

Effect of the Think-Pair-Share Strategy on Senior Secondary School Students' Achievement in Biology

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Abstract

This study investigated the effect of the Think-Pair-Share (TPS) strategy on senior secondary school students' achievement in Biology, and examined whether the effect was moderated by gender. Drawing on a larger factorial intervention in public secondary schools in Ibadan South West Local Government Area, Oyo State, a quasi-experimental pre-test post-test non-equivalent control group design was used. Intact SS2 classes were assigned to a Think-Pair-Share condition ($n = 85$) and a conventional lecture condition ($n = 42$), and both groups were taught the topic of Ecology over a six-week period. Achievement was measured with a 40-item Biology Achievement Test (BAT) constructed from past senior school certificate examination items, with reliability established using the Kuder-Richardson 20 formula. Data were analysed using analysis of covariance (ANCOVA), with pre-test scores as the covariate. The Think-Pair-Share group attained a higher post-test mean ($M = 66.50$) than the conventional group ($M = 55.40$), and the difference was statistically significant when prior achievement was controlled. Neither the main effect of gender nor the strategy by gender interaction reached significance. The results indicate that Think-Pair-Share is an effective and gender-equitable strategy for improving achievement in senior secondary Biology, particularly when its think, pair and share phases are structured to manage cognitive load. Implications for teaching, teacher development and curriculum policy are discussed.

Keywords: Think-Pair-Share, cooperative learning, Biology achievement, cognitive load, gender, senior secondary school

Introduction

Biology is a core science subject in the Nigerian senior secondary curriculum and a gateway to medicine, agriculture, biotechnology and allied professions, yet achievement in the subject has remained disappointing over many years (Ahmad, Abubakar, & Yau, 2018). Examiners repeatedly observe that candidates struggle to explain mechanisms, interpret diagrams and apply concepts, and that performance reflects superficial rather than deep learning (Aina, 2022; West African Examinations Council, 2025). These difficulties are widely linked to the dominance of teacher-centred instruction, in which learners are positioned as passive recipients and have few structured opportunities to articulate and test their understanding.

In response, science educators have advocated cooperative strategies that give every learner a defined role in constructing knowledge (Fashola & Okoro, 2023; Pius & Anidu, 2023). Think-Pair-Share, introduced by Lyman, is among the most accessible of these. The strategy segments a task into three phases: learners first think individually about a prompt, then pair to compare and refine their reasoning, and finally share their conclusions with the class. The structure guarantees individual processing time before social negotiation, which lowers the threshold for participation and makes every learner accountable for an initial response.

Cognitive load theory offers a productive lens for understanding why a well-designed Think-Pair-Share sequence supports learning in Biology, and why a poorly designed one may not (Sweller, Ayres, & Kalyuga, 2011). Segmenting the task into think, pair and share limits split attention and allows learners to stabilise a tentative schema privately before negotiating meaning with a partner. Signalling key terms in the prompt, pre-teaching essential vocabulary and providing a single clean diagram reduce extraneous load, so that working memory can be devoted to the

germane processing of biological mechanisms rather than to managing confusing materials (Ouwehand, Lespiau, Tricot, & Paas, 2025). Where these design controls are absent, and prompts cue recall rather than reasoning, pair talk tends to drift and achievement effects are unlikely to appear.

Empirical evidence supports the strategy when it is well structured. A systematic review concluded that Think-Pair-Share generally improves participation and performance across subjects and levels (Thavaro, Plangsorn, & Siripattanakul, 2023). Studies report gains in confidence, critical thinking and understanding when a writing phase is added to anchor individual thinking (Rahman & Golamgouse-Toraub, 2025), and improvements in participation and performance in secondary classrooms (Ismail, Bungsu, & Shahrill, 2023). In Nigeria, work in Ekiti State found positive effects of Think-Pair-Share on secondary school performance (Popoola & Olofinlae, 2023). Evidence on gender within cooperative formats commonly shows parity between male and female learners when participation is balanced and contribution is visible (Pius & Anidu, 2023).

However, much of the Nigerian evidence is drawn from conditions that are not always representative of large, mixed-ability public school classrooms, and the relative contribution of Think-Pair-Share to Biology achievement under routine conditions is not firmly established (Raiyegbemi, 2020). Questions also remain about whether the strategy serves male and female learners equitably in such settings. The present study therefore examined the effect of Think-Pair-Share on senior secondary students' achievement in Biology in public schools in Ibadan South West Local Government Area, and tested whether the effect was moderated by gender.

The following null hypotheses were tested at the .05 level of significance:

H₀1: There is no significant difference in the Biology achievement of students taught with Think-Pair-Share and those taught with the conventional method when pre-test scores are controlled.

