THINK-PAIR-SHARE AND PEER-TUTORING TEACHING APPROACHES AS DETERMINANTS OF STUDENTS' ACHIEVEMENT IN BIOLOGY

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Abstract
Biology is a scientific subject that investigates living organisms' characteristics, structure, and behaviors, and their interactions with the environment. Unfortunately, teachers have often relied on less effective approaches and have been unable to utilize learner-centered approaches in teaching biology instead of the conventional teacher-centered approaches. This has led to persistently poor performance among secondary school students in biology and remains a concern for researchers. This study investigated the effects of Think-Pair-Share (TPS) and Peer Tutoring (PT) teaching approaches on students' achievement in biology. A quasi-experimental pre-test–post-test, non-equivalent control group design was adopted. The sample comprised 172 Senior Secondary Two (SS2) students from Education District II, Lagos State, assigned to TPS, PT, and control groups. Data were collected using the Biology Achievement Test (BAT), validated by experts with a reliability coefficient of 0.89. A research question and hypothesis guided the study. Mean scores were used to answer the research questions, while Analysis of Covariance (ANCOVA) tested the hypothesis at the 0.05 significance level. Findings revealed a statistically significant main effect of the teaching approach on students' achievement in biology, with both the TPS and PT groups outperforming the control group. The results indicate that TPS and PT approaches substantially enhance students' achievement in biology. It is therefore recommended that biology teachers adopt Think-Pair-Share and peer tutoring strategies to improve learning outcomes in secondary schools.

Keywords: Achievement, Biology, Lecture teaching approach, Peer-Tutoring, Think-Pair-Share

Introduction

Biology is a scientific subject that investigates the characteristics, structure, and behaviors of life and living things with their surroundings. 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 G.I., Etokeren, I.S., & Okwelle, P.C., 2019). According to Nwuba & Osuafor (2021), biology is the study of life. Biology has 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).

Academic accomplishment is an increase in one's knowledge that occurs as a direct consequence of participating in an educational activity or program (Nwuba et al., 2022). Despite the value of biology to students and the popularity of the subject, the 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 et al., 2022). The fall in academic successes of students in biology in recent years is reflected annually in students' results reported by the testing boards, as is their performance or accomplishments in senior secondary certificate exams (Eno, 2022). Poor performance of students in biology has been attributed to teaching approaches or issues unique to each student (Sarkingobir et al., 2022; Nwuba et al., 2023). However, Munir (2022) pointed out that factors such as attendance, extracurricular activities, student grades, and teacher teaching methods contribute to improved academic achievement.

To enhance the teaching and learning of scientific subjects such as biology, several approaches have been proposed (Adam et al., 2022). These approaches are either teacher-centered or student-centered (Ezurike & Ayo-Vaughan, 2020). Teacher-centered 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 et al., 2022). It has also been noted that teacher-centered teaching tends to be more monologic, with less emphasis on student-teacher interactions in the classroom (Ning et al., 2020). The teacher-centered approach encourages student passiveness (Leon, 2021), has been linked to lower levels of self-efficacy beliefs among teachers (Kaygisiz et al., 2020), and leads to low performance among students (Samosa, 2021).

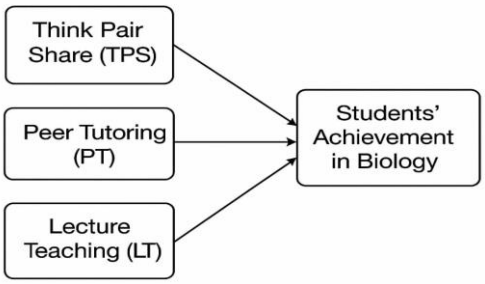
Conceptual Framework

A shift from teacher-centered to student-centered teaching has been advocated in various contexts (Madjdi et al., 2020). Cooperative learning is a student-centered, instructor-facilitated instructional approach in which small groups of students are responsible for their own learning and that of all group members (Kingdom-Aaron et al., 2019). Student-centered approaches have been found to be more conducive to student learning, with a growing interest in experiential teaching as an alternative to traditional teacher-centered approaches (Wang & Wen, 2023). The student-centered approach encompasses several instructional techniques that shift the role of the teacher from being a sole decision maker and issue solver inside the classroom. Instead, this approach views the teacher as a guide, facilitator, mentor, coach, or consultant who supports and facilitates the teaching and learning process (Ezurike & Ayo-Vaughan, 2020). Among others, Think-Pair-Share and peer tutoring are student-centered approaches (Adam et al., 2022).

