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A Comparison of Think Pair Share and Group Investigation: Which Cooperative Learning Model Is More Effective in Biology Education?

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ABSTRACT

Purpose of the study: This study aims to compare students' Biology learning outcomes taught using the cooperative learning methods of Group Investigation and Think Pair Share, in order to identify which method leads to higher cognitive achievement in junior high school Biology learning.

Methodology: This study employed a quasi-experimental design using a two-group pretest–posttest model. The research instruments included a 25-item objective test, interview guidelines, observation sheets, and an item analysis tool (ANATES). Data were collected through tests, interviews, and observations, and subsequently analyzed using tests of normality and homogeneity, N-gain analysis, and an independent samples t-test.

Main Findings: The results indicate that there was no significant difference in pretest scores between the Group Investigation and Think Pair Share groups. Posttest and N-gain analyses revealed that the Think Pair Share method produced significantly higher learning outcomes than the Group Investigation method. Students in the Think Pair Share group achieved higher mean scores, demonstrated better conceptual mastery, and showed more substantial learning gains. Interview results also indicated that students were more confident, active, and focused when learning through the Think Pair Share method.

Novelty/Originality of this study: This study provides a direct comparison between Group Investigation and Think Pair Share in Biology learning, an empirical investigation that has rarely been conducted. The findings contribute to the existing body of knowledge by demonstrating that Think Pair Share offers more structured interaction, better focus, and more evenly distributed participation, resulting in more effective learning compared to Group Investigation.

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1. INTRODUCTION

The learning process in schools continues to face fundamental challenges related to students' low ability to develop higher-order thinking skills. Numerous studies have shown that classroom learning is still dominated by rote memorization and one-way content delivery, which provides limited opportunities for students to engage in critical and reflective thinking [1]-[3]. As a result, students experience difficulties in connecting conceptual knowledge with real-life contexts, leading to low levels of creativity and innovative capacity. These problems occur across various subjects, including science, which ideally should train students to think analytically and systematically. Therefore, learning models that actively engage students and involve them directly in the construction of knowledge are urgently needed.

From a legal perspective, Law No. 20 of 2003 stipulates that education aims to develop students' potential so that they become intelligent individuals with strong character and moral integrity. The principle of student-centered active learning embedded in this law requires instructional processes that provide students with opportunities to develop their potential independently (Ministry of National Education, 2003). Normatively, education demands learning processes that are student-centered and that facilitate holistic potential development. Active learning approaches have been proven to enhance conceptual understanding and student engagement more effectively than traditional lecture-based methods [4]-[6]. However, in practice, school education often remains trapped in teacher-centered instruction and content transmission without positioning students as active learners [7]. This situation constrains the development of students' cognitive, affective, and psychomotor domains, which are core objectives of national education. Consequently, learning should be directed toward more interactive strategies that empower students' potential.

Teachers play a strategic role as facilitators in creating interactive and dialogic learning environments that encourage active student participation. Research indicates that two-way interactions between teachers and students significantly contribute to improved learning outcomes, motivation, and positive attitudes toward science learning [8]-[10]. Through active learning, students not only acquire knowledge but also develop social skills and critical thinking abilities. Therefore, teachers are required to master various innovative instructional strategies to ensure meaningful learning experiences. In this context, the selection of appropriate learning models becomes a key factor in improving the quality of Biology instruction.

Science education, including Biology, emphasizes the importance of inquiry-based learning that enables students to gain direct learning experiences through scientific processes. Studies indicate that effective science learning should integrate science process skills, scientific attitudes, and cognitive abilities in a balanced manner to facilitate meaningful conceptual understanding [11]-[13]. However, learning practices in many schools are still dominated by lecture-based methods with minimal practical activities and scientific investigations [14]-[16]. This condition leads to low student engagement and limited development of critical thinking and problem-solving skills. Therefore, alternative instructional approaches are needed to actively engage students in constructing knowledge independently and collaboratively.

Cooperative learning models are regarded as one of the most effective approaches for enhancing student participation and interaction in Biology learning. Numerous studies have reported that cooperative learning improves cognitive learning outcomes, social skills, and students' positive attitudes toward science learning [17], [18]. Nevertheless, most existing studies have examined the Group Investigation (GI) and Think Pair Share (TPS) models separately, resulting in limited direct comparative research between these two models, particularly in the context of secondary-level Biology education [19], [20]. This limitation highlights a research gap regarding the relative effectiveness of GI and TPS in improving student learning outcomes. Therefore, comparative research is necessary to provide empirical evidence that can support teachers in selecting the most appropriate instructional strategies.

