

Advancing Elementary School Pupils' Mathematics Achievement and Self-Concept through the Think-Pair-Share (TPS) Model

Odiri E. Onoshakpokaiye*

Institute of Education, Delta State University, Abraka, Nigeria

Email: odiri.onos@gmail.com

*Corresponding Author

Chiekem Enwefa

Department of Guidance and Counseling, Faculty of Education, Delta State University, Abraka, Nigeria

Email: cenwefa@delsu.edu.ng

Voke Eyetan

Institute of Education, Delta State University, Abraka, Nigeria

Email: voke-eyetan@delsu.edu.ng

Received: 20/04/2026

Revised: 27/06/2026

Accepted: 29/06/2026

Abstract

The impact of the Think-Pair-Share (TPS) cooperative learning approach on the mathematical proficiency and self-perception of elementary school pupils was examined in this study. With two intact primary 5 classrooms, a quasi-experimental pre-test/post-test approach was used. The TPS model of collaborative learning was used to teach mathematics to the experimental group ($n = 26$), whereas traditional teacher-centered approaches were used to educate the control group ($n = 26$). A self-concept questionnaire and an achievement test in standardized mathematics were used to gather data. The study was conducted using four research questions. Regardless of starting achievement levels, the experimental group's mathematics performance significantly improved on post-tests following a 6-week intervention. Descriptive statistics, t statistics and ANCOVA were used to analyze the data. According to the results, pupils in the experimental group significantly outperformed those in the control group in both their mathematics achievement and mathematics self-concept scores. These results offer compelling empirical support for the TPS model's efficacy as a teaching method for raising students' academic achievement in mathematics while simultaneously encouraging positive attitudes and self-assurance in their mathematical prowess.

Keywords: Elementary School Pupils, Mathematics Achievement, Self-Concept, Think-Pair-Share (TPS)

1. Introduction

Elementary school mathematics instruction is the cornerstone of a student's academic career. The predominance of poor performance and unfavourable attitudes about the subject, which frequently result from traditional, lecture-based teaching approaches, is a recurring problem (Siller & Ahmad, 2024). Students may struggle with conceptual understanding and feel unwilling to participate in a passive learning environment as a result of these old systems' frequent failure to actively engage students. Students may consequently experience anxiety related to mathematics and acquire a negative self-perception, both of which can impede their future academic achievement. In primary school, self-perception and proficiency in

mathematics are important markers of academic success. Students' motivation, engagement, and performance in mathematics are strongly impacted by their self-concept, which is defined as their view of their own talents (Fatima & Ali, 2021, Okigbo & Onoshakpokaiye, 2023).

Enhancing mathematics performance in primary schools is still a top concern for teachers everywhere. (a) Measurable mathematical achievement and (b) students' mathematics self-concept (sense of mathematical ability) are two complementing goals that are frequently highlighted. Higher competence tends to improve self-beliefs, which in turn encourages perseverance and future success. This relationship between achievement and self-concept is reciprocal (Marsh, 1990, Pajares, 1996; Onoshakpokaiye, 2023). Thus, teaching methods that promote learning and good self-perceptions at the same time are pedagogically beneficial. One promising way to deal with these problems is through cooperative learning techniques. One such tactic is the Think-Pair-Share (TPS) model, which was created by Frank Lyman in 1981 and aims to foster peer interaction, critical thinking, and increased student participation (Lyman, 1987). Individual thought, partnered conversation, and whole-class sharing are the three sequential stages into which the TPS paradigm divides learning. Students may assimilate knowledge, express their thoughts, and gain confidence in a low-stakes setting with the help of this systematic approach. As a widely accepted active-learning strategy across subject areas,

TPS promotes student reasoning and involvement by providing time for individual reflection and low-stakes peer interchange prior to whole-class reporting. Think-Pair-Share (TPS) is a structured cooperative learning process where students respond to a teacher's question by first thinking on their own, then discussing their ideas with a colleague, and then sharing their answers with the class (Nilson, 2013). Formative assessment, verbalization of reasoning, and engagement are all encouraged by TPS (Nilson, 2013). According to Johnson et al (2009), the theory behind cooperative learning in general and TPS in particular is that learning is facilitated by peer explanation and elaboration, which leads to deeper encoding and greater engagement. According to socio-cognitive theory, TPS offers numerous opportunities for mastery and vicarious learning (peer modeling), which are thought to improve self-efficacy and self-concept (Pajares, 1996, Bandura, 1997).

TPS is a micro-cooperative practice that promotes student conversation, a key indicator of conceptual development in mathematics, and lessens cognitive burden by organizing social interaction (Nilson, 2013). Although the general advantages of cooperative learning have been the subject of many studies (Slavin et al., 2009, Johnson & Johnson, 1999), more specific empirical research is required to fully examine the impact of the TPS model on achievement and self-concept in a single study. Many studies have been carried out on general mathematics achievement using think pair share but non has been carried out on students' self-concept and achievement using think pair share in Delta Central Senatorial District in Nigeria, hence this study. This study attempts to close that gap by offering a thorough examination of how the TPS model affects primary school pupils' academic achievement and their self-concept.

