

Effectiveness of Think-Pair-Share Learning Strategy on Achievement and Retention in Electrolysis among Secondary School Chemistry Students in Dutsin-Ma, Nigeria

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Abstract

This study examined the impact of the Think-Pair-Share (TPS) cooperative learning strategy on students' academic achievement and retention in the electrolysis concept of chemistry among SSII students in Dutsin-Ma Educational Zone, Katsina State, Nigeria. Using a quasi-experimental design, 130 students were randomly assigned into experimental (TPS) and control (lecture method) groups. A validated 30-item Electrolysis Achievement Test (EAT) was administered as pre-test, post-test, and retention test. Data analyzed via ANCOVA revealed that students taught using TPS significantly outperformed those taught with the conventional method in both achievement and retention. Gender had no significant effect on outcomes. The findings recommend adopting TPS for improving understanding and long-term recall of difficult chemistry topics.

Keywords: Think-Pair-Shares, Achievements, Electrolysis, Learning Strategy, Dutsinma Zonal Quality Assurance Office

Introduction

Chemistry is a foundational science subject in Nigeria's secondary education system that is essential due to the fact that chemistry which involves the study of matter, its applications, and reactions, is a subject that is significant in both our daily lives and the growth of nations. This supports the claim made by Ezeudu et al. (2019) that chemistry provides the majority of a nation's labour force. As a result, chemistry aids in human comprehension of common materials and processes. Onyi & Nwafor (2022) and Ezeudu et al. (2019) provided empirical evidence for the low and fluctuating achievement of students in chemistry. This is supported by the Chief Examiners Reports (2017–2021) of the West African Examination Council (WAEC), which show

a pattern of inconsistency and a pressing need for improvement in students' achievement in the subject.

Low students' achievement in Chemistry has largely been linked to the employment of traditional teaching methods (lecture method) rather than student-centered learning strategies (Odukwe & Nwafor, 2022). Despite the fact that the conventional teaching approach (lecture method) ensures that students' course material is quickly covered, it also encourages rote learning and turns students into passive learners by preventing them from actively engaging in the learning process. Their success will unavoidably be impacted by this. Chemistry is a science topic that emphasizes hands-on learning and encourages student participation. Therefore, in order to improve student achievement, chemistry teachers must adopt activity-based instructional strategies like the think -pair-share (TPS), which encourages interaction between the students and the course materials.

Think -pair-share (TPS) is a method whereby students cooperate in groups to solve academic difficulties and attain their learning objectives. According to Nokes-Malach & Richey (2015), a TPS instructional strategy is one where students participate in small group activities to share their knowledge and experience. TPS instruction, according to Ali et al. (2021), "is an instructional strategy in which teachers work together on specific subject". Therefore, in the TPS strategy, the teacher helps to address a specific problem in order to facilitate the day-to-day instructions. This method encourages students to actively participate in their learning experience and acquire the knowledge required to address societal issues. The teacher acts as a facilitator in TPS learning and directs the students' learning activities. Group work, a component of a TPS educational technique, is acknowledged by Liu et al. (2018) as improving student performance, confidence, autonomy in learning, and good feelings while lowering anxiety.

Additionally, a TPS instructional strategy improves students' academic and social skills (Sears & Reagin, 2013), fosters student satisfaction, improves learning outcomes, and develops critical thinking (Mosley et al., 2016), improves students' learning (Fatimah et al., 2020), and supports the development of learners' positive attitudes as well as their confidence and public speaking skills (Ha et al., 2022). From the foregoing, studies show lack of literature on the effect of think-pair-share instructional strategy on students' achievement in Chemistry in Nigeria and as observed by Johnson et al. (2007),

the learning potential by think-pair-share is underutilized in practice, particularly in science education, therefore Chemistry, like other science subjects, requires the adoption of a think-pair-share instructional strategy to attain a specified learning result, hence, the gap of the study. Furthermore, the study considered the influence of gender on the achievement of students in Chemistry when taught using TPS instruction strategy. This is necessitated due to some contradictory evidences (Onyi & Nwafor, 2022; Ezeudu et al., 2019; Aniodoh & Egbo, 2013) and lack of clear trend on the influence of gender on students' achievement in Chemistry.

Hence, the main purpose of the study was to determine the effect of TPS instruction on secondary school students' achievement in chemistry. Specifically, the study determine the effect of think-pair-share instructional strategy on the achievement of secondary school students on electrolysis, find out the effect of think-pair-share instructional strategy on student's retention of electrolysis, determine the differences in achievement level between male and female students in electrolysis when taught using think-pair-share instructional strategy and to ascertain the differences in retention level of male and female students in electrolysis concepts when taught using think-pair-share strategy. In this study, the researcher investigated the effects of think-pair-share instructional strategy on secondary school students' achievement and retention in electrolysis in Dutsin-Ma education zone only.