This study offers novelty by directly examining the effectiveness of two cooperative learning models—Group Investigation (GI) and Think Pair Share (TPS) in Biology learning, which involves both conceptual and procedural characteristics. Previous studies indicate that GI emphasizes group investigation processes, independent planning, and in-depth exploration of problems, whereas TPS focuses on paired interaction and structured idea exchange [21], [22]. These differences in group structure and learning dynamics may lead to variations in learning outcomes, particularly in higher-order cognitive achievement. However, empirical studies that directly compare the effectiveness of GI and TPS in Biology learning remain limited [23]. Therefore, this study is important in providing relevant empirical evidence to guide teachers in selecting learning models that align with student characteristics and curriculum demands.

Based on this research gap, the present study aims to compare Biology learning outcomes between students taught using the Group Investigation (GI) and Think Pair Share (TPS) models. Several studies have shown that cooperative learning models significantly influence students' cognitive learning outcomes; however, the effectiveness of each cooperative learning type may vary depending on its design and implementation. This study seeks to empirically identify which model is more effective in enhancing students' cognitive learning outcomes. The findings are expected to provide data-driven scientific recommendations for Biology teachers in selecting appropriate instructional strategies. Furthermore, this study is expected to enrich the literature on Biology pedagogy by presenting comparative empirical evidence that has been relatively underexplored.

2. RESEARCH METHOD

The method employed in this study was a quasi-experimental design. Quasi-experimental methods are widely used in educational research when full randomization of subjects is not feasible, yet researchers seek to examine causal relationships through controlled interventions [24]-[26]. Educational research has shown that quasi-experimental designs are effective for comparing learning outcomes between experimental and control groups in real classroom settings, thereby offering high ecological validity [27], [28]. This study compared Biology learning outcomes between two groups taught using the Group Investigation and Think Pair Share methods. Therefore, this research can be classified as a causal-comparative study. The research design applied was a two-group pretest–posttest design. Observations were conducted twice, namely before and after the experimental treatment.

The population refers to the entire group of research subjects, while the sample represents a subset of the population. Based on this definition, the population of this study comprised all students of State Junior High School 10, South Tangerang City. Determining the target population is essential to ensure clear research boundaries and to maintain the relevance of the findings to the studied context [29]. The target population in this study was all eighth-grade students of State Junior High School 10, South Tangerang City, while the sample consisted of selected members of the target population chosen using a random sampling technique. This technique is considered effective in minimizing selection bias and enhancing the validity of educational research findings [30], [31].

The data obtained in this study consisted of students' Biology learning outcome scores, which were collected through Biology achievement tests in multiple-choice format, as well as non-test data obtained through interviews in the form of students' responses.

Table 1. Data Collection

Data Type	Data Source	Data Collection Techniques
Student Response	Students	Interviews
Student Cognitive	Students	Tests
Teacher Response	Teachers	Interviews

The primary instrument used in this study was a test instrument in the form of objective tests administered as a pretest and a posttest. The pretest–posttest design is highly effective for assessing the impact of instructional interventions, as it allows for direct comparison between students' initial and final conditions [32], [33]. In addition, objective tests are considered to have high levels of reliability and objectivity in measuring cognitive learning outcomes when they are constructed based on clear and valid indicators.

Furthermore, to obtain supporting data for the expected conclusions of this study, a non-test instrument in the form of interview guidelines was employed. Interviews serve as an effective qualitative instrument for understanding the meaning of learning experiences from the participants' perspectives, particularly in educational research.

Table 2. Grid of Human Digestive System Instruments

No.	Subconcept	Indikator	Cognitive Aspect			Total
			C1	C2	C3	
1	The digestive system in humans	Define food digestion	1	-	-	1
		State the correct order of the digestive tract	3,7	-	-	2
		Explain the digestive process in the mouth	8	5	-	2
2	Esophagus	Explain the digestive process in the esophagus	-	-	6	1
3	Stomach	Identify the function and function of the stomach as a digestive organ	-	*10	-	1
4	Intestines	Explain the digestive process in the intestine	11,12,14	15	-	4
		Name the parts of the small intestine	13	-	-	1
5	Nutrition and calories	Explain nutrients that are useful for the body	-	16,19	-	2
		Explain foods that contain protein	20,	-	-	1
		Explain the function of protein and fat for the body	*24	-	-	1
		Identify and predict nutritional or vitamin deficiency disorders and their solutions	34,21	-	37	3
		Identify the function of enzymes in the digestive system and where they are produced	27,28,29	-	-	3
6	Digestive system disorders	Explain disorders or diseases of the digestive organs	39,36	40	-	3
		Total	17	6	2	25