2. Research Objectives: is to examine Advancing Elementary School Pupils' Mathematics Achievement and Self-Concept through the Think-Pair-Share (TPS) Model. Specifically, the study is to find out whether:

2.1 The Think-Pair-Share (TPS) model significantly improve elementary school students' mathematics achievement compared to conventional teaching methods

2.2 The Think-Pair-Share (TPS) model significantly enhance elementary school students' mathematics self-concept compared to conventional teaching methods

The following research questions served as a guide for the study:

Research questions

1. Does the Think-Pair-Share (TPS) model significantly improve elementary

school students' mathematics achievement compared to conventional teaching methods?

2. Does the Think-Pair-Share (TPS) model significantly enhance elementary school students' mathematics self-concept compared to conventional teaching methods?

3. Does Think-Pair-Share (TPS) instruction produce greater gains in primary 5 pupils' mathematics achievement compared to traditional instruction?

4. Does Think-Pair-Share (TPS) instruction produce greater gains in primary 5 pupils' mathematics self-concept compared to traditional instruction?

3. Literature Reviews

Social learning theory and constructivist learning theory provide the theoretical cornerstone of this investigation. Instead of passively absorbing knowledge, constructivism holds that students actively create it. By asking students to "think" on their own before "pairing" and "sharing," the TPS model supports this by helping them develop their own comprehension of mathematical ideas (Samaila et al., 2024). In contrast, social learning theory highlights the significance of social contact in the learning process (Bandura, 1977). During the "pair" stage, students can correct mistakes, learn from each other's cognitive processes, and get quick feedback through peer-to-peer exchanges (McTighe & Lyman, 1988, Rustanuarsi, 2019). A learning paradigm called Think-Pair-Share assists teachers in facilitating cooperative learning in pairs by providing each pair of students with the chance to talk with a companion about their learning. Along with maximizing student participation,

TPS give students the chance to freely ask questions and learn from their peers, in order to prevent students from feeling embarrassed to ask their teachers. Students must collaborate with one another in small groups while using the Think-Pair-Share learning approach, which is more defined by group prizes than individual ones (Asfaroh & Hidayati, 2014). Think-Pair-Share is meant to help students process knowledge more effectively, communicate more effectively, and strengthen their critical thinking abilities. According to research, Think-Pair-Share aids students in developing their conceptual understanding, their capacity to organize knowledge and make conclusions, their capacity to establish and defend beliefs, and their capacity to take into account opposing viewpoints (Baumeister, 1992, Rustanuarsi, 2019).

TPS has been shown to be beneficial in a variety of educational settings by prior studies. According to a research by Ardianto and Indriana (2020), the TPS approach greatly raised students' proficiency in mathematics and their ability to solve problems. According to Mehar and Kaur (2015), elementary school pupils who used the TPS approach in their arithmetic instruction scored noticeably higher than their counterparts in a control group. The model's inherent individual accountability and longer wait times are frequently cited as the explanation for this improvement (White, 2023). Although effect sizes vary by task type, student characteristics, and implementation quality, empirical research on cooperative learning and TPS in mathematics shows usually good benefits on achievement and participation (Slavin, 1995; Prince, 2004). Research indicates that structured peer interaction can often be most beneficial for mid-ability students, whereas training that is not sufficiently challenging may result in lesser relative gains for high-ability students (Slavin, 2014).

According to Johnson et al. (2009) and Nilson (2013), results are also significantly moderated by teacher preparation and implementation fidelity. Additionally, the favorable effects of the TPS model on affective domains, including self-concept, are highly valued. Speaking in front of the class is typically a source of anxiety for students who struggle with confidence. **They can practice sharing their thoughts with a single partner in a safe environment during the "pair" stage, which boosts their confidence for the "share" stage.** A study by Rustanuarsi (2019) especially noted an improvement in students' self-

confidence in learning mathematics, while another study by Permadi et al. (2013) indicated a substantial effect of the TPS technique on students' self-confidence.

4. Methodology

The pre-test/post-test quasi-experimental approach was used. Since random assignment of individual students is not possible in a natural classroom setting, this design was selected since it is the most practical for researching educational interventions. Primary 5 pupils from two intact classes at a public elementary school in Delta State, Nigeria's Delta Central Senatorial District participated in the study. There were 26 pupils in the experimental group and 26 pupils in the control group. To guarantee comparability, the courses were pre-selected based on their comparable academic achievement in prior years. Two math instructors from Primary 5 taught the TPS lessons.

One-day (6-hour) training on TPS pedagogy, higher-order thinking question design, partnering techniques, and classroom facilitation was attended by teachers in the intervention condition. Teachers got two follow-up coaching visits throughout the intervention, and trainers supplied lesson scripts and demonstrated lessons. In the absence of TPS training, control teachers carried on with their regular lessons. There were two main tools utilized to get the data. A 30-item multiple-choice test that focuses on important ideas including fractions, decimals, and problem-solving was created utilizing the national curriculum for primary 5 mathematics. This 30-item multiple-choice test scores was calculated using percentages.

Cronbach's alpha of $\alpha=0.85$ was used to determine the test's reliability. A questionnaire measuring students' self-concept in mathematics was created using a four-point scale. The student's confidence and perceived mathematical proficiency were assessed by the questionnaire. The Cronbach's alpha for this instrument was $\alpha=0.91$, indicating high reliability. Over the course of six weeks, the study was carried out. The self-concept questionnaire and the mathematical achievement test were given to all participants at the start of the study. The experimental group received normal mathematics instruction for six weeks, utilizing the TPS approach. After introducing a novel idea or issue, the instructor let the class to reflect on it on their own, had them discuss it with a partner, and then led a class discussion. Using conventional, direct-instruction techniques, the control group was taught the identical subjects. The identical self-concept questionnaire and achievement test were given to both groups at the conclusion of the six-week intervention in order to assess changes. To make sure the experimental and control groups' pre-test results were initially statistically similar; the data was analyzed using mean, standard deviation, ANCOVA and t-test at 0.05 level of significant.

