



Leveraging Think Pair Share in Improving Students' Academic Achievement and Retention in Algebraic Expression in Secondary Schools in Kano State

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Abstract

The research investigated leveraging think-pair-share (TPS) in improving student's academic achievement and retention in Algebraic Expression in Secondary Schools Kano state. Three each of objectives, research questions and hypotheses guided the study. The study adopted quasi experimental research design. A population of 9,573 senior secondary school year two students with the sample size of 148 students was used for the study. Algebraic Achievement Test (AAT) and Algebraic Retention Test (ART) were the tools used to gather data. The reliability of the AAT was found to be .88 using Spearman-Brown Product Reliability Coefficient and the ART was developed by swapping the items and options in AAT which retains the same reliability coefficient. The data obtained were analyzed using SPSS. The research questions were answered using the mean and standard deviation and the hypotheses were tested using the z-test at the significance level of .05. Findings revealed that students taught algebraic concepts using TPS performed better academically and retained the concept better than those taught using conventional method. Additionally, no significant relationship exists between the gender of the students and the TPS teaching style. Therefore, it can be said that using the think-pair-share method improved academic achievement of students in algebraic concept. The study recommended that since the method improves academic achievement of students in algebraic concepts, math teachers should adopt it.

Keywords: Think Pair Share, Academic Achievement, Retention, Algebra

Introduction

The modernization of several aspects of life indicates the application of scientific and technological improvement (Ahmad 2019). Technology contributes significantly to the generation of wealth, improving quality of life and fostering economic growth. Societal transformation relies on society, which is the foundation of industrialization and proffering solutions to technological challenges faced by nations (Gambari et al, 2017; and Aina & Adedo, 2013). Sidi, Badar and Shu'aibu (2023) opined that mathematics has been a driving force behind any development scientifically and technologically. It is a resourceful tool used to develop human thinking ability, investigate problem and make assumptions about the future. According to Abimbola (2020) innovative skill development of students is

dependent on their achievement in mathematics which also serves as a springboard for development of science and technology.

Academic achievement refers to student's performance in an examination. Academic achievement, according to Mutua (2015), is the effective completion of the acquisition of academic knowledge and abilities through effort, as measured by the scores that students receive on an exam or test. Academic achievement can be view as student's performance in a given academic field. Researchers such as Suleiman and Hammed (2019), Awofala and Fatade (2023), revealed that academic performance and retention of students is perpetually deteriorating in mathematics. One of the most poorly taught, disliked,

and poorly understood subjects is mathematics. Teacher-centered pedagogy is the norm for teaching mathematics in Nigerian secondary schools (Ibok & Unoh, 2019; Awofala & Lawani, 2020), outdated teaching method, insufficient mastering skills teaching and learning materials (Bah, 2022) are factors attributed to the declining performance of students in mathematics. Additionally, pupils perform below average academically in the subject on both internal and external exams (Umar et al, 2022; Lekan & Emmanuel, 2020; Gagara, et al, 2019; Marpa, 2019; and Gagara, Kwari & Dikop 2019).

There are a number of factors that contribute to students' persistent failure in mathematics, including but not limited to teachers' incapacity to incorporate appropriate instructional aids into their lessons, students' lack of interest, improper time allotted for mathematics, the overcrowding in the classroom, and the use of instructional strategies (Aye bale, Habaasa, & Tweheyo; 2020; Adamu, Shehu, and Mohammed, 2020; Yusuf and Araba, 2019; and Tali & Peter, 2019). Okafor and Chiagozie, (2021) opined that, in order to limit the issue of students' poor achievement and retention in mathematics, there is need for mathematics teachers to employ suitable method of teaching the subject.

Retention is the ability to recall things experienced or learned. For students to benefit from learning they must retain information from class for better achievement. Retention according to Okeke (2015) is defined as learners' ability to repeat performance earlier acquired, after a period of time. The inability to retain the learnt concepts is one of the major obstacles that hinder students' achievement in mathematics (Jimoh, Mamman & Kaseem, 2020). In Haakachima and Lunjebe (2019) findings show that males outperformed their female counterparts who were both subjected to the same learning instruction in teaching mathematics. Retention is closely connected to long-term academic achievement and serves as an important indicator of an educational success (Jimoh, Mamman & Kaseem, 2020), high retention rates ensure that students remain engaged and advance along their learning paths, developing their existing knowledge and abilities (Oluwaniyi 2020). According to ogbu (2020) algebra is the foundation for more complex mathematics and solutions to problems, its abstract form often leads to comprehension issues. These difficulties may lead to retention gaps, which can have a compounding effect, making it difficult for students to understand succeeding topics. This failure has an

effect on academic achievement as well as retention since students are not confident in their algebraic skills.