Think-Pair-Share (TPS) enables students 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 approach that promotes inclusive education for learners from various backgrounds (Saju & Mathew, 2022). Peer tutoring is an instructional approach 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 two approaches that successfully improve students' learning outcomes. Student-centered approaches positively influenced students' attitudes toward and performance in biology (Akinbadewa & Sofowora, 2020).

Researchers have studied the effect of teacher-centered and student-centered approaches on student academic achievement. Among others, the study of Precious & Feyisetan (2020) found that the student-centered approach is more effective in improving student performance in biology. Think-Pair-Share cooperative learning has positive effects on student achievement and attitudes (Ismail et al., 2022). Mundelsee & Murkowski (2021) also reported that the TPS approach improves student academic outcomes. Parker and Asare's (2021) study provided evidence that TPS enhances students' performance in biology. On the other hand, the use of PT has also been reported to facilitate the learning process for students due to the conducive environment (Alegre, 2020; Odo & Nwachukwu, 2020; Gongden, 2021). The evidence in the existing literature indicates that both Think-Pair-Share (TPS) and Peer-Tutoring (PT) approaches enhance students' academic performance (Akinbadewa & Sofowora, 2020). With this lack of consensus, the present study seeks to compare the effect of Think-Pair-Share (TPS) and Peer-Tutoring (PT) teaching approaches on students' achievement in biology.

Figure 1.1 Relationship of Variables



Theoretical Framework

This study is based on Jean Piaget's constructivist learning theory, which highlights active learning through exploration and discovery (Akpan et al., 2020). Peer tutoring builds on social constructivism by promoting learning through interaction and collaboration among students (Gok, 2017; Woo et al., 2022). This approach encourages students to take charge of their learning and boosts their thinking skills (Michinov et al., 2015). From a behaviorist perspective, rewards can motivate peer tutors, showing that external factors influence the success of peer tutoring (Fakiye, 2021). Vygotsky's Zone of Proximal Development also supports peer tutoring, suggesting that learners progress best when helped by peers within their learning capacity. Additionally, cooperative methods like Think-Pair-Share, which are rooted in constructivism, encourage social interaction and shared understanding, highlighting the key

role of peer engagement in effective learning (Fauzia, 2017).

Statement of the Problem

The West African Examination Council (WAEC) has reported consistently poor achievements in external examinations over the past eleven years, highlighting the inconsistency in students' performance, according to the Chief WAEC examiner. Furthermore, reports indicate that biology students struggle to exhibit the critical thinking necessary for the subject after completing their secondary school program. Aside from this, the students' achievement in biology also needs to be tackled by investigating and implementing effective teaching approaches such as Think Pair Share and peer tutoring to address the long-standing issues of poor performance in biology. Due to the central role of biology in attaining science, technology, engineering, and mathematics (STEM) goals, the consistent unimpressive achievements in biology have hurt the vision of STEM in science learners; several scholars have suggested the need for retraining of biology teachers and improvement in teaching materials and laboratories, but little or no research has pointed to the effect of think-pair-share and peer tutoring strategies on student achievement in biology. The research also examines how the Think-Peer-Share and peer tutoring approaches can be applied to teaching biology to secondary school students and how they benefit the teachers, students, and education authorities.

Purpose of the Study

Specifically, the study aims to investigate the relative effects of Think-Pair-Share, peer tutoring, and the lecture teaching approach on students' achievement in biology.

Research Question

What is the relative effect of the Think-Pair-Share, peer tutoring, and lecture teaching approaches on students' achievement in biology?

Hypothesis

There is no significant difference in students' achievement in biology among those taught using Think-Pair-Share, peer tutoring, and lecture teaching approaches.

Methodology

This research employed a quasi-experimental design with a pre-test, post-test, non-equivalent control group setup. The participants were 172 Senior Secondary Two (SS II) students selected from three co-educational public secondary schools in Education District II, Lagos State, through purposive sampling. Before the intervention began, the research assistants underwent a two-week training on using the Think-Pair-Share (TPS) and Peer Tutoring (PT) instructional guides. After training, intact classes were preserved, and two classes were randomly assigned to the experimental group, while one class was assigned to the control group by simple random sampling. The experimental group included 56 students (26 males and 30 females) who received instruction using the TPS and PT guides, whereas the control group comprised 68 students (22 males and 38 females) taught via the conventional method.