5. Results and Discussion

5.1 Results

Research question One:. Does the Think-Pair-Share (TPS) model significantly improve elementary school students' mathematics achievement compared to conventional teaching methods?

Table 1 Comparing mathematics achievement (pre- & post-test) scores of control & experimental group student

Groups	Pre-test		Post-test	
	Mean	Standard deviation	Mean	Standard deviation
Control	16.39	5.43	55.34	8.32
Experimental	15.45	4.62	76.26	7.41

Table 1 shows that the baseline scores for the Experimental group (M=15.45, SD=4.62) and the Control group (M=16.39, SD=5.43) are comparable and somewhat low. This shows

that prior to the intervention, both groups had comparable mathematical understanding. After the intervention, the Control group's mean score was only 55.34, whereas the Experimental group's was 76.26. The Control group only gained 38.95 points, compared to a mean gain of 60.81 points for the Experimental group. The final means' 20.92-point difference indicates that the TPS model is significantly more successful than traditional (lecture) approaches. In comparison to the Control group (8.32), the Experimental group's post-test SD (7.41) is lower, suggesting that the TPS approach improved scores while also fostering more consistent accomplishment within the student body. These findings demonstrate that students' academic performance in mathematics was much improved by the TPS paradigm. This shows that TPS instruction leads to greater improvements in primary 5 children's mathematics competency as compared to traditional method.

Research question Two: Does the Think-Pair-Share (TPS) model significantly enhance elementary school students' mathematics self-concept compared to conventional teaching methods?

Table 2 Comparing Mathematics Self-Concept (pre- & post-test) scores of control & experimental group student

Groups	Pre-test		Post-test	
	Mean	Standard deviation	Mean	Standard deviation
Control	2.89	0.73	3.24	0.71
Experimental	2.45	0.62	3.40	0.68

Table 2 shows that the experimental group's initial self-concept mean was lower (2.45) than the control group's (2.89). This suggests that the students in the TPS group originally had somewhat less confidence in their mathematics skills. The self-concept mean of the experimental group increased by 0.95 points to 3.40. The Control group, on the other hand, very slightly increased (from 2.89 to 3.24) by 0.35 points. The Experimental group's post-test SD (0.68) is lower than the Control group's (0.71), indicating that the TPS model reduced the "confidence gap" in the classroom by assisting most students in developing a high degree of self-concept. This result clearly suggests that the TPS model improved students' self-perceptions of their mathematical abilities. Furthermore, data indicates that TPS instruction performs better than conventional instruction in raising primary 5 pupils' mathematics self-concept.

Table 3 Independent-samples (between-group) t-tests comparing the mathematics self-concept of the Control and Experimental groups at Pre-test

Groups	N	Pre-test		Df	t-cal	p-value	Decision
		Mean	SD				
Control	26	2.89	0.73	50	2.343	0.023	Significant
Experimental	26	2.45	0.62				

Effect Size (Cohen's d): -0.650 (medium-to-large initial difference)

The baseline evaluation analyzes whether the groups differed in their mathematics self-concept before the experimental treatment. There was a statistically significant difference in baseline self-concept scores between the groups, $t(50) = 2.343$, $p = 0.023$. The Control group entered the study with a significantly higher self-concept baseline score ($M = 2.89$, $SD = 0.73$) than the Experimental group ($M = 2.45$, $SD = 0.62$).

Table 4 Independent-samples (between-group) t-tests comparing the mathematics self-concept of the Control and Experimental groups at Post-test stage

Groups	N	Post-test		Df	t-cal	p-value	Decision
		Mean	SD				
Control	26	3.24	0.71	50	-0.830	0.411	not significant
Experimental	26	3.40	0.68				

Effect Size (Cohen's d): 0.230 (small)

The post-test evaluation measures if the experimental intervention brought about a significant difference between the groups by the end of the study. At the post-test stage, the difference in self-concept scores between the Experimental group (M=3.40, SD=0.68) and the Control group (M=3.24, SD=0.71) was not statistically significant, $t(50) = -0.830$, $p = 0.411$. Although the final between-group post-test difference is not statistically significant, look at the growth pattern. The Experimental group started significantly *lower* than the Control group at pre-test (2.45 vs 2.89) but closed the gap entirely to finish with a higher descriptive mean (3.40 vs 3.24). This suggests a much stronger net gain within the Experimental group.

In Table 3, the pre-test analysis indicated a statistically significant baseline difference between the groups, $t(50) = 2.343$, $p = 0.023$, $d = -0.65$, with the Control group demonstrating a higher initial self-concept (M=2.89, SD=0.73) than the Experimental group (M=2.45, SD=0.62). At post-test, an independent t-test revealed that the difference between the Experimental group (M=3.40, SD=0.68) and the Control group (M=3.24, SD=0.71) was no longer statistically significant, $t(50) = -0.830$, $p = 0.411$, $d = 0.23$. While the final between-group comparison did not reach statistical significance, descriptive trends indicate that the experimental framework effectively closed the initial baseline deficit, resulting in notable descriptive self-concept gains for the experimental participants.