The branch of mathematics known as algebra expresses and solves problems through the use of symbols and the rules guiding their use. In equations and expressions, these symbols frequently replace letters, stand for numbers and other quantities. Because it enables the study of relationships between quantities and generalizations, algebra is fundamental to mathematics (Jimoh, Mamman & Kaseem, 2020). It has several various areas of study, such as advanced algebra, which studies intricate structures like polynomials, matrices, and functions, and introductory algebra, which concentrates on fundamental operations and equations. Iyamuremye, Ndayambaje and Muwonge (2021), and Suleiman and Hamed (2019) found that students face difficulties when solving problem that requires the skill of algebraic concepts, by struggling with idea that variables represent unknown quantities leading to confusion and also finding it difficult in translating world problems into algebraic expression. Researchers such Salami and Popoola, (2016) and Bassey, Ubi, Anagbougu and Owan (2020) According to Owan (2020), maintained that the use of ineffective teaching methodologies in mathematics is a key factor contributing to students' low academic performance and limited retention of mathematical concepts. Students' lack of active participation and engagement during the process of learning are part of the major factors that contribute to their poor achievement in mathematics (Kaur & Kaur, 2021). Effective teaching strategy that gives all students opportunity for hands-on practice can help to develop students' algebraic reasoning skills.

According to the studies conducted by Omiola, Muhammad and Ojeleye (2020) submitted that through allowing each student to share their ideas with one or two peers, the Think-Pair-Share (TPS) method of instruction encourages a greater sense of inclusion and participation in the process of teaching and learning. To improve students' academic achievement and retention in mathematics, Educators should implement effective teaching strategies that encourage students to think independently, exchange ideas with peers, respond to questions, and actively engage during the process of learning (Anaduaka, Sunday & Olaoye 2018; Akanmu, 2019 and Adedjeji, 2021). The goal of TPS is to encourage kids to think of ideas and share them with their peers in a collaborative setting and minimizes competitiveness in the learning environment.

Studies conducted by Yusuf, Owede and Bello (2018) on “Effect of TPS Instructional Strategy Students’ Achievement in Civic Education” revealed that Students who were taught using the TPS learning style performed better than those who were taught using the traditional way. Ugwuanyi, Nduji, Elejere and Omeke (2020) recommends TPS learning strategy for possible improvement in academic achievement and retention, also, Ajai and Imoko (2015) observed that male and female students demonstrated comparable achievement scores in algebra when taught using TPS strategy. Okafor and Chiagozie (2021) revealed in their findings that when the TPS technique is used, students’ confidence in participating in class discussions is greatly increased, active engagement is encouraged, and their memory of previous learning improved. Also, Lekan and Emmanuel (2020) found that cooperative learning strategy guarantees improvement in students’ academic retention in mathematics.

Furthermore, Akanmu (2019) found that gender has no significant influence in the mathematics performance of the students, as the use of think-pair-share enhanced the retention ability of the students. It was suggested that think-pair-share be used to promote teaching and learning mathematics at all levels of educational.

The lack of teaching strategies that improve students’ algebraic skills has been the reason for continuous failure in mathematics. Participating actively in the teaching and learning process boosts students’ retention and makes them eager to learn and ask more questions. Therefore, there is need for teacher to change from teacher-based teaching method to innovative strategies. For this reason, this research paper investigated leveraging TPS in improving students’ academic achievement and retention in algebra at senior secondary school level in Kano State, Nigeria.

Research Questions

The study was guided by the following research questions.

1. How does the mean achievement score differ from of students taught algebra using think pair share co-operative learning strategy and those taught using conventional method?
2. What is the difference between the mean retention scores of students taught algebra with think pair share co-operative learning strategy and those taught using conventional (expository) method?

3. Is there any difference in the mean retention scores of male and female students taught algebra using think pair share co-operative learning strategy?

Research Hypotheses

The following tests were performed on the research hypotheses at a significance level of 0.05:

- H₀₁: There is no significant difference between the mean academic achievements scores of students taught algebra concepts using think pair share co-operative learning strategy and those taught using conventional method.
- H₀₂: There is no significant difference in the mean retention scores of students taught algebra using think pair share co-operative learning and those exposed to conventional method.
- H₀₃: There is no significant difference in the mean retention scores of male and female students taught algebra using think pair share co-operative learning strategy.