Research Questions

The study provided answers to the following research questions:

1. What is the difference in the mean academic performance scores of students taught electrolysis using think-pair-share strategy and those taught using conventional teaching method?
2. What is the difference between the mean retention scores of students taught electrolysis using think-pair-share strategy and those students taught using conventional method?
3. What is the difference between the mean academic performance scores of male and female students taught electrolysis using think-pair-share strategy?

4. What is the difference between the retention mean scores of male and female students in electrolysis when taught using think-pair-share strategy?

Hypotheses

The following null hypotheses were formulated to guide this study and were tested at 0.05 level of significance.

1. There is no significant difference in the mean academic achievement scores of students taught electrolysis using think-pair-share strategy and those taught using conventional method.
2. There is no significant difference in the mean retention scores of students taught electrolysis using think-pair-share strategy and those taught using conventional method.
3. There is no significant difference in the mean achievement scores of male and female students taught electrolysis using think-pair-share strategy.
4. There is no significant difference in the mean retention scores of male and female students taught electrolysis using think-pair-share strategy

Methodology

The study adopted a quasi-experimental design involving pre-test, post-test and post-posttest (retention test). The population of the study comprised 781 SS II chemistry students in public co-educational senior secondary schools in Dutsin-Ma Education Zone which consists of 437 males and 344 females with an average age of 16 to 17 years. According to Zonal Education Quality Assurance unit there are twelve (12) co-educational public secondary schools in Dutsin-Ma Education Zone that are offering chemistry **and** total number of 130 SS II chemistry students are drawn from two public senior secondary schools in Dutsin-Ma Zonal Education Quality Assurance formed the sample of the study Two (2) Co-educational schools were selected using simple random sampling techniques (ballot boxing). Out of the twelve (12) public Co-educational schools in Dutsin-Ma Education Zone for good representation and to avoid biasness that may arise from single sex schools. These schools are Government Pilot Senior Secondary School, Dutsin-Ma and Government Day

Senior Secondary School Karofi. Government Pilot Senior Secondary School Dutsin-Ma was selected randomly as the control group while Government Day Senior Secondary School, Karofi was selected to be the experimental group and one intact class in each of the sampled school was selected using the simple random sampling from the SS II arm of each school for the study.

Results

Research Question One: What is the difference in the mean achievement scores of students taught electrolysis using think-pair-share strategy and those taught using conventional teaching method?

Table 1: Descriptive Statistics of the Post-test Means Scores and Standard Deviations of Both Experimental and Control Groups

Groups	N	Mean	SD	Std. Error Mean	Mean Difference
Experimental	60	45.87	7.860	1.015	13.43
Control	70	32.44	9.615	1.149	

In Table 1 the post-test scores mean and standard deviation of the experimental group are 45.87 and 7.860 while those of control group are 32.44 and 9.615 respectively. The mean difference between the two groups is 13.43. This implies that the students in the experimental group achieve more.

H01: There is no significant difference in the mean achievement scores of students taught electrolysis using think-pair-share strategy and those taught using conventional teaching method.

Research Question Two: What is the difference between the mean retention scores of students taught electrolysis using think-pair-share strategy and those students taught using conventional method?

Table 2: Descriptive Statistics of the Post Post-test Means Scores and Standard Deviations of Both Experimental and Control Groups

Groups	N	Mean	SD	Std. Error Mean	Mean Difference
Experimental	60	45.87	7.860	1.015	13.43
Control	70	32.44	9.615	1.149	

Table 2 displays that, the post post-test scores mean and standard deviation of the experimental group are 45.87 and 7.860 respectively while those of control

group are 32.44 and 9.615. The mean difference between the two groups is 13.43. Thus, the experimental group retain higher than the control group.

Research Question Three: What is the difference between the mean achievement scores of male and female students taught electrolysis using think-pair-share strategy?

Table 3: Descriptive Statistics of the Post-Test Means Scores and Standard Deviation of Male and Female Students in the Experimental Group

Gender	N	Mean	SD	Std. Error Mean	Mean Difference
Male	40	46.13	7.640	1.208	-1.12
Female	20	47.25	8.602	1.923	

Table 3 revealed that the post-test means scores and standard deviation of male students in the experimental group as 46.13 and 7.640 while post-test score and standard deviation of the female students was 47.25 and 8.602 with mean difference of -1.12. From the mean scores, female student slightly achieves higher than the male counterpart when exposed to the treatment.

