

THINK-PAIR-SHARE AND PEER-TUTORING AS DETERMINANTS OF STUDENTS' RETENTION IN BIOLOGY

Akinola Yetunde Falilat

Department of Science, Education

Faculty of Education

University of Lagos, Akoka – Lagos

Abstract

Concerns on how to improve academic achievement, retention capacity and critical thinking skills in Biology has steadily gained attention in Nigeria. These have necessitated the call for a more interactive and student-centred instructional strategies. This study examines Think-Pair-Share and Peer-Tutoring as determinants of students' retention in Biology using a quasi-experimental research design. The study was guided by two research questions and two null hypotheses tested at 0.05 level of significance. A total of 172 Senior Secondary School II (SS 2) students from three in-tact class of three co-educational schools in Somolu Local Government, Educational District II of Lagos State, Nigeria participated in the study. The respondents were assigned to three groups: Think-Pair-Share (n=56), Peer-Tutoring (n=56), and a Control group (n=60) taught using conventional lecture methods. The Instrument for data collection was a 30-item Biology Achievement Test (BAT) and four instructional guides were developed and validated by experts in Biology Education and Curriculum. The reliability of the instrument was established using Kuder-Richardson KR20 formula (KR-20) at coefficient of 0.84. The intervention lasted for six weeks. Data collected were analyzed using mean, standard deviation and Analysis of Covariance (ANCOVA). The study revealed a statistical significance in Biology Achievement Test scores across the three groups, with think-pair-share and peer-tutoring group scoring higher. However, the students assimilated better with Peer Tutoring. The study concludes that student-centred strategies such as peer-tutoring significantly enhanced students' retention in Biology. It recommends the training and retraining of biology teachers towards the implementation of peer-tutoring and think-pair strategies and the call to curriculum developers for the inclusion of active learning models into the Senior Secondary School Curriculum.

Keywords: Achievement, Biology, Peer-Tutoring, Retention, Think-Pair-Share

Introduction

Biology is the scientific examination of living things and their relationships with the surrounding environment. It is a scientific discipline that investigates the characteristics and behaviours of life and living things (Abidoye, 2021). A solid understanding of biology equips students with the ability to effectively use fundamental scientific principles in addressing a wide range of everyday challenges, as well as to get a comprehensive understanding of the natural world (Kingdom-Aaron, Etokeren & Okwelle, 2019). Biology is the study of life (Nwuba & Osuafor, 2021). Biology play a crucial role in elucidating the transformations that occur inside human bodies, offering insights into complex issues on a broad scale, addressing

basic inquiries about the nature of life, facilitating scientific inquiries, and enhancing our comprehension of the environment (Nwuba & Osuafor, 2021).

The acquisition of biology education is vital for the development of an expanding economy such as that of Nigeria. Despite the value of Biology to students and the popularity of the subject, performance of students in external examinations has remained poor and inconsistent (Nwuba et al., 2023). Reports of West African Examination Council (WAEC) examinations conducted in Nigeria highlighted the fluctuating underachievement of students in Biology (Vakhoya, 2022). The fall in academic successes of students in Biology in recent years is reflected annually in students' results reported by the examiner boards, as is their performance or accomplishments in senior secondary certificate examinations (Eno, 2022). Poor performance of student in Biology has been attributed to teaching strategies or issues unique to each individual student (Sarkingobir, 2022; Nwuba, 2023). Concerns on how to improve academic achievement, retention capacity and critical thinking skills in Biology has steadily increased.

To enhance the teaching and learning of scientific subjects such as Biology, several strategies have been proposed (Adam, 2022). These strategies are either teacher-centred or student-centred (Ezurike & Ayo-Vaughan, 2020). Teacher-centred learning offers numerous benefits, including its compatibility with large class sizes, its efficiency in facilitating class activities and ensuring well-prepared learning materials, and its potential to alleviate teachers' feelings of anxiety, embarrassment, and tongue-tying (Ahmed, 2022). It has also been noted that teacher-centred teaching tends to be more monologic, with less emphasis on student-teacher interactions in the classroom (Ning, 2020). Teacher-centred strategy encourages student passiveness (Leon, 2021), has been linked to lower levels of self-efficacy beliefs among teachers (Kaygisiz, 2020) and could lead to low performance of students (Samosa, 2021).

