

Discussions

The results of this study revealed that both think-pair-share and peer-tutoring had positive effects on the Chemistry students' retention in chemical kinetics. However, there is no significant difference in the mean retention scores of Chemistry students taught chemical kinetics using think-pair-share and those taught using peer-tutoring strategy. This study therefore suggests that think-pair-share strategy and peer-tutoring strategies enhanced students' retention

in chemical kinetics. This finding is in line with the study of Sunday, Nyakno and Assan (2023) which revealed that think-pair-share had a positive effect on the retention of students in science subjects. The finding is also in agreement with the study of Akanmu (2019) which revealed that think-pair-share had a positive effect on the retention of students in Mathematics. The finding is also in agreement with the study of Aftab, Tehsain and Bagum (2022), Egbujuo (2020), which revealed that peer-tutoring had a positive effect on students' performance in Chemistry. The finding is in disagreement with the study of Juweto (2018) which indicated that students taught Biology using Small Group tutoring strategy achieved higher than those taught using Peer tutoring. However, this study showed that, there is no significant difference in the mean retention scores of Chemistry students taught chemical kinetics using think-pair-share and those taught using peer-tutoring strategy.

The result showed that the male students had higher mean retention scores than female students. It was further found that though male students had slight retention edge over their female counterparts, there is no significant difference in mean retention scores of male and female Chemistry students. The reason might be that the strategies did not discriminate the roles to be played by male and female students. This finding is aligned with the studies of Okeke (2018) and Gongden (2022) which found that there was no statistically significant difference of gender on students' retention in Chemistry. The finding is also in line with the study of Ajayi and Angura (2017) which found that there was no significant difference in mean retention scores of male and female students in Chemistry. This finding is in disagreement with the finding of Sor, Jambo and Igwe (2018) which revealed that male Chemistry students achieved and retained knowledge more than their female counterparts in Chemistry. The finding is also in disagreement with the study of Sylvanus and Eke (2017) which revealed that male Chemistry students achieved and retained knowledge higher than their female counterparts. However, the findings of this study showed that gender has no

significant influence on students' retention in chemical kinetics.

The findings revealed that male students taught chemical kinetics using think-pair-share strategy had higher mean retention scores than the female students of the same group. The female students taught chemical kinetics using peer-tutoring strategy had higher mean retention score than the male students of the same group. The finding showed that there was no interaction effects of strategy and gender on students' mean retention scores in chemical kinetics. This implies that retention scores of the students in chemical kinetics as a result of their exposure to think-pair-share and peer tutoring were not dependent on gender. This finding is in agreement with the studies of Gongden (2022) which revealed that there is no significant interaction effect of strategy and gender on students' retention in Chemical kinetics. The finding is in line with the study of Juweto (2018) which revealed that there is no significant interaction effect of strategy and gender on students' retention in Biology. The finding is also in line with the findings of Lawal and Hamman (2021) which revealed that there is no significant interaction effect of strategy and gender on students' retention in Economics. However, the findings of this study showed that there is no significant interaction effect of strategy and gender on students' retention in chemical kinetics.

Conclusion

Based on the findings and discussion of this study, the researchers concluded that think-pair-share and peer-tutoring strategies enhanced students' retention in chemical kinetics. However, there is no significant difference on mean retention scores of students taught using think-pair-share and peer-tutoring strategies. The retention of students in chemical kinetics was not influenced by gender. There was no significant interaction effect of strategy and gender on students' mean retention scores in chemical kinetics. Thus, think-pair-share strategy and peer-tutoring strategies are gender friendly and enhanced male and female students' mean retention scores in chemical kinetics.

Recommendations

Based on the findings of the study, the researchers recommended that:

1. Think-pair-share and peer-tutoring strategies should be adopted by chemistry teachers in the teaching and learning of chemistry since it has been found to enhance students' retention in chemical kinetics

2. The Ministry of Education in Nigeria should organize seminars, workshops and conferences for chemistry teachers on how to use think-pair-share and peer-tutoring strategies in teaching chemistry.
3. The school authorities and administrators should organize periodic training and workshops for Chemistry teachers to acquaint them on how to use think-pair-share and peer-tutoring strategies during instruction.

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