The study was guided by three research questions and focused on two variables: the independent and dependent variables. The independent variable—treatment—had three levels: TPS, PT, and the conventional teaching method. A 3×1 factorial design was used to

organize the treatment groups. The dependent variable was the students' achievement in biology.

Data were collected using the Biology Achievement Test (BAT), which was developed based on a table of specifications to ensure content validity. The BAT contained 30 multiple-choice questions sourced from West African Senior School Certificate Examination (WASSCE) past questions from 2011 to 2022, covering the topic "Ecology and Habitat." Validation of the test instrument was conducted by two lecturers from the Department of Science and Technology Education and two from the Department of Measurement and Evaluation at the University of Lagos, who provided feedback for improvement.

To establish reliability, the BAT was administered twice within a one-week interval to a comparable group of SS II students from a school outside the study area. Scores from the two tests were correlated using Pearson's Product-Moment Correlation, resulting in a reliability coefficient of 0.88.

Following the pretest administration, the trained research assistants delivered instruction using the TPS and PT guides to the experimental group. Lessons on "Ecology and Habitat" were taught sequentially, following lesson plans prepared by the researcher. Teaching sessions adhered to the school timetable, with periods lasting 40 minutes for single sessions and 80 minutes for double sessions. The instructional intervention spanned six weeks.

Pre-test and post-test scores were analyzed using mean scores to address the research questions, while hypotheses were evaluated using Analysis of Covariance (ANCOVA) at a 0.05 significance level.

Results

Research Question: To what extent is the relative effect of the Think-Pair-Share and Peer Tutoring on students' achievement in biology?

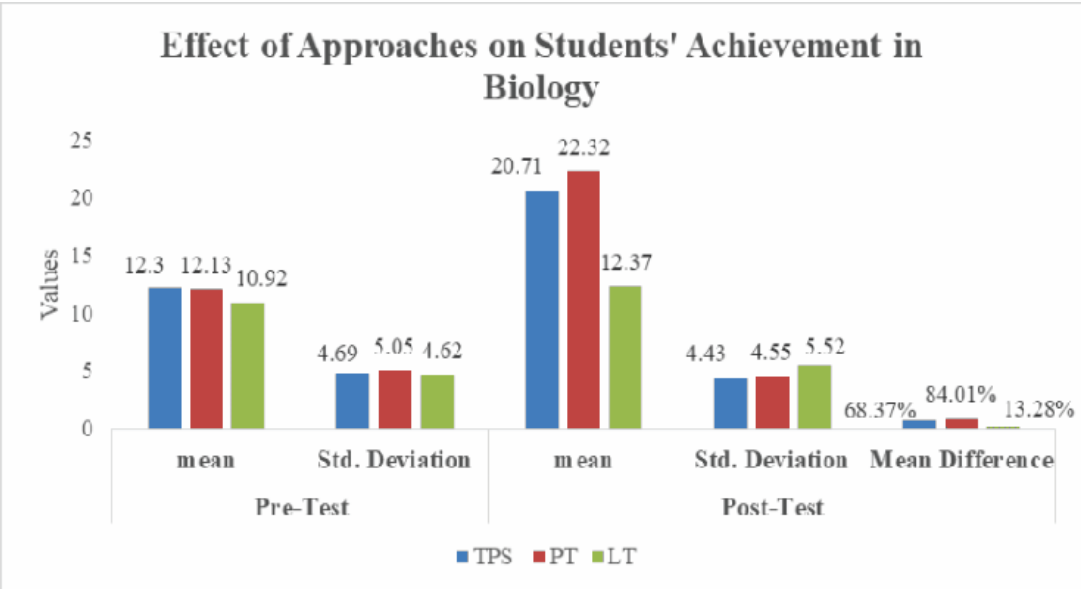


Figure 2.1: Descriptive Statistics of Students' Achievement in Biology

Figure 2.1 provides evidence that students in the experimental groups (Think Pair Share Approach (TPSA) and Peer Tutoring Approach (PTA)) 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 Approach (LTA)) with a post-test mean score of 12.37 and a mean gain of 1.45. Specifically, the peer tutoring approach treatment resulted in an 84.01% increase in achievement, while the Think Pair Share approach yielded a 68.37% increase in students' achievement in biology.