A shift from teacher-centred to student-centred teaching has been advocated in various contexts (Madjdi, 2020). Student-centred approaches are more conducive to student learning, with a growing interest in experiential teaching as an alternative to traditional teacher-centred methods (Wang & Wen, 2023). The student-centred approach encompasses several instructional techniques that shift the role of the teacher from being a sole decision maker and issue solution inside the classroom. Instead, this strategy views the teacher as a guide, facilitator, mentor, coach, or consultant who supports and facilitates the teaching and learning process (Ezurike & Ayo-Vaughan, 2020). The effects of teacher-centred and student-centred strategies on student academic achievement of students have been researched. Among others, the study of Precious and Feyisetan (2020) found that the student-centred strategy is more effective in improving student performance in Biology. Aside from concern about student academic performance, student retention, which is the capacity to remember or identify something learned or experienced, is also important in teaching and learning experience (Adonu, 2021). As retention is measured in conjunction with accomplishment, it is likely that if what has been learned is retained, it will result in more remarkable achievement.

Think-Pair-Share and Peer Tutoring strategies, among others as co-operative teaching and learning strategies, could be a good suggestion (Adam, 2022) to foster full classroom

cooperation between teachers and students (Sharma & Priyamvada, 2018); improve expertise and understanding towards implementing elements of the content materials (Wang et. al, 2023).

Think-Pair-Share is a collaborative discussion strategy where students pair up with a partner to discuss questions for a few minutes. Frank Lyman first used it in 1981 (Sharma & Priyamvada, 2018). It works when a teacher asks questions; students can think quietly and form a pair to brainstorm ideas. Finally, the entire class participates in a discussion. According to Abdurrahman (2015), the think-pair-share method is an approach that is intended to provide students with the opportunity to reflect on a certain subject by coming up with their thoughts and then discussing those ideas with other students. Think-Pair-Share (TPS) enables student to express their independence of thought, engage in conversation with their seatmates to share ideas and demonstrate their desire to participate in or contribute to class debates (Mundelsee & Murkowski, 2021). In addition to the TPS strategy, Peer Tutoring (PT) is another functional cooperative strategy that promotes inclusive education for learners from various backgrounds (Saju & Mathew, 2022). Peer tutoring is an instructional strategy that involves student groups connecting high achievers with low achievers or students who have similar success levels for group reading and study sessions (Alane & Scott, 2022).

According to the findings of research conducted by Sharma and Mahajan (2021), TPS and PT are strategies that successfully improved students' learning outcomes. Student-centred strategies positively influenced students' attitudes toward and performance in Biology (Akinbadewa & Sofowora, 2020). Think-Pair-Share cooperative learning has positive effects on student achievement and attitudes (Ismail et al., 2022). Mundelsee and Murkowski (2021) also reported that TPS strategy improves student academic outcomes. Evidence from the study of Parker and Asare (2021) revealed that performance of students in Biology is enhanced by TPS. On the other hand, the use of PT has also been reported to facilitate learning process for students due to the conducive environment engendered (Alegre, 2020; Odo & Nwachukwu, 2020; Gongden, 2021). From researches, evidences show that both TPS and PT improve student academic performance (Akinbadewa & Sofowora, 2020). The Think Pair Share strategy involving observation experiments has been reported to benefits student retention and cognitive learning outcomes (Aslami, 2021). Studies such as Kaviva (2021) and Kalu-Uche and Ogbonna (2021) have also shown that Peer Tutoring has a beneficial impact on the academic performance and retention of students with lower learning abilities.

Argument abounds concerning which student-centred strategy is best determinants of students' performance and retention in Biology. Some authors are of the opinion that Think-Pair-Share (TPS) yields superior levels of student achievement and retention when compared to alternative instructional strategies (Hasibuan, 2019; Kurjum, 2020; Abiodun, 2022). Others maintain the position that Peer-Tutoring (PT) is more effective in improving student academic performance and retention (Kaviva, 2021; Kalu-Uche & Ogbonna, 2021). With this lack of consensus, the present study seeks to determine the effect of Think-Pair-Share (TPS) and Peer-Tutoring (PT) Teaching Strategies as determinants of Students' retention in Biology. This study aims to examine the relative impact of Think Pair Share and Peer Tutoring strategies on students' learning outcomes in Biology, with a special attempt to answer the following question: What is the main effect of TPS teaching strategies on students' achievement and retention in

Biology? What is the relative effect of PT teaching strategies on students' achievement and retention in Biology?

Hypotheses

The following research hypotheses were addressed in the study:

1. There is no significant main effect of TPS and TS teaching strategies on students' achievement and retention in Biology.
2. There is no significant relative effect of TPS and PT teaching strategies on students' achievement based on gender in retention test in Biology.

Methodology

In this study, a quasi-experimental research design with a pre-test, post-test, re-test, and non-equivalent control group was used.