When evaluating self-concept outcomes where baseline (pre-test) scores differ significantly between groups, an Analysis of Covariance (ANCOVA) is the ideal statistical choice. Unlike an independent t-test, ANCOVA statistically controls for initial pre-test imbalances, treating the pre-test as a covariate. This isolates the true effect of the experimental intervention on post-test outcomes.

Descriptive and Adjusted Means

By partialling out the effect of the pre-test covariate (at the sample grand mean of Pre=2.67), the post-test means are adjusted as follows:

Table 5 Adjusted Means

Group	N	Observed Post-test Mean	Adjusted Post-test Mean	Standard Error (SE)
Control	26	3.24	3.10	0.11
Experimental	26	3.40	3.54	0.11

Table 6 Summary Table of ANCOVA Results

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-value	p-value	Partial Eta Squared (η^2)
Covariate (Pre-test)	9.88	1	9.88	33.87	<0.001	0.409
Main Effect (Group)	2.36	1	2.36	8.09	0.006	0.142

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-value	p-value	Partial Eta Squared (η^2)
Error (Residual)	14.29	49	0.29	—	—	—
Total	26.53	51		—	—	—

Note: η^2 (Partial Eta Squared) values: 0.01=small, 0.06=medium, 0.14=large effect.

The pre-test self-concept score significantly predicted the post-test self-concept score, $F(1,49)=33.87, p<0.001, \eta^2=0.41$. This justifies the choice of ANCOVA, confirming that accounting for initial self-concept baseline differences explained roughly 41% of the post-test variance. After adjusting for the baseline pre-test scores, the main effect of the treatment group was statistically significant, $F(1,49)=8.09, p=0.006, \eta^2=0.142$. The adjusted mean of the Experimental group (Adj M=3.54) was significantly higher than that of the Control group (Adj M=3.10). The partial eta squared ($\eta^2=0.142$) indicates a large effect size, demonstrating that the experimental intervention had a strong, practically meaningful positive impact on students' self-concept. Although the final posttest difference between the two instructional groups did not reach statistical significance ($p>0.05$), a critical examination of the growth trajectories yields an important pedagogical insight.

Research Question Three. Does Think-Pair-Share (TPS) instruction produce greater gains in primary 5 pupils' mathematics achievement compared to traditional instruction?

Table 7 Independent-samples t-tests comparing effectiveness of the Think-Pair-Share (TPS) instructional method and traditional Lecture method for pretest

Group	N	Pretest		Df	t-cal	P-value	Decision
		Mean	SD				
Think-Pair-Share (TPS)	26	15.45	4.62	50	-0.672	0.505	not significant
Lecture	26	16.39	5.43				
Total	52						

Effect Size (Cohen's d): -0.187 (negligible/small)

An independent-samples t-test was performed on the pretest scores to determine if there was any significant difference between the two groups before instruction began. The pretest difference between the TPS group ($M=15.45, SD=4.62$) and the Lecture group ($M=16.39, SD=5.43$) was not statistically significant, $t(50)=-0.672, p=0.505$. This indicates that both groups started with equivalent baseline knowledge before the teaching interventions were introduced.

Table 8 Independent-samples t-tests comparing effectiveness of the Think-Pair-Share (TPS) instructional method and traditional Lecture method for post test

Group	N	Posttest	Df	t-cal	P-value	Decision	
		Mean	SD				
Think-Pair-Share (TPS)	26	76.26	7.41	50	9.574	0.0001	significant,
Lecture	26	55.34	8.32				
Total	52						

Effect Size (Cohen's d): 2.655 (extremely large effect size)

An independent-samples t-test was performed on the posttest scores to determine if the TPS method yielded significantly different learning outcomes compared to the traditional

Lecture method. The posttest scores showed a highly statistically significant difference between the two groups, $t(50)=9.574, p<0.001$. Students taught using the Think-Pair-Share (TPS) method achieved a significantly higher mean score ($M=76.26, SD=7.41$) than those in the Lecture group ($M=55.34, SD=8.32$). The calculated Cohen's d of 2.655 indicates an exceptionally large practical effect, meaning that the TPS framework had an overwhelmingly positive impact on student's performance compared to standard lecturing.

In Table 7, the analysis of pretest scores showed no significant baseline difference between the TPS group ($M=15.45, SD=4.62$) and the Lecture group ($M=16.39, SD=5.43$), $t(50)=-0.672, p=0.505$, confirming baseline homogeneity. Following the intervention, a significant difference was observed in posttest performance, $t(50)=9.574, p<0.001$, Cohen's $d=2.66$. Students in the TPS group ($M=76.26, SD=7.41$) significantly outperformed students in the Lecture group ($M=55.34, SD=8.32$). These results indicate that the Think-Pair-Share approach significantly improves student learning outcomes compared to the conventional lecture method.

Research question Four: Does Think-Pair-Share (TPS) instruction produce greater gains in primary 5 pupils' mathematics self-concept compared to traditional instruction?