Research Question Four: What is the difference between the retention mean scores of male and female students in electrolysis when taught using think-pair-share strategy?

Table 4: Descriptive Statistics of Post Post-Test Means Scores and Standard Deviation of Male and Female Students in the Experimental Group Exposed to TPS

Gender	N	Mean	SD	Std. Error Mean	Mean Difference
Male	40	41.00	7.736	1.223	0.95
Female	20	40.05	9.162	2.049	

Table 4: revealed that, the post post-test scores, mean and standard deviation of male students in the experimental group is 41.00 and 7.736 and those of the female students are 40.05 and 9.162, their mean difference is 0.95. Hence from the mean scores, the males retained higher than the female after posttest.

Hypotheses Testing

For the inferential analysis, ANCOVA was used to test the null hypotheses at 0.05 level of significance.

H₀₁: There is no significant difference in the mean achievement scores of students taught electrolysis using think-pair-share strategy and those taught using conventional teaching method.

To test null hypothesis one, the achievement scores of students in experimental and control groups were subjected to ANCOVA and summary of analysis is presented in Table 4.7.

Table 5: ANCOVA analysis of post-test scores of experimental group and control groups

Source	Type III sum of squares	Df	mean square	F	Sig.	Rm
Corrected model	5821.803 ^a	1	5821.803	74.339	.000	S
Intercept	43425.042	1	43425.042	554.498	.000	S
GROUP 2	5821.803	1	5821.803	74.339	.000	S
Error	10024.205	128	78.314			
Total	209927.000	130				
Corrected total	15846.008	129				

R Squared = .367 (Adjusted R Squared = .362)

Table 5 indicated that, there is significant difference in the mean achievement scores of students taught electrolysis using think-pair-share and their counterparts taught using Conventional Method. [$F = 74.33$, $p = 0.000$ and Adjusted R Squared = .362 hence $p < 0.05$] and therefore the null hypothesis is rejected. The p- value obtained was 0.00, at 0.05 level of significance with degree of freedom of 130. Hence, the null hypothesis was rejected. This means that there is significance different in the mean scores of experimental group taught electrolysis concept using think-pair-share as an Instructional Strategy. Compare with those taught using conventional method. 08034607865 Eng Ka

Ho2: There is no significant difference in the mean retention scores of students taught Electrolysis using think-pair-share strategy and those taught using conventional method.

Table 6: ANCOVA analysis of post-post test scores of experimental group and control group

Source	Type III sum of squares	Df	mean square	F	Sig.	R
Corrected model	1441.030 ^a	1	1441.030	20.478	.000	S
Intercept	27437.145	1	27437.145	389.906	.000	S
GROUP 4	1441.030	1	1441.030	20.478	.000	S
Error	9007.193	128	70.369			
Total	187015.000	130	1441.030			
Corrected total	10448.223	129				

R Squared = .138 (Adjusted R Squared = .131)

Table 6 indicated that, there is significant difference in the mean achievement scores of students taught electrolysis using think-pair-share and their counterparts taught using Conventional Method. [$F = 20.47$, $p = 0.000$ and Adjusted R Squared = .131 hence $p < 0.05$] and therefore the null hypothesis is rejected. The p- value obtained was 0.00, at 0.05 level of significance with

degree of freedom of 130. Hence, the null hypothesis was rejected. This means that there is significance different in the mean scores of experimental groups taught electrolysis concept using think-pair-share as an Instructional Strategy.

H₀₃: There is no significant difference in the mean achievement scores of male and female students taught electrolysis using think-pair-share strategy.

Table 7: ANCOVA analysis of males and females' chemistry students in the experimental group

Source	Type III sum of squares	Df	mean square	F	Sig.	R
Corrected model	202.073 ^a	1	202.073	3.352	.072 NS	
Intercept	4463.085	1	4463.085	74.025	.000 S	
Gender Pre	202.073	1	202.073	3.352	.072 NS	
Error	3496.927	58	60.292			
Total	133434.000	60	202.073			
Corrected total	3699.000	59				

Table 7 revealed that there is no significance difference in the mean achievement scores of male and female students taught electrolysis using think-pair-share strategy. Considering the result of this test, the hypothesis is not rejected. The p-value obtained was 0.72, while the F-value is 3.35 at 0.05 level of significance with Adjusted R Squared = .038. Hence, the null hypothesis is not rejected. Since the p-value is greater than 0.05 level of significance, the null hypothesis which states that there is no significant difference in the mean achievement scores of male and female students taught electrolysis using think-pair-share strategy is thereby upheld.