Participants comprised all senior secondary school two students in Somolu Local Government Area, Education District II, Lagos State. The study sample was made up of 172 students selected from senior secondary schools in Somolu Local Government Area. The sampling adopted a multistage approach. Firstly, one Education District was selected at random from among the six Education Districts within Lagos State. Secondly, one Local Government was randomly selected from the three local government areas in Educational District II. Thirdly, three senior secondary schools were randomly selected from the Local Government. Finally, one SS II (science class) class was randomly selected in each school. The three schools were randomly assigned to one of the three experimental groups.

The instrument for this study was developed, validated and used to collect data were as follows: Instructional Guide for Research Assistants (IGRA), Instructional Guide for Think Pair Share Strategy (IGTPSS), Instructional Guide for Peer Tutoring Strategy (IGPTS), Instructional Guide for Lecture Teaching Strategy (LGTTS) and Biology Achievement Test (BAT). The reliability of BAT was established using Kuder-Richardson KR20 formula (KR-20) at coefficient of 0.84. The researcher developed and validated the instruments to ensure their sensitivity in distinguishing differences among the treatment groups. Additional measures were taken to uphold the instruments' sensitivity and ensure their internal and external validity.

The Instructional Training Guide for Research Assistants (ITGRA) consists of the stages in which the research assistants were trained and the guiding principles of each strategy, with the lesson format. The Instructional Guide and lesson guide for the three treatments outlined step-by-step instructions for the research assistants for the purpose of effective teaching. The Biology Achievement Test (Form A and B) instrument consists of two sections; section A comprises students' bio data which included subject, class, gender, time, age and name/number, while section B consists of thirty objective questions drawn with four options A – D which included one correct option among the options given from ten years (2011-2022) of WAEC past questions. This instrument was concurrently used for the achievement test and retention test.

The students took the Form A of BAT before the commencement of the five-week instructional period. At the end of the instructional periods, the post-test BAT (Form B) was conducted in tandem with the instructions. The outcomes of both the experimental and control groups were thus recorded. A single point was allocated to each test item in the pre-test, post-test, and retention test. The minimum score was zero (0), and the maximum score was thirty (30).

The experiment lasted for five weeks, and the study's chosen subject was taught using an instructional strategy, within eighty minutes allocated for each teaching session. Each accurate response received a score of one on the Biology Achievement Test (BAT), whereas an incorrect response received a score of zero. BAT allowed for a maximum score of 30. Two weeks after the post-BAT, the retention test was administered, and as indicated earlier, the Form A of-BAT was used as the retention test. The researcher revisited the sample schools and administered the retention test to the same students she used for the experiments.

The researcher used the statistical measures of mean and standard deviation to analyse the data. The hypotheses formulated were tested using the Analysis of Covariance (ANCOVA) at a significance level of 0.05.

Results

Research Question 1

What is the main effect of TPS and PT teaching strategies on students' achievement and retention in Biology?

Table 1: Descriptive Statistics of Achievement by main effect of TPS and PT teaching strategies on students' achievement

Treatment	Pre-test		Post-test		Mean Difference
	mean	SD	Mean	SD	
TPS Strategy (56)	12.30	4.69	20.71	4.43	8.41
PT Strategy (56)	12.13	5.05	22.32	4.55	10.19
LT Strategy (60))	10.92	4.62	12.37	3.52	1.45

Table 1 provides evidence that students in the experimental groups (Think Pair Share Strategy (TPSS) and Peer Tutoring Strategy (PTS)) achieved higher post-test mean scores (20.71 and 22.32, respectively) and greater mean gains (8.41 and 10.19, respectively) compared to students in the control group (Lecture Teaching Strategy (LT)) with a post-test mean score of 12.37 and a mean gain of 1.45. Specifically, the Peer Tutoring Strategy treatment resulted in 84.01% increase in achievement, while Think Pair Share Strategy yielded a 68.37% increase in students' achievement in Biology.

Table 2: Descriptive Statistics of Retention in Biology by main effect of TPS and PT teaching strategies on students' achievement

Treatment	Pre-test		Post-test		Mean Difference
	Mean	SD	mean	SD	
TPS Strategy (56)	20.71	4.43	20.96	4.42	0.25
PT Strategy (56)	22.32	4.55	22.61	4.97	0.29
LT Strategy (60))	12.37	5.52	10.45	5.07	1.92

The mean of retention test scores for the Peer Tutoring Strategy (22.61, SD 4.97) was slightly higher than that of the Think Pair Share Strategy (20.96, SD 4.42). However, all the students in the experimental groups outscored the other students in the Lecture Teaching Strategy (control group) (10.45, SD5.07) in terms of retention.