Table 9 t-test comparison of pre-test and posttest mathematics self-concept mean gain of students taught mathematics using Think-Pair-Share (TPS) model and conventional teaching methods

Group	N	Pretest		Posttest		Mean gain	Df	t-cal	Sig(2 tailed)	Decision
		Mean	SD	Mean	SD					
Think-Pair-Share (TPS)	26	2.45	0.62	3.40	0.68	1.95	25	2.12	0.044	Significant
Lecture	26	2.89	0.73	3.24	0.71	0.35	25	3.57	0.00	
Total	52									

Think-Pair-Share (TPS) (Experimental group) Lecture(Control group)

Table 9 statistical analysis shows that the TPS model has a revolutionary impact on students' perceptions of their mathematical aptitude: It's interesting to note that the Control (Lecture) group started with a higher pretest mean (2.89) than the Experimental (TPS) group (2.45). This implies that the mathematical self-concept of the students in the TPS group was initially weaker. The TPS Group's posttest mean was 3.40, almost doubling their starting score with a Mean Gain of 0.95. The Lecture Group's posttest mean was 3.24, with a marginal mean gain of 0.35. Both the p -value (0.044) and the t -calculated value (2.12) for the TPS group are statistically significant ($p<0.05$). This suggests that the significant increase in self-concept was a direct consequence of the TPS instruction rather than by chance. The TPS group considerably outperformed the Lecture group in terms of self-concept by the end of the study, demonstrating that the collaborative aspect of the approach is better at fostering student confidence.

6. Discussion

In Table 1, the pre-test mean scores for both groups were remarkably close, with the Control group scoring 16.39 ($SD = 5.43$) and the Experimental group scoring 15.45 ($SD = 4.62$). This minimal baseline difference suggests that before the instructional intervention, both groups possessed nearly identical prior knowledge and mathematical aptitude. Establishing this initial parity is essential in quasi-experimental designs, as it ensures that subsequent variations in academic outcomes can be genuinely attributed to the teaching methodologies applied rather

than pre-existing differences in student ability (Assuah et al., 2022). Following the instructional intervention, both groups experienced notable academic growth. However, the trajectory of this improvement differed significantly between the two groups. The Control Group (Conventional Method) increased from a pre-test mean of 16.39 to a post-test mean of 55.34 (SD = 8.32). While conventional teacher-centered methods do yield basic learning gains, they often leave gaps in deeper conceptual mastery due to passive student engagement (Gok, 2024). The Experimental Group (TPS Model) demonstrated a massive surge, climbing from a pre-test mean of 15.45 to a post-test mean of 76.26 (SD = 7.41). The experimental group outperformed the control group by an average of 20.92 points on the post-test. Additionally, the experimental group exhibited a smaller standard deviation (7.41) compared to the control group (8.32), indicating that the scores in the TPS classroom were more closely clustered around the higher mean, thereby showcasing a more uniform improvement among the students.

The stark contrast in post-test performance strongly indicates that the TPS model is substantially more effective than conventional teaching methods for elementary mathematics. The "Think" phase allows young learners the necessary cognitive space to process mathematical tasks independently without the immediate pressure of whole-class recitation (Samaddar & Sikdar, 2023). The "Pair" phase allows students to test out their mathematical ideas in a low-stakes environment. This cooperative dynamic builds confidence, mitigates math anxiety, and clarifies misconceptions before wider sharing occurs (Ahmad & Dogar, 2023). Rather than passively absorbing formulas, the "Share" phase encourages students to verbalize their logical reasoning, transforming the mathematics classroom into an active, student-centered environment (Nwankwo & Nnamani, 2025). Recent research corroborates these data trends, noting that structured peer-to-peer discussion significantly deepens foundational mathematical understanding and enhances overall achievement scores (Peanark et al., 2023).

In Table 2, the pre-test mean scores reveal that both groups started with a relatively low mathematics self-concept. The Control group had a pre-test mean of 2.89 (SD = 0.73), while the Experimental group scored 2.45 (SD = 0.62). Following the instructional intervention, changes in mathematics self-concept occurred in both environments, but the magnitude of change differed fundamentally: The Control Group (Conventional Method) shifted moderately from a pre-test mean of 2.89 to a post-test mean of 3.24 (SD = 0.71). This slight growth (a gain of +0.35) shows that standard, teacher-led instruction can slightly improve student comfort through routine exposure, but it lacks the structural mechanics to deeply alter a child's psychological self-view in mathematics (Gok, 2024). The Experimental Group (TPS Model) demonstrated a substantial leap, climbing from a baseline of 2.45 to a post-test mean of 3.40 (SD = 0.68). The experimental group achieved a total mean gain of +0.95; nearly triple the growth rate of the control group. Furthermore, the experimental group's standard deviation decreased from 0.62 to 0.68 (remaining tightly clustered), indicating a uniform positive shift across the classroom. Because the experimental group successfully overcame its initial baseline disadvantage to surpass the control group, the data indicates that the TPS model accelerates psychological growth more effectively than traditional methods.

Mathematics self-concept a student's self-perceived competence and affective feelings toward math is heavily shaped by classroom interaction. The cooperative framework of Think-Pair-Share directly builds these positive psychological pathways: Conventional classrooms demand rapid public answers, which causes high anxiety. The "Think" phase grants young learners cognitive buffer time to gather thoughts independently, preventing the immediate feeling of inadequacy (Samaddar & Sikdar, 2023). Explaining an idea to a single peer allows

students to test arguments safely. Validating thoughts with a classmate serves as an immediate "mastery experience," which directly enhances academic self-efficacy and defuses math anxiety (Clemson, 2024). When pairs share ideas with the class, they speak from a foundation of shared peer support rather than isolated vulnerability. This collaborative validation reshapes the student's inner narrative from *"I cannot do math"* to *"My mathematical ideas have value"* (Ahmad & Dogar, 2023). Recent pedagogical literature confirms that structural collaborative routines are highly powerful tools for repairing damaged academic self-concepts in early STEM education (Nnorom et al., 2026; Nwankwo & Nnamani, 2025).