Notes:
1. Bloom's Taxonomy Classification:
   C1 = Knowledge, C2 = Comprehension, C3 = Application
2. *Items marked with an asterisk (*) indicate invalid items that were revised to improve distractor quality.*

The test device was tested and then analyzed. Based on the validity calculation results, it was found that out of 40 questions tested, 22 were declared valid and 3 questions were revised. These questions were questions number 1, 3, 5, 6, 7, 8, 9, 11, 12, 13, 16, 19, 20, 21, 27, 28, 29, 34, 36, 37, 39, 40 and 10, 14, 24. The results of the test using Anates showed that the reliability was 0.71, which is included in the high criteria. Meanwhile, based on the calculation of the difficulty level of each question, there are 3 medium category questions, namely numbers 29, 22, and 10, 20 easy category questions, namely numbers 1, 6, 9, 13, 15, 17, 20, 21, 23, 25, 26, 27, 28, 31, 33, 34, 35, 37, 38, and 39, 17 very easy category questions, namely numbers 2, 3, 4, 5, 7, 8, 11, 12, 14, 16, 18, 19, 24, 30, 32, 36, and 40. And from the calculation of the question's discriminating power, the lowest discriminating power result is -0.27 in the bad category and the highest is 0.55 included in the good category.

The data analysis technique in this study was carried out with the help of SPSS through several stages, namely: first, calculating the Normalized Gain (N-Gain) value to determine the increase in student learning outcomes by processing pretest and posttest scores, then classifying them into high ($g > 0.70$), medium ($0.30 < g \leq 0.70$), and low ($g \leq 0.30$) categories; second, conducting a normality test on the N-Gain data and/or learning outcome scores using the Kolmogorov–Smirnov or Shapiro–Wilk test (according to the number of samples) at a significance level of 0.05, with the criteria for normally distributed data if the Sig. value is > 0.05; third, conducting a homogeneity test of variance using Levene's Test to determine the similarity of variance between the Group Investigation and Think Pair Share method groups, with the criteria for homogeneous data if the Sig. value is > 0.05; Next, after the assumptions of normality and homogeneity are met, a hypothesis test is conducted using the Independent Samples t-test to determine the differences in Biology learning outcomes between the two groups, with degrees of freedom (db) = $N_1 + N_2 - 2$ and a significance level of $\alpha = 0.05$, where the alternative hypothesis is accepted if the Sig. (2-tailed) value is <0.05, which indicates that student learning outcomes with the Think Pair Share method are better than those with the Group Investigation method.

3. RESULTS AND DISCUSSION

The pretest results obtained from students in the Group Investigation and Think Pair Share classes in this study are presented in the table below.

Table 3. Measures of Central Tendency and Dispersion of Pretest Scores

No.	Measure	Group Investigation	Think Pair Share
1	Minimum score	24	20
2	Maximum score	64	60
3	Mean	49.71	50.70
4	Median	52	52
5	Mode	52	52
6	Standard deviation	13.03	9.94
7	Variance	169.78	98.80

The pretest results indicate that the initial Biology learning abilities of students in the Group Investigation and Think Pair Share classes were relatively comparable. The mean pretest scores of the Group Investigation class (49.71) and the Think Pair Share class (50.70) show only a slight difference, suggesting similar baseline knowledge prior to the intervention. Both groups shared identical median and mode values (52), indicating a similar distribution pattern of scores. However, the Group Investigation class exhibited a higher standard deviation and variance, reflecting greater variability in students' initial abilities compared to the Think Pair Share class. Overall, these findings suggest that both groups started the study with relatively equivalent cognitive levels, thereby supporting the validity of subsequent comparisons of posttest learning outcomes.

The results obtained in the posttest by students in the group investigation and think pair share groups from this study are presented in the table below.