A critical examination of table 2 reveals that students in the Think Pair Share Strategy experimental group experienced a mean gain of 0.25 in retention, while the Peer Tutoring Strategy treatment resulted in a mean gain of 0.29 in retention. On the other hand, students in the Lecture Teaching Strategy control group experienced a mean loss of 1.92 in retention in learning Biology. Specifically, the Peer Tutoring Strategy had a positive impact on students' retention to learn Biology, while Think Pair Share Strategy also influenced students' retention to learn the subject. The Lecture teaching strategy also resulted in the negative post-retention scores. Therefore, Lecture teaching does not have impact in students' retention in Biology.

Hypothesis One

There is no significant main effect of TPS and TS teaching strategies on students' achievement and retention in Biology.

Table 3: Pair wise Comparison of Biology Achievement

Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
TPSS	20.362 ^a	.492	19.391	21.333
PTS	22.201 ^a	.511	21.192	23.210
LTS	12.895 ^a	.494	11.919	13.871

a. Covariates appearing in the model are evaluated at the following Values Achievement = 11.7616

Table 3 reveals that the differences in mean achievement scores between the experimental groups were statistically significant. The Peer Tutoring Strategy had significantly higher scores than the Think Pair Share Strategy, and both experimental groups had significantly higher scores than the control group.

Regarding Retention in Biology, the main effect of treatment was found to be statistically significant. The post hoc tests showed a statistically significant difference in mean retention scores between the Peer Tutoring Strategy and Think Pair Share strategy.

Research Question 2:

What is the main effect of TPS and PT teaching strategies students' achievement based on gender in retention test in Biology?

Table 4: Descriptive Statistics of Achievement gain by Interaction of Treatment and Gender

Gender	Pre-test		Post-test		Mean Difference
	Mean	SD	Mean	SD	
TPSS Male (26)	12.26	4.98	21.19	4.42	8.54
Female (30)	12.00	4.48	20.30	4.47	8.30
PTS Male (20)	11.55	4.12	22.50	3.73	10.95
Female (36)	12.44	5.54	22.22	4.99	9.78
LTS Male (22)	10.09	5.19	11.59	6.12	1.50
Female (38)	11.39	4.25	12.82	6.43	1.43

Table 4 above shows the impact of treatment and gender interaction on students' achievement and retention in Biology. The analysis showed that male students in the Peer Tutoring Strategy in experimental group had a significant increase in achievement, with an average score rising from 11.55 to 22.50 (a mean gain of 10.95, representing a 94.81% increase). Female students in the same group also demonstrated improvement, going from 12.44 to 22.22 (a mean gain of 9.78, equivalent to a 79% increase).

In the Think Pair Share Strategy, female students experienced a gain in achievement, going from 12.00 to 20.30 (a mean gain of 8.30, representing 69.17%), while male students had an increase of 8.52 (representing 67.15%), going from 12.65 to 21.19.

Male students in the control group showed progress in achievement, going from 10.09 to 11.59 (a mean gain of 1.50), while female students' achievement increased from 11.39 to 12.82 (a mean gain of 1.43). The interaction between treatment and gender had the highest impact on the achievement of male students in the Peer Tutoring strategy, followed by female students in the Peer Tutoring Strategy. The lecture teaching strategy had the lowest gains in achievement for both male and female students (1.50 and 1.43 respectively) when comparing pre-test and post-test scores.

Table 5: Descriptive Statistics of Retention by Interaction of Treatment and Gender

Gender	Pre-test		Post-test		Mean Difference
	Mean	SD	Mean	SD	
TPSS Male (26)	21.19	4.42	21.50	4.44	0.31
Female (30)	20.30	4.47	20.50	4.43	0.20
PTS Male (20)	22.50	3.73	22.65	3.70	0.15
Female (36)	22.22	4.99	22.58	5.59	0.36
LTS Male (22)	11.59	6.12	9.55	5.75	2.04
Female (38)	12.82	6.43	10.97	4.62	1.85

Analyzing the interaction effect of treatment and gender on students' retention in Biology, as shown in the table 5 above, male students exposed to the Peer Tutoring Strategy treatment showed a increase in retention, going from 22.50 to 22.65 (a mean gain of 0.15), followed by female students of the same treatment had an increase from 22.22 to 20.58 (a mean gain of 0.36). In the Think Pair Strategy, male students experienced an increase in retention, going from 21.19 to 21.50 (a mean gain of 0.31), and female students of the same treatment showed improvement, going from 20.30 to 20.50 (a mean gain of 0.20).