H₀₄: There is no significant difference in the mean retention scores between male and female students exposed to think-pair-share (TPS).

Table 8: ANCOVA analysis Test of post posttest scores of male and female students of the experimental groups

Source	Type III sum of squares	Df	mean square	F	Sig.	R
Corrected model	169.241 ^a	1	169.241	2.603	.112 NS	
Intercept	3351.468	1	3351.468	51.537	.000 S	
Gender Pre	169.241	1	169.241	2.603	.112 NS	
Error	3771.743	58	65.030			
Total	103249.000	60	169.241			
Corrected total	3940.983	59				

. R Squared = .043 (Adjusted R Squared = .026)

Table 8 revealed that the p-value obtained was 0.11, while the f-value is 2.603 at 0.05 level of significance. Since the p-value of 0.11 is less than 0.05 level of significance, the null hypothesis was rejected which means there is a

significant difference in the mean retention scores of male and female students taught electrolysis using TPS strategy.

Discussion

The finding of research question one and hypothesis one revealed that chemistry students taught using think-pair-share instructional strategy had high mean academic achievement scores than those taught using conventional lecture method. This implies that the use of TPS strategy in teaching electrolysis concepts enhances students' academic achievement in the subject. The reasons for the good achievement of the experimental group when comparing the general academic achievement of experimental group and control group is that the students in experimental group were stimulated to learn by seeing themselves in a group and also feel free to communicate and find the solution to their problems themselves and this prompted more attention by the students.

The findings of research question two and hypothesis two and four revealed that students taught using TPS strategy gained retention more than the control group taught using conventional lecture method. The findings of this study corroborated the earlier findings of; Carss (2007), who earlier suggested that think-pair-share could sustain students' retention in science, Technology and Mathematics (STM), it was also found out that TPS group significantly retained higher than the lecture methods group. Therefore, the research hypothesis was rejected. The two teaching strategies are significantly different in their effects on students' retention in chemistry. This implies that TPS strategy is more effective in retention than lecture method.

The last finding of this study revealed that there is significant difference in the mean retention ability scores of male and female students in electrolysis concepts when taught using TPS. Hence from the mean scores, the males retained higher than the female after posttest. think-pair-share likely improved students' performance and retention ability for several reasons:

1. Active Engagement: Think-pair-share encourages active participation and engagement, allowing students to discuss and think critically about the material, which enhances understanding and retention.

2. **Peer Learning:** Students benefit from explaining concepts to each other, reinforcing their own understanding and helping peers clarify doubts.
3. **Collaborative Environment:** The strategy fosters a sense of community and cooperation, reducing anxiety and making learning more enjoyable, which can lead to better academic outcomes.
4. **Immediate Feedback:** Students receive immediate feedback from peers, allowing them to adjust their understanding and correct misconceptions in real-time. These factors combined may explain why think-pair-share outperformed conventional lecture methods in improving both achievement and retention among students in electrolysis concepts.

Conclusion

The following conclusion were drawn based on the findings of this study:

1. TPS learning strategy has positive effect on students achievement and performance in electrolysis improves secondary school students' achievement in learning Electrolysis.
2. TPS learning strategy enhances the performance of both male and female students in learning Electrolysis Concepts; this is evident in the second finding of this study which indicates that there is no significant difference in the mean achievement of male and female students in Electrolysis concept when taught using TPS.
3. TPS learning strategy also improves students' retention ability in learning Electrolysis concepts when taught using it as method of instruction.
4. TPS learning strategy is not gender friendly with regards to the retention ability of the students, just as the result discloses that there is a significant difference in the mean retention scores of male and female students in Electrolysis concepts when TPS is used to teach.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Secondary schools Chemistry teachers should expose their students to TPS instructional strategy, in order to improve the students' achievement and retention.
2. For better achievement in chemistry, chemistry teachers should incorporate use of TPS strategies to complement their traditional teaching-learning approach which was found ineffective in enhancing students' achievement and retention.
3. Government and stakeholders in Education should encourage chemistry teachers by creating enabling instrument to incorporate TPS in teaching chemistry, as a means to improve both male and female students' achievement and retention in learning chemistry.
4. Professional bodies and educational agencies like STAN, TRCN, VESA, and NERDC should collaborate to organize workshops, seminars, and conferences for training science teachers on think-pair-share skills, develop subject-specific models, and facilitate training for teacher trainees.

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