Table 4. Measures of Centralization and Distribution of Posttest Data Results

No.	Measure	Group Investigation	Think Pair Share
1	Minimum score	20	28
2	Maximum score	92	100
3	Mean	64,84	81.51
4	Median	68	84
5	Mode	68	96
6	Standard deviation	18.58	17.90
7	Variance	345.21	320.41

The posttest results reveal a clear difference in Biology learning outcomes between the Group Investigation and Think Pair Share classes. Students in the Think Pair Share group achieved a substantially higher mean score (81.51) compared to those in the Group Investigation group (64.84), indicating superior overall learning performance. This difference is further supported by higher median (84) and mode (96) values in the Think Pair Share class, suggesting that most students attained higher achievement levels. Although both groups showed relatively similar standard deviations, the slightly lower variability in the Think Pair Share group indicates more consistent learning outcomes. Overall, these findings suggest that the Think Pair Share model was more effective in improving students' Biology learning outcomes than the Group Investigation model.

Normalized gain analysis was conducted to examine the improvement in students' conceptual mastery after the instructional intervention. The normalized gain score was calculated based on the difference between students' pretest and posttest scores. Based on the calculation results, the normalized gain scores for the Group Investigation and Think Pair Share classes are presented as follows:

Table 5. Normal Gain Calculation

Normal Gain	Group Investigation Class	Group Investigation Class
Lowest	-0.3330	-0.2857
Highest	0.8000	1.0000
Average	0.3147	0.6393
Standard Deviation	0.3088	0.3170
Category	Moderate Gain	Moderate Gain

Each N-Gain value is grouped into three categories: low ($G < 0.30$), medium ($0.30 \leq G < 0.70$), and high ($G \geq 0.70$). The initial step before data processing is to test the prerequisite data analysis, namely the normality test. The normality test is used to determine whether the data is normally distributed or not. The data is normally distributed if the Lo < Lt criterion is measured at a certain significance level and confidence level. The data normality test used was the Liliefors Test.

The results of the normality calculation are as follows:

Table 6. Normality Test Results

Group	Sig.	Criteria	Conclusion
Group Investigation (GI)	0.092	Sig. > 0.05	Data is normally distributed
Think Pair Share (TPS)	0.200	Sig. > 0.05	Data is normally distributed

Based on the results obtained, the data were normally distributed. A homogeneity test was then conducted to determine the difference in scores between students using the Group Investigation method and those using the Think Pair Share method. The homogeneity test for both classes was conducted using Levene's Test in SPSS. For more details, see the following Table 7.

Table 7. Homogeneity Test Calculation

Data	Levene Statistic	df1	df2	Sig.	Description
Pretest	1.27	1	70	0.077	Homogeneous
Posttest	1.08	1	70	0.175	Homogeneous

The results of the homogeneity test using Levene's Test in SPSS showed that the pretest and posttest significance values were greater than 0.05, thus concluding that the Biology learning outcomes data in the Group Investigation and Think Pair Share classes had homogeneous variance.

After the data were declared normally distributed and homogeneous, the hypothesis was tested using a two-sample independent t-test (ISamples t-Test) with the help of SPSS at a significance level of $\alpha = 0.05$. This test aimed to determine the differences in Biology learning outcomes between students who studied using the Group Investigation and Think Pair Share methods.

Table 8. Results of the Independent Samples t-Test

Data	Class	N	Mean	t count	df	Sig. (2-tailed)	Description
Posttest	GI	35	64,86	6,14	70	0,000	H_0 rejected
	TPS	37	81,51				Description

Based on the results of the independent samples t-test conducted using SPSS, the Sig. (2-tailed) value was 0.000. This value is lower than the significance level of 0.05 (Sig. < 0.05), indicating that the null hypothesis (H_0) was rejected and the alternative hypothesis (H_a) was accepted. These results demonstrate a statistically significant difference in Biology learning outcomes between students taught using the Group

Investigation method and those taught using the Think Pair Share method. The mean posttest score of the Think Pair Share class (81.51) was higher than that of the Group Investigation class (64.86), leading to the conclusion that the Think Pair Share method is more effective in improving students' Biology learning outcomes.

Interviews were conducted with six students and one science teacher. The six students consisted of three representatives from the Group Investigation class and three representatives from the Think Pair Share class. The selected students from each class represented heterogeneous pretest and posttest achievement levels. The interview results revealed that students felt enthusiastic about learning science, particularly the topic of the digestive system, and found the material easier to understand. Prior to the implementation of the Group Investigation and Think Pair Share methods, science learning was predominantly teacher-centered, with students mainly listening to the teacher and completing assigned tasks, positioning them as passive recipients of instruction.

Students who participated in learning through the Group Investigation method became more active than before. Collaborative skills were developed through group-based worksheet activities, and students experienced effective teamwork in solving problems collaboratively. The Group Investigation method was also perceived as easy to follow and understand, as students reported no significant difficulties during the learning process. Moreover, students expressed strong interest in the investigation stages of this method, as these activities challenged them to explore and solve problems collectively. Based on interviews with students from the Group Investigation class, it can be concluded that this method facilitated students' understanding of science concepts, particularly the digestive system, and increased their learning engagement and enjoyment.