Both male and female students in the lecture teaching strategy experienced a decrease in retention in Biology, decreasing from 11.59 to 9.55 and 12.82 to 10.97 (a mean loss of 2.04 and 1.85) respectively. Overall, the highest increase in retention in Biology was observed from the interaction of the Peer Tutoring Strategy treatment for both male and female students, followed by both male and female students of the Think pair Strategy treatment. The lecture teaching strategy had a negative impact both on male and female students' retention.

Hypothesis One

There is no significant relative effect of TPS and PT teaching strategies students' achievement based on gender in retention test in Biology.

Table 6: Summary of Analysis of Covariance of Achievement in Biology Scores by treatment and Gender

Source of Variation	Sum of Squares	d.f.	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5144.483a	6	857.414	63.920	.001	.699
Intercept	2639.556	1	2639.556	196.778	.001	.544
Covariate	1767.305	1	1767.305	131.752	.001	.444
Treatments	2601.464	2	1300.732	96.969	.001	.540
Gender	4.449	1	4.449	.332	.565	.002
Treatment vs Gender	10.387	2	5.193	.387	.680	.005
Error	2213.284	165	13.414			
Total	65120.000	172				
Corrected total	357.767	171				

R Squared = .699 (Adjusted R Squared = .688)

The result in table 6 showed that there was a significant main effect of treatment on students' achievement in Biology. Since the $p < 0.005$ then Post hoc tests scores ($F(2,155) = 96.969$; $p = < .001$) revealed that the main effect of treatment on Students' achievement in Biology is statistically significant.

Summary of Findings

1. There is a statistically significant effect of TPS and TS teaching strategies on students' achievement and retention in Biology.
2. There is a statistically significant effect of TPS and PT teaching strategies students' achievement based on gender in retention test in Biology.

Discussion

Based on the ANCOVA analysis for the research question, it was observed that the academic achievement of students in all three treatment groups improved, with the peer tutoring strategy showing a more substantial impact. The findings indicate that students taught biology through think pair share and peer tutoring strategies outscored those taught using lecture teaching strategy. This difference might be attributed to the active involvement of students in constructing their knowledge through these strategies. This finding aligns with previous studies that found higher achievement when using the Think Pair Share and Peer Tutoring Strategy (Ajayi, 2023).

The study reveals that there were significant improvements in students' retention in the field of Biology after their exposure to both the TPSS and PTS strategies. The data analysis demonstrated a statistically significant disparity in the retention scores among biology students who were instructed via the use of think pair share and peer tutoring strategies, as opposed to those who received lecture teaching strategy. According to research conducted by (Kurjum, 2020), the observed variation might perhaps be attributed to the heightened levels of enthusiasm and motivation that arise when students actively participate and involve themselves in the educational experience. The observed beneficial result aligns with other research that has shown a notable impact of therapy on students' retention in the field of Biology. However, students exposed to PTS showed more significant retention gains compared to the TPS and control group.

Conclusion

The research reveals a number of significant discoveries. The impact of both the Think Pair Share Strategy and Peer Tutoring Strategy interventions on students' academic performance in the field of Biology was shown to be statistically significant. Furthermore, the use of the Peer Tutoring Strategy had favourable outcomes in terms of retention; however the utilization of the Think Pair Share Strategy resulted in a marginal decline in retention. The findings of the research demonstrated a statistically significant impact of the treatment on the rate of student retention within the discipline of Biology. This implies that Peer Tutoring is more effective in improving students' achievement and retention in Biology compared to Think-Pair-Share. The observed impact of the intervention on students' academic performance and ability to retain knowledge in the field of Biology implies that traditional lecture-based teaching methods should be substituted with more efficacious and motivational cooperative tactics, such as Think Pair Share and Peer Tutoring. This suggests that given the inclusive nature of teaching and

learning, including all students rather than particular cohorts, it becomes incumbent upon educators to foster a sense of inspiration among students, so cultivating their engagement in the study of Biology via the facilitation of collaborative efforts.

Recommendations

Based on the study findings, the following recommendations are proposed:

1. The study revealed that the therapy had a statistically significant effect on the retention of students in the field of Biology. Teachers, Educational administrators and Curriculum experts should incorporate and train teachers for the implementation of Peer tutoring and Think Pair Share in developing Biology lesson plans thereby improving student's learning of the subject. Also, teachers should encourage peer teaching among students by fostering heterogeneous study groups.
2. Male students exhibited a slightly larger average increase in success compared to their female counterparts. Though, statistical analysis did not provide any significant findings on the interaction effects of therapy and gender on accomplishment and retention in the field of Biology. More initiatives should be implemented to encourage female students to study Biology, as their retention in the subject was low.

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