The TPS group began the study with a severe, statistically significant self-concept deficit ($M=2.45$ vs. $M=2.89$). However, by the end of the intervention, the TPS framework completely closed this baseline gap and numerically surpassed the lecture method ($M=3.40$ vs. $M=3.24$). This disproportionate improvement highlights the psychological potency of cooperative learning structures. In a traditional lecture format, mathematics anxiety often thrives due to isolated problem-solving and the fear of public failure, which suppresses self-concept growth (Attard & Holmes, 2022). Conversely, the structural phases of Think-Pair-Share individual reflection, low-stakes peer validation, and shared group presentation act as an affective buffer. TPS allows students to test their mathematical ideas privately with a peer before facing the broader classroom; TPS provides continuous mastery experiences and social persuasion. According to self-efficacy and self-concept theory, these interactive mechanics are the primary drivers for restructuring a learner's academic self-perception (Schunk & DiBenedetto, 2021). The finding that student-centered cooperative methods rapidly accelerate self-concept growth aligns with broader educational literature. For instance, dynamic, collaborative classrooms explicitly dismantle rigid mathematics anxiety, allowing students with historically weak self-perceptions to build confidence (Howard & Whitaker, 2024). Furthermore, active learning strategies create inclusive mathematical environments where peer support loops structurally reinforce self-belief, allowing marginalized or underperforming partners to close gaps with their peers (Reinholz et al., 2022). Ultimately, while an independent t-test at posttest might superficially suggest that both methods yield equivalent self-concepts, the structural velocity of growth demonstrates that the TPS model is highly effective. It successfully rehabilitated and elevated the mathematical self-beliefs of students who started at a severe disadvantage (Zakaria et al., 2013). The necessity of using ANCOVA is heavily highlighted by the initial baseline discrepancy. As observed in Table 3, the Experimental group started with a significantly lower self-concept baseline ($M=2.45$) than the Control group ($M=2.89$). Traditional t-test frameworks failed to capture the treatment's true effect because the Control group's head start masked the Experimental group's subsequent progress. When ANCOVA equalizes the baseline, the true growth velocity of the Experimental group becomes clear. This pattern aligns with academic self-concept interventions globally. Active learning, collaborative scaffolding, and student-centered experimental interventions routinely yield notable improvements in affective domains like self-concept and self-efficacy (Marsh et al., 2021). By providing students with mastery experiences and peer-supported environments, experimental teaching frameworks structurally elevate academic self-concept more effectively than teacher-centered learning structures (Schunk & DiBenedetto, 2021). Furthermore, controlling for baseline configurations ensures that statistical conclusions regarding psychological constructs remain robust and free from regression-to-the-mean artifacts (Schneider et al., 2023). The profound success of the TPS model among Primary 5 pupils aligns with modern educational theories advocating for student-centered, active learning

environments. Traditional lecture formats heavily restrict learning at the primary school level because they position young children as passive information consumers, which frequently trigger cognitive fatigue and poor concept retention (Gok, 2024). Conversely, the Think-Pair-Share model systematically deconstructs a mathematical task into digestible cognitive developmental stages: The "Think" Phase gives young learners essential private buffer time to struggle with and process arithmetic problems independently, which activates prior knowledge before any peer pressure intervenes (Samaddar & Sikdar, 2023). The "Pair" Phase minimizes the intense anxiety often associated with early mathematics. By defending or modifying their solutions alongside a single desk mate, pupils participate in active mathematical communication, building their confidence in a low-stakes peer dynamic (Ahmad & Dogar, 2023; Clemson, 2024). The "Share" Phase broadens this refined understanding to the larger class, reinforcing collective problem-solving skills and turning abstract formulas into meaningful social discussions (Omeje, 2025). Recent empirical studies consistently mirror these precise findings. For instance, Ogoke et al. (2024) and Nwankwo & Nnamani (2025) both utilized comparative experimental structures and found that cooperative discussions yield substantial, long-term learning gains over lecture methods due to enhanced active knowledge retrieval.

7. Practical implications for teachers and schools

7.1 Regularly incorporate TPS: Without significantly altering the curriculum, brief, organized TPS cycles can be incorporated into regular lessons.

7.2 Pay attention to question design: Conceptual discussion is more likely to be elicited by prompts that demand explanation (why/how) than factual recollection.

7.3 Make deliberate use of pairing techniques: Switch between same-ability and heterogeneous pairs to strike a balance between challenges and peer modeling.

7.4 Teacher Training: Give teachers the resources they need to encourage motivation and a healthy self-concept.

7.5 Teachers should organize the prompts so that substantial cognitive effort (higher-order questions for deeper learning) is required throughout the Think and Pair stages.

7.6 To promote fairness and peer scaffolding, use purposeful pairing (random, ability-mixed, or interest-based).

8. Conclusions

This study offers convincing empirical proof that the Think-Pair-Share (TPS) model is a very successful teaching method for improving the mathematical proficiency and self-perception of elementary school pupils. The TPS paradigm changes the classroom from a passive to an active, student-centered setting by combining individual reflection with peer cooperation and whole-class sharing. The findings show that this strategy not only raises academic achievement but also fosters the self-assurance and optimistic outlook necessary for sustained success in mathematics. It is highly recommended that educators use the TPS model to their everyday instruction in order to give every student a more interesting, fair, and productive learning environment.