Similar positive responses were reported by students who learned through the Think Pair Share method. Students acknowledged that this method enhanced their confidence, as evidenced by increased participation in asking questions and expressing opinions during group presentations. Students who were initially reluctant to speak became more active and confident in classroom discussions. In addition, a sense of collaboration was fostered as students worked together to solve problems provided by the teacher. Students expressed high levels of enjoyment in learning science through this method, as it not only promoted cooperation and self-confidence but also encouraged critical thinking when responding to questions posed by peers during presentations. Based on interviews, it can be concluded that the Think Pair Share method is enjoyable and effective in enhancing students' confidence, critical thinking skills, and collaborative learning.

Both instructional methods were positively perceived by the science teacher as innovations in classroom science instruction. During the interview, the teacher stated that both methods were engaging and effective. The teacher also acknowledged that previous learning practices tended to position students as passive learners who merely listened to instructional explanations. Additionally, limited access to learning resources, such as textbooks, was identified as a challenge in science instruction, as not all students possessed textbooks. The teacher further noted that both the Think Pair Share and Group Investigation methods led to noticeable improvements in student participation and learning outcomes, as students who were previously reluctant to speak or ask questions became more active and showed improved academic performance.

Observations were conducted by the science teacher as an observer to evaluate whether each instructional stage was implemented correctly and in accordance with the procedural steps of each learning method. The observation results, as recorded in the observation sheets, indicated that all stages of both instructional methods were implemented appropriately and in alignment with their respective procedures.

The findings of this study indicate that the application of both instructional methods resulted in a significant difference in learning outcomes and contributed to improvements in students' academic achievement. As discussed previously, both methods had a positive impact on enhancing students' Biology learning outcomes. This conclusion is supported by interview data obtained from the science teacher as the observer and three student representatives from both the Group Investigation and Think Pair Share classes, who stated that both methods facilitated a better understanding of science learning, particularly the topic of the digestive system. Although both methods led to improvements in students' learning outcomes, the results of this study demonstrate that the Think Pair Share method produced a higher level of improvement compared to the Group Investigation method. This greater improvement can be attributed to the more structured and conducive learning environment created through the implementation of the Think Pair Share method.

In practice, the Think Pair Share method organizes students into small groups consisting of two students working in pairs. This pairing structure enables students to remain more focused and allows teachers to manage classroom activities more effectively. During presentations, students do not rely solely on one group member; instead, both students actively collaborate in responding to questions, ensuring that learning is distributed more evenly across participants. Consequently, understanding of the learning material is not limited to a single student but is shared equally between both members of the pair.

In contrast, the Group Investigation method forms groups of approximately five students, which can result in uneven participation. While some students actively engage in discussion, others tend to be less involved. This condition occasionally leads to reduced focus and increased classroom noise. As a result, conceptual understanding is not evenly distributed among group members; students who are more active and engaged tend to develop stronger mastery of the material, whereas less active students often rely on their peers. This dependency limits the effectiveness of collaborative learning and reduces overall learning equity within the group.

Clear differences were also observed during group work and presentations. In the Think Pair Share method, students demonstrated greater discipline and focus when solving problems, with minimal classroom disruption. Task distribution was more effective due to the small group size, allowing students to work efficiently. During presentations, students were more active and motivated to ask questions and express their opinions. These findings are consistent with previous research conducted by Sugiyanta, which reported that classrooms implementing the Think Pair Share method were more interactive, characterized by increased student questioning and reduced classroom noise during instructional activities.

Regarding the Group Investigation method, each group typically consisted of five students, yet only two or three members actively participated in presentations, while others provided limited support in responding to questions from other groups. In many cases, some students did not pay attention during peer presentations, relying instead on their more active group members to represent the group. Students who were not involved in presentations often became passive observers and occasionally contributed to classroom disruption during problem-solving activities. Consequently, only students who actively participated in discussions and presentations demonstrated strong mastery of the material, while less active students remained disengaged, necessitating greater classroom management efforts from the teacher.