Hypothesis 1: There is no significant difference in students' achievement in biology among those taught using Think-Pair-Share, peer tutoring, and lecture teaching approaches.

Table 1a: Summary of Analysis of Covariance of Achievement in Biology Scores by treatment

Sources	Squares	df	Mean Square	F	Sig.	Squared
Corrected Model	5144.483	6	857.414	63.920	<0.01	0.699
Intercept	2639.556	1	2639.556	196.778	<0.01	0.544
Covariates	1767.305	1	1767.305	131.752	<0.01	0.444
Strategies	2601.464	2	1300.732	96.969	<0.01	0.540
Error	2213.284	165	13.414			
Total	65120.000	172				
Corrected Total	7357.767	171				

a. R-squared = .699 (Adjusted R-squared = .688)

The results in table 1a showed that there was a significant main effect of treatment on students' achievement in biology. Since $p < 0.005$, the post hoc test scores ($F(2,155) = 96.969$; $p = <.001$) revealed that the main effect of treatment on students' achievement in biology is statistically significant.

Table 1b: Pairwise comparisons of Biology Achievement (Post Hoc)

	TREATMENTS (I)	TREATMENTS (J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Scheffe	TPS	PT	-1.60714	.92097	.221	-3.8816	.6673
		LT	8.34762*	.90549	.000	6.1114	10.5838
	PT	TPS	1.60714	.92097	.221	-.6673	3.8816
		LT	9.95476*	.90549	.000	7.7186	12.1910
	LT	TPS	-8.34762*	.90549	.000	-10.5838	-6.1114
		PT	-9.95476*	.90549	.000	-12.1910	-7.7186

*. The mean difference is significant at the 0.05 level.

Table 1b presents the results of the Scheffe post hoc test, which analyzes the achievement scores of the treatments and indicates that the mean post-test scores differ significantly among the treatment groups. The peer tutoring experimental group has the highest mean score, followed by the Think Pair Share group, and then the control group.

The mean difference between the peer tutoring and the Think Pair Share experimental groups is quantified as 9.95476; $p < 0.05$, which is statistically significant. The mean difference of the Think Pair Share group and control group is derived as 8.34762; $p < 0.05$, which was also statistically significant. Lastly, the mean difference of the peer tutoring experimental group and control group was found to be statistically significant and is given as 1.60714; $p<0.05$. The results indicate that the experimental methods (peer tutoring and Think Pair Share) are significantly more effective than the lecture teaching (control group) in improving student achievement scores.

Discussion

The ANCOVA analysis for the research question revealed an improvement in the academic achievement of students in both treatment groups. The findings indicate that students taught biology through think-pair-share and peer tutoring approaches outscored those taught using the lecture teaching approach. The active involvement of students in constructing their knowledge through these approaches may account for this difference. This finding aligns with Mundelsee & Murkowski (2021, and Saju & Mathew, 2022, who found higher achievement when using the Think Pair Share and Peer Tutoring approaches.

Conclusion

The research reveals several significant discoveries. The effect of both the Think Pair Share Approach and Peer Tutoring Approach interventions on students' academic performance in the field of biology was shown to be statistically significant. Furthermore, the use of the peer tutoring approaches had favorable outcomes in terms of academic achievement; however, the utilization of the think-pair-share approach resulted in a marginal decline in academic achievement. The findings of the research show a statistically significant effect of the treatment on the student achievement within the discipline of biology. This implies that peer tutoring is more effective in improving students' achievement in biology compared to think-pair-share.

The observed effect of the intervention on students' academic performance in the field of biology implies that the lecture teaching approach 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, thus cultivating their engagement in the study of biology via the facilitation of collaborative efforts.

Recommendation

The study's findings lead to the following recommendations:

i. Biology teachers should utilize peer tutoring and think-pair-share strategies in teaching biology to enhance students' achievement in the subject.

ii. Curriculum developers and experts should organize seminars and workshops across various educational levels to sensitize teachers, textbook authors, and other stakeholders on creating biology instructional materials that address individual learner differences.

iii. Teachers should promote peer teaching by encouraging students to form heterogeneous study groups to facilitate collaborative learning and improved academic outcomes.

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