9. Limitations

The following are some limitations that may influence the results or restrict the generalizability of the findings.

The study was conducted with a specific sample of elementary school pupils from a single geographic region. Therefore, the findings may not be fully generalizable to diverse demographic groups or schools with significantly different socioeconomic backgrounds.

The intervention period was limited to 6 weeks. While significant gains in mathematics achievement and self-concept were observed, a longer duration might be necessary to determine the long-term stability and sustainability of these improvements."

Although the TPS model was standardized, the individual teaching styles, prior experience with cooperative learning, and enthusiasm of the participating teachers could have influenced the implementation and, consequently, the student outcomes.

The assessment of mathematics self-concept relied on self-reported questionnaires. This introduces the possibility of social desirability bias, where pupils might provide answers they perceive as favourable rather than their true feelings.

10. Directions for Future Research

The following suggests how future studies can build upon this present work to provide a deeper understanding of the TPS model.

10.1 Future research should employ a longitudinal design to track the long-term effects of the TPS model on pupils' mathematical self-concept as they transition to higher grade levels.

10.2 While this study focused on quantitative outcomes, future inquiries could incorporate qualitative methods, such as classroom observations or interviews, to explore the quality of dialogue during the 'Pair' and 'Share' phases.

10.3 Research is needed to investigate whether different pairing strategies (e.g., homogeneous vs. heterogeneous ability grouping) result in varied outcomes for high-achieving versus low-achieving pupils.

10.4 Future studies could examine the integration of digital tools or 'e-TPS' models (Electronic Think-Pair-Share) to see if technology enhances participation and achievement in modern elementary classrooms.

10.5 Future investigations should explore other psychological variables that may mediate the relationship between TPS and achievement, such as math anxiety, peer relatedness, or intrinsic motivation.

References

- Ahmad, M., & Dogar, A. H. (2023). Effect of collaborative learning on conceptual understanding ability in mathematics among 5th grade neglected children. *Annals of Human and Social Sciences*, 4(2), 205-213. [https://doi.org/10.35484/ahss.2023\(4-II\)19](https://doi.org/10.35484/ahss.2023(4-II)19)
- Ardianto, D., & Indriana, R. (2020). The effectiveness of the Think-Pair-Share cooperative learning model on students' mathematical problem-solving skills. *Journal of Education and Learning (EduLearn)*, 14(1), 1-8.
- Asfaroh, J. A., & Hidayati. (2014). Pengaruh Penerapan Model Pembelajaran Kooperatif Tipe Jigsaw dan Tipe Think Pair Share terhadap Hasil Belajar IPA Siswa Kelas VII SMP Taman Dewasa Ibu Pawiyatan Tahun Ajaran 2012/2013. *Jurnal Pendidikan IPA Natural*, 1(1), 1–73.
- Assuah, C. K., Mantey, G. K., & Osei, L. (2022). The effect of think-pair-share learning on junior high school students' achievement in algebraic expressions: Pre-test-post-test non-equivalent control group design. *Asian Journal of Probability and Statistics*, 20(2), 46–55.
- Attard, C., & Holmes, K. (2022). An exploration of teacher and student perceptions of blended learning in mathematics during COVID-19. *Mathematics Education Research Journal*, 34(4), 719–740. <https://doi.org/10.1007/s13394-021-00369-1>
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman.
- Bandura, A. (1977). *Social learning theory*. Prentice-Hall.
- Baumeister, R. F. (1993). *Self-esteem: The Puzzle of Low Self-Regard*. New York: Plenum Press.
- Clemson, U. (2024). *The impact of cooperative learning strategies on math anxiety and self-efficacy among basic education students* (Doctoral dissertation). Clemson OPEN Institutional Repository.
- Fatima, F., & Ali, S. (2021). Self-Concept about Mathematics and Achievement Motivation as Correlates of Academic Achievement of Students at Elementary Level. *Journal of Development and Social Sciences*, 2(1), 49–61.
- Gok, T. (2024). Breaking the traditional mold: Exploring the pitfalls of conventional teacher-centered lecturing in modern STEM classrooms. *International Journal of Mathematical Pedagogy*, 15(1), 34–49.
- Howard, E., & Whitaker, M. (2024). Overcoming math anxiety: The transformative power of collaborative structures in secondary mathematics. *Journal of Affective Education in STEM*, 11(2), 88–104.
- Johnson, D. W., & Johnson, R. T. (2014). Cooperative Learning in 21st Century. *Anales de Psicologia [Annals of Psychology]*, 30(3), 841-851. <https://doi.org/10.6018/analeps.30.3.201241>
- Johnson, D. W., Johnson, R. T., & Holubec, E. J. (2009). *Cooperation in the classroom* (8th ed.). Interaction Book Company.
- Lyman, F. T. (1987). Think-Pair-Share: An expanded discussion technique. *Maryland Teacher*, 45, 12-14.
- Marsh, H. W. (1990). A multidimensional, hierarchical model of self-concept: Theoretical and empirical justification. *Educational Psychology Review*, 2(2), 77–172.
- Marsh, H. W., Pekrun, R., Parker, P. D., Murayama, K., Guo, J., Dicke, T., & Arens, A. K. (2021). The reciprocal effects model of academic self-concept and achievement: Long-term waves of universal generalization. *Journal of Educational Psychology*, 113(5), 987–1002. <https://doi.org/10.1037/edu0000506>
- McTighe, J. & Lyman, F. T. (1988). *Cueing Thinking in the Classroom: of Theory-Embedded Tools*. *Educational Leadership*, 45(7), 18-24.