Methodology

Research Design

This study employed quasi experimental, specifically pre-test, post-test and post-posttest research design. The population consisted of 9573 (3909 boys and 5664 girls) SSII students from Nassarawa Educational Zone, Kano. There are 24 public senior secondary schools in Nassarawa educational zone, Kano, out of which 10 are boys’ schools and 14 are girls’. The sample of this study was selected from four (2 boys and 2 female) schools consisting of 248 students in SSII composed of 117 male 131 female. The subjects of this study were sampled out through stratified sampling technique. The stratification was based on gender, because Kano State operates single sex school system at secondary level. In each school in the four (4) sampled schools one intact class were used. The Algebra Achievement Test (AAT) and Algebra Retention Test (ART) was the instruments use for data collection. The AAT contain 30 items multiple choice objective with option A-D. The Algebra Retention Test (ART) was developed by swapping the items and the options in AAT, it was made up of 30 items with option A-D. This instrument was validated by experts in the area of mathematics and mathematics education, and pilot tested to guarantee the instrument measure measures what it is supposed to measure. Split-Half method of reliability was adopted to statistically estimate internal consistency and the reliability

coefficient of 0.88. The researcher prepared two (2) set of lesson plans for teaching algebraic topics, which based on TPS instructional strategy and expository method. Two Mathematics teachers were employed and trained as research assistants to assist teaching the experimental classes, in order to prevent treatment bias, while the researcher taught the control groups. Before the treatment began, the researcher administered AAT to both experimental and control groups as a pre-test.

After six-week of treatment, AAT was administered as post-test on the groups and Algebraic Retention Test (ART) was administered on both groups as post-posttest two weeks after the administration of AAT. The data obtained from the two groups were answered using mean and standard deviation for the research questions, while the hypotheses were tested using the z-test at the significance level of .05.

Table 1: Illustration of the Research Design

Group	Pre-test	Treatment	Posttest	Post-Posttest
Experimental	O ₁	TPS	O ₂	O ₃
Control	O ₁	Expository Method	O ₂	O ₃

Results

Table 2: Mean Achievement Scores of Students Taught Algebra Using Think-Pair-Share strategy and Those Taught Using Conventional (expository) Method

Group	N	Pretest		Posttest		MD	Stand. Error Difference
		\bar{X}	δ	\bar{X}	δ		
Experimental	133	11.65	4.52	16.12	4.52	4.17	.3807
Control	115	11.62	4.24	13.56	4.24	1.94	.3124
Difference		0.03		2.57			

MD = Mean Difference

Result of Table 2 shows that the experimental and control groups started with very close mean score and similar standard deviation indicating that had comparable entry performance having the mean of 11.65 and 11.62 with the standard deviation of 4.52 and 4.24 respectively in the pretest. Also, in the posttest, the experimental had a mean score of 16.13 with the standard deviation of 4 and control groups had a mean score of 13.56 with the standard deviation of 4.24. The

mean difference (MD) in the posttest is 2.57 indicating that experimental group achieved higher than the control group in the posttest mean achievement score. The higher the mean difference in the experimental group indicates the effectiveness of the treatment, while the lower the error in the control group indicates less variability in improvement. Therefore, experimental group achieved significantly than the control group.

Table 3: Independent Sample z – test for post-test mean achievement scores of the experimental and control group

Group	N	\bar{x}	SD	MD	DF	Z-cal.	Sig.	Decision
Experimental	133	16.13	4.52	2.57	246	4.597	.000	Rejected
Control	115	13.56	4.24				.000	

$P = .05$

Table 3 reveals that the z-cal is 4.597 and Sig-Value is .00001 which is lower than the significant level of 0.05. The result affirms that the mean achievement scores of the students who were taught algebra using the

TPS strategy differed significantly to those taught using conventional method. Therefore, the null hypothesis is rejected. This implies that leveraging TPS strategy improves student academic achievement.

Table 4: Mean retention scores of students taught algebra using Think-Pair-Share strategy and those taught using conventional method

Group	N	Post-test		Post-posttest		MD	Stand. Error Difference
		\bar{x}	δ	\bar{x}	δ		
Experimental	133	16.12	4.52	15.97	4.39	-.15	.3807
Control	115	13.55	4.24	11.36	3.35	-2.19	.3124
Difference		2.57		4.61			

From Table 4, it was revealed that the mean retention score for the students taught algebra using TPS strategy is 15.97 while those taught using expository method is 11.36 in the post-posttest score. The mean difference between the retention and posttest scores for experimental group is -.15, while it is -2.21 for the control group. This indicates that the group exposed to TPS strategy had higher retention than the group taught

algebra using conventional (expository) method. Also, the standard deviation for post-posttest is 4.39 for the experimental group and 3.35 for the control group, indicating that the variation in retention score of the experimental group is higher than the control group. From the result this implies that students taught algebra using TPS strategy had higher retention than those taught using expository method.