These observations were further confirmed by the science teacher acting as the observer, who noted that student engagement was more prominent in the Think Pair Share class than in the Group Investigation class. From a classroom management perspective, the teacher reported that managing the Think Pair Share class was more effective and efficient than managing the Group Investigation class. These findings indicate that the Think Pair Share method is slightly superior and more effective than the Group Investigation method. This conclusion reinforces the hypothesis testing results, which revealed a statistically significant difference in learning outcomes and learning gains between the two classes. Therefore, it can be concluded that improvements in learning outcomes are closely aligned with the quality of instructional practices, as higher-quality learning environments are consistently associated with better student achievement.

Several challenges were encountered during the implementation of the study. One major constraint was the limited availability of learning resources, as not all students owned science textbooks. Consequently, instructional time was occasionally reduced due to the need to borrow reference books from the school library. In addition, transitions between subjects sometimes caused delays, particularly when preceding lessons exceeded the scheduled time. As a result, the allocated time for science instruction was shortened, requiring the researcher to extend the lesson duration. This situation occasionally reduced students' learning motivation, as their break time was affected.

Both cooperative learning techniques, namely Jigsaw and Group Investigation, possess distinct strengths in promoting active student engagement through collaboration, discussion, and mutual assistance among group members. Cooperative learning enables students to construct understanding socially through meaningful interaction [34]-[36]. Johnson and Johnson emphasize that structured group work significantly enhances students' cognitive, affective, and social learning outcomes [37]. Similarly, Slavin highlights that cooperative learning models such as Group Investigation and Jigsaw are effective in improving academic achievement because they position students as active participants in the process of information seeking and processing [38]. Experimental research findings also demonstrate that the implementation of Jigsaw and Group Investigation positively influences students' cognitive, psychomotor, and affective achievements. Studies by Hertiavi, Langlang, and Khanafiyah report significant improvements in learning outcomes and social skills, while Gillies emphasizes that Group Investigation encourages deeper thinking and greater responsibility for group learning processes [39], [40].

Nevertheless, not all students immediately demonstrated active participation in cooperative learning activities. During the initial implementation of the Think Pair Share model, some students tended to work individually and were reluctant to engage in interaction. Research by Kaddoura indicates that the effectiveness of Think Pair Share is strongly influenced by habituation, teacher guidance, and the quality of questions posed during discussions. These findings suggest that the success of cooperative learning is determined not only by the instructional model itself but also by students' readiness and the quality of teacher facilitation in managing group interactions. Therefore, the appropriate selection of instructional models combined with effective teacher guidance is essential for maximizing the impact of cooperative learning on students' academic achievement and learning motivation.

Based on relevant theoretical perspectives and empirical studies discussed in the literature review, as well as the statistical analyses conducted in this study, it is evident that there was a significant improvement in students' Biology learning outcomes and a notable difference between students taught using the Group Investigation and Think Pair Share models. These results indicate that the implementation of both instructional models had a significant effect on students' Biology learning outcomes, with a substantial difference in effectiveness between the two approaches.

4. CONCLUSION

Based on the results of both quantitative and qualitative analyses, it can be concluded that the implementation of the Group Investigation and Think Pair Share learning models was effective in improving Biology learning outcomes of eighth-grade students at State Junior High School 10, South Tangerang City on the topic of the human digestive system. However, the Think Pair Share model demonstrated a significantly higher level of improvement compared to the Group Investigation model. This conclusion is supported by differences in posttest mean scores, normalized gain (N-Gain) values, and hypothesis testing results, which indicated a statistically significant difference between the two groups in favor of the Think Pair Share class. These findings were further reinforced by interview and observation data showing that the pair-based structure of Think Pair Share encouraged more active participation, better focus, greater confidence, and more equitable distribution of conceptual understanding among students than the larger group structure used in Group Investigation. Therefore, Think Pair Share can be recommended as a more effective cooperative learning strategy for enhancing students' Biology learning outcomes at the junior high school level. For future research, it is recommended to involve larger and more diverse samples, extend the duration of implementation, and examine additional learning outcomes such as higher-order thinking skills, scientific attitudes, and social skills, as well as to explore the integration of Think Pair Share with digital or technology-based learning media to provide a more comprehensive understanding of cooperative learning effectiveness in various educational contexts.

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Conceptualization, S.W. and M.S.; Methodology, S.W.; Software, S.W.; Validation, S.W. and M.S.; Formal Analysis, S.W.; Investigation, S.W.; Resources, M.S.; Data Curation, S.W.; Writing – Original Draft Preparation, S.W.; Writing – Review & Editing, S.W. and M.S.; Visualization, S.W.; Supervision, M.S.; Project Administration, M.S.; Funding Acquisition, M.S.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

Not applicable.

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