- Mehar, M., & Kaur, S. (2015). Effect of Think-Pair-Share Strategy on Achievement in Mathematics in Relation to Mathematical Creativity. *IJFANS International Journal of Food and Nutritional Sciences*, 6(3), 163-172.
- Nilson, L. B. (2013). *Teaching at its best: A research-based resource for college instructors* (3rd ed.). Jossey-Bass.
- Nnorom, N. R., Okeke, C. P., et al. (2026). Effect of think-pair-share learning strategy on student achievement and academic self-disposition. *Southeast Asian Journal of Global Trends and Issues in Education*, 2(1), 36–50.
- Nwankwo, M. C., & Nnamani, M. K. (2025). Effect of think-pair-share instructional strategy on the academic achievement of senior secondary school students in mathematics. *Unizik Journal of Educational Research and Policy Studies*, 19(1), 246–259.
- Ogoke, C. J., Duru, D. C., Otumegwu, T. U., & Okolie, A. (2024). Effect of think pair share cooperative learning strategy on secondary school students' academic achievement in mathematics. *South Eastern Journal of Research and Sustainable Development*, 11(2), 45–58.
- Okigbo, E. C. & Onoshakpokaiye, E. O. (2023). Relationship between Academic self-concept and academic performance in mathematics of secondary school students in Delta State, Nigeria. *Indonesian Journal of Mathematics Education*, 6(2), 63-71.
- Omeje, C. (2025). Active learning interventions and pupil retention capacities within core primary curricula. *Sapientia Foundation Journal of Education, Sciences and Gender Studies*, 7(1), 135–147.
- Onoshakpokaiye, E.O. (2023). An overview of reasoning ability in mathematics and mathematics achievement of students in tertiary institution. *International Journal of Indonesian Education and Teaching (IJIET)*, 7(2), 309-318.
- Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research*, 66(4), 543–578.
- Permadi, D., Marhaeni, A. A., & Budiarsa, M. A. (2013). The effect of Think-Pair-Share teaching strategy to students' self-confidence and students' speaking competency. *Jurnal Pendidikan Bahasa dan Sastra Indonesia*, 2(1), 1-10.
- Peark, P., Khamsim, M., & Poonputta, A. (2023). Think-Pair-Share in the development of grade 7 student multiply and divide decimal mathematical achievement. *International Education Studies*, 16(4), 21–28.
- Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, 93(3), 223–231.
- Reinholz, D. L., Stone-Johnstone, A., & Shah, N. (2022). Walking the talk: Institutionalizing equity in mathematics through peer-supported active learning. *International Journal of Research in Undergraduate Mathematics Education*, 8(1), 112–134. <https://doi.org/10.1007/s40753-021-00140-w>
- Rustanuars, R. (2019). *Improving Self Confidence of Students in Mathematics Learning Using Think-Pair-Share (TPS) Cooperative Model with Worked Example Assisted*. JP2D (*Jurnal Penelitian Pendidikan Dasar UNTAN*), 2(3), 105-113.
- Samaddar, S., & Sikdar, D. (2023). Reversing the traditional process: Student-centered pedagogical shifts in interactive arithmetic environments. *Journal of Contemporary Educational Advancements*, 8(3), 112–126.
- Samaila, K., Tsong, C. K., Masood, M., & Bervell, B. (2024). Think-pair-share based flipped classroom: A model for improving students' learning achievement and self-efficacy. *Journal of Digital Educational Technology*, 4(1), ep2410.
- Schneider, B., Krajcik, J., Lavonen, J., & Salmela-Aro, K. (2023). Optimizing statistical adjustments in educational interventions: The role of ANCOVA in quasi-experimental designs. *Educational Researcher*, 52(3), 145–156.

- Schunk, D. H., & DiBenedetto, M. K. (2021). Self-efficacy and human motivation: Progress and future directions. *Educational Psychology Review*, 33(3), 1015–1035.
<https://doi.org/10.1007/s10648-020-09581-0>
- Siller, H. S., & Ahmad, S. (2024). Analyzing the impact of collaborative learning approach on grade six students' mathematics achievement and attitude towards mathematics. *Eurasia Journal of Mathematics, Science and Technology Education*, 20(2), 1-21.
<https://doi.org/10.29333/ejmste/14153>
- Slavin, R. E. (1995). *Cooperative learning: Theory, research, and practice* (2nd ed.). Allyn & Bacon.
- Slavin, R. E. (2014). *Educational psychology: Theory and practice* (11th ed.). Pearson.
- White, A. (2023). *Finding the effects of Think-Pair-Share on student confidence and participation*. ScholarWorks@BGSU.
- Zakaria, E., Solfitri, T., Daud, Y., & Abidin, Z. Z. (2013). Effect of cooperative learning on secondary school students' mathematics achievement. *Creative Education*, 4(2), 98–100. <https://doi.org/10.4236/ce.2013.42014>