Table 5: Independent Sample z – test of mean retention scores of the experimental and control group

Group	N	\bar{x}	SD	DF	z- cal.	Sig.	Decision
Experimental	133	15.98	4.39	246	7.99	.000	Rejected
Control	115	11.37	3.35				

$P = .05$

From Table 5, it shows that the z-cal and the sig-value are 7.991 and .00001 respectively with respect to the mean achievement score of the students taught algebra using TPS strategy, while the significant sig-value is .00001 < .05 level of significance, so the null hypothesis which stated that there is no significant difference in the mean retention scores of students

taught algebra using think pair share co-operative learning and those taught using conventional method is rejected. It indicates that students who received algebra teaching using the TPS method outperformed those who received teaching using the traditional method in terms of retention.

Table 6: Mean retention scores of male and female students taught algebra using Think-Pair-Share strategy

Group	N	\bar{x}	Stand. Deviation	MD	Stand. Error Mean
Male	64	16.49	4.35	0.24	.55
Female	69	15.25	4.41		.53

Table 6 shows that the mean retention score of the male students taught algebra using TPS strategy was 16.49 with standard deviation of 4.35 while the female counterpart was 15.51 with the standard deviation of 4.41. The mean difference is 0.24, and the standard deviations are significantly similar, indicating that both genders' retention score taught using TPS strategy

demonstrate similar variability. As the mean retention scores are relatively high, the result implies that TPS strategy is effective for male and female students. Therefore, leveraging TPS in algebra class improve both the male and female students' retention in algebra skills.

Table 7: Independent Sample Z – test of mean retention scores of male and female students taught algebra using think pair share teaching strategy.

Group	N	\bar{x}	SD	DF	Z-Cal.	Sig.	Decision
Male	64	16.49	4.3498	131	1.285	.201	Supported
Female	69	15.25	4.4080				

$P = .05$

Table 7 indicates that the z-cal is 1.285 and the sig-value is .201. This result shows that the sig-value (.201) is greater than the p-value (.005). This implies that the assumption (H_{03}) is accepted. Therefore, there is no significant different in the mean retention scores of male and female students taught algebra using TPS strategy. Hence, it is gender friendly.

Discussion

The findings of this study revealed that who learn algebraic concept using TPS strategy achieved higher academic achievement than the students taught using conventional methods. This finding revealed that TPS strategy is an effective strategy for improving students' understanding and academic achievement in algebra. These findings agree with the results of Ugwuanyi, Nduji, Elejere and Omeke (2020) who also proposed using the TPS method of learning to improve students' academic achievement. Also, the findings is in line with Okafor & Chiagozie (2021) and Akanmu (2019) who maintained that leveraging TPS strategy increase student' confidence, engagement and active participation. Furthermore, the study established that the students taught algebra with TPS strategy demonstrated significantly better retention of knowledge compared to those taught using conventional methods.

Similarly, this finding agrees with the findings of Lekan and Emmanuel (2020) and Akanmu (2019) who submitted that TPS guarantees improvement in students' academic retention in mathematics. This indicated that the students taught with TPS strategy retained knowledge and were able to reproduce it than their counterpart taught with conventional method in control group. The findings of this study revealed further, that the difference in the mean retention scores of male and female students taught algebra using TPS strategy is not statistically significant. This shows that when TPS strategy was used in teaching algebra, it produces similar effect on male and female retention ability. This is in line with finding Ajai and Imoko (2015) who reported that male and female students

taught algebra did not significantly differ in achievement scores.

This implies that the strategy is effective in promoting both the male and female retention ability. In contrary, this finding disagrees with Haakachima and Lunjebe (2019) who find that males benefited more than their female counterparts when subjected to the same learning instruction in teaching mathematics. in another study Lawal (2016), reviewed that the performance of females in mathematics was higher than that of the males. This means TPS strategy closes the gap in female students' retention ability in mathematics. Therefore, when both male and female students are exposed to a favorable methodology providing them with opportunity to work in group and discuss their ideas, they tend to achieve equally in mathematics.

Conclusion

Based on the findings of this study, TPS strategy was found effective for teaching algebraic concept and enhance student's academic achievement. Also, TPS improve academic retention and not gender bias. Therefore, TPS is an effective instructional strategy to enhance students' academic achievement and retention particularly in algebraic concepts and closed the gender gap in academic achievement.

Recommendations

As a result of the findings obtained and discussed, the following recommendations were made

- Mathematics teachers should be trained on how to use the TPS strategy in teaching mathematics to improve students' academic achievement.
- Teacher training program such as Federal Colleges of Education, State Colleges of Education, Universities and National Teacher Institute (NTI) should incorporate cooperative teaching strategy such as TPS strategy into their methodology curricula. This will improve teachers on training requisite knowledge and close the gender gap.

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