H₀2: There is no significant difference in the Biology achievement of male and female students.

H₀3: There is no significant interaction between instructional strategy and gender on students' Biology achievement.

Methods

Participants

Participants were senior secondary two (SS2) students offering Biology in public secondary schools in Ibadan South West Local Government Area, Oyo State, Nigeria. SS2 students were chosen because they have completed foundational Biology instruction and can engage in structured collaborative tasks. Intact classes were used to preserve the natural classroom environment. The analytic sample for this study comprised 127 students: 85 in the Think-Pair-Share group and 42 in the conventional control group. The wider study from which the sample is drawn included 216 students and was approximately balanced by gender, with female students forming a slight majority, reflecting the natural composition of the participating intact classes.

Materials

Achievement was measured with the Biology Achievement Test (BAT), a 40-item multiple-choice instrument with options lettered A to D. The items were sourced from senior school certificate examination past questions and aligned to the Ecology content taught during the intervention, including ecosystem components, food chains and food webs, and energy flow. Content validity was established through expert review by Biology educators. Reliability was

estimated using the Kuder-Richardson 20 formula, with an acceptable coefficient of at least .70. Parallel pre-test and post-test forms were equated for difficulty through piloting and expert judgement. Lesson plans for the Think-Pair-Share and conventional conditions standardised content and time on task across groups.

Design

A quasi-experimental, pre-test post-test non-equivalent control group design was adopted, since random assignment of individual students within intact classes was not feasible. The independent variable was instructional strategy (Think-Pair-Share versus conventional), the moderator variable was gender (male, female), and the dependent variable was Biology achievement measured by the BAT post-test. Both groups were pre-tested in the second week, taught the same Ecology content for four weeks, and post-tested in the sixth week. The Think-Pair-Share group experienced structured think, pair and share cycles with individual thinking time, paired comparison and whole-class sharing, while the conventional group was taught the same content through teacher explanation, board illustration and question-and-answer.

Data Analysis

Data were analysed using descriptive statistics (means, mean gains) and analysis of covariance (ANCOVA), with the pre-test as the covariate to adjust for initial differences between the non-equivalent groups. The main effect of strategy was tested using the omnibus ANCOVA from the wider study, and the focal contrast between the Think-Pair-Share and conventional groups was examined using Bonferroni-adjusted pairwise comparison. The main effect of gender and the strategy by gender interaction were tested within the same factorial model. All hypotheses were tested at the .05 level of significance.

Results

Table 1. *Pre-test and Post-test Achievement Means for the Think-Pair-Share and Conventional Groups*

Group	N	Pre-test M	Post-test M	Mean gain
Think-Pair-Share	85	42.30	66.50	24.20
Conventional	42	41.60	55.40	13.80

Note. Standard deviations are available in the source dataset and should be inserted prior to submission.

Table 1 shows that the two groups began at a comparable level, with pre-test means of 42.30 (Think-Pair-Share) and 41.60 (conventional). After the intervention, the Think-Pair-Share group reached a post-test mean of 66.50, compared with 55.40 for the conventional group, an observed advantage of 11.10 points. The mean gains were 24.20 and 13.80 respectively, indicating that the Think-Pair-Share group improved by roughly three quarters more than the conventional group. Figure 1 illustrates the pattern.

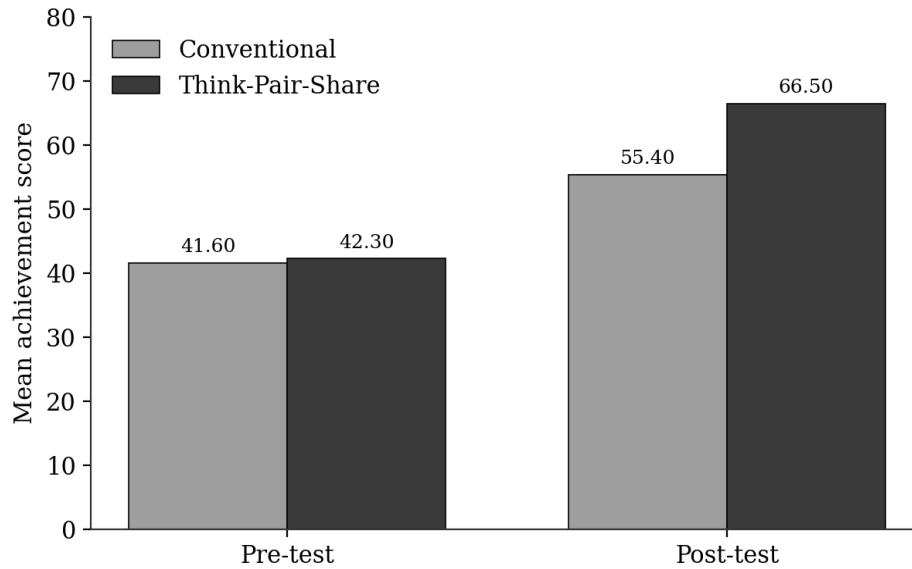


Figure 1. Pre-test and post-test achievement means for the Think-Pair-Share and conventional groups.

Table 2. *Analysis of Covariance for Achievement by Instructional Strategy*

Source	SS	df	MS	F	Sig.
Strategy (Method)	2486.35	3	828.78	124.62	.000
Pre-test (covariate)	398.42	1	398.42	59.84	.000
Error	1403.56	211	6.65		

Note. F-values are from the omnibus factorial analysis from which this contrast is drawn.

As shown in Table 2, the main effect of instructional strategy on achievement was statistically significant, $F(3, 211) = 124.62$, $p < .05$, with the pre-test covariate also significant, $F(1, 211) = 59.84$, $p < .05$. The Bonferroni-adjusted pairwise comparison confirmed that the Think-Pair-Share group significantly outperformed the conventional group ($p < .05$), with an observed post-test advantage of 11.10 points. The first null hypothesis is therefore rejected: Think-Pair-

Share produced significantly higher Biology achievement than the conventional method when prior achievement was controlled.

The main effect of gender on achievement was not statistically significant, $F(1, 211) = 1.58$, $p = .210$, and the strategy by gender interaction was likewise not significant, $F(3, 211) = 0.82$, $p = .482$. The second and third null hypotheses are therefore retained, indicating that male and female students achieved at comparable levels and that the advantage of Think-Pair-Share did not depend on gender.

Discussion

The study examined whether the Think-Pair-Share strategy improves senior secondary students' achievement in Biology, and whether the effect is moderated by gender. The results show that students taught with Think-Pair-Share achieved significantly higher post-test scores and a larger mean gain than students taught conventionally, even after adjusting for prior achievement. This pattern is consistent with cognitive load theory, which predicts that segmenting a task into private thinking, paired comparison and public sharing protects working memory and channels effort towards the germane processing of biological mechanisms (Sweller et al., 2011; Ouwehand et al., 2025). The individual thinking phase appears especially important, since it ensures that every learner forms a position before negotiation, increasing both accountability and the quality of subsequent talk.

The finding corroborates the wider literature. The direction of the effect matches the systematic review evidence that Think-Pair-Share improves participation and performance (Thavaro et al., 2023), the secondary-school gains reported by Ismail et al. (2023), and the Nigerian evidence from Ekiti State (Popoola & Olofinlae, 2023). It also reinforces the argument that the

benefits of the strategy depend on careful design, including reasoning-oriented prompts and load-aware materials, rather than on the mere act of pairing students (Rahman & Golamgouse-Toraub, 2025).

The non-significant gender effect and interaction indicate that Think-Pair-Share benefited male and female students comparably. This is consistent with the gender similarities hypothesis (Hyde, 2005) and with parity findings in cooperative settings where participation is structured and visible (Pius & Anidu, 2023). The structured turn-taking of the share phase may help to distribute participation more evenly than open class discussion, in which more confident learners can dominate.

These findings have practical implications. For teaching, they support the routine use of Think-Pair-Share with reasoning prompts, individual thinking time and concise, well-signposted materials. For teacher development, they suggest that training should focus on prompt design and load management, not merely on the mechanics of pairing. For curriculum policy, they add to the case for embedding accessible cooperative routines in the senior secondary Biology curriculum, since Think-Pair-Share requires little additional resourcing and fits readily into ordinary lesson time.

The study has limitations. The quasi-experimental design relied on intact classes, so unmeasured class-level differences cannot be ruled out, although the pre-test covariate adjusts for initial achievement. The intervention was short and confined to Ecology, which limits generalisation to other Biology strands. Retention was not assessed, so the durability of the gains is unknown. The study was also restricted to one local government area. Future work should test retention over time, span additional topics, and replicate the design across diverse settings.

Conclusion

The Think-Pair-Share strategy produced significantly higher achievement in senior secondary Biology than the conventional lecture method, and it did so equitably for male and female students. When its think, pair and share phases are structured to manage cognitive load, the strategy converts individual thinking and peer discussion into measurable attainment, while remaining simple and inexpensive to implement. Teachers, teacher educators and curriculum planners should therefore promote the disciplined use of Think-Pair-Share as a practical means of strengthening Biology achievement.

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