JURNAL KAJIAN PENDIDIKAN DAN CAKRAWALA PEMBELAJARAN

IMPROVING MATHEMATICS LEARNING OUTCOMES IN MULTIPLICATION AND DIVISION AT ELEMENTARY SCHOOLS

Article Information

e-ISSN: 3089 – 9702
Volume 2 Issue 4
Pages 90 – 101

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Abstract

Background: *Mathematics is a fundamental subject in elementary education, yet some students experience difficulties understanding multiplication and division operations. Initial assessment in Grade IV at SD Negeri 008 Simpang Gaung showed that students' average scores were 63.50 and 64.70, while 24 of 38 students had not achieved the minimum mastery criterion of 70.* ***Objective:*** *This study aimed to improve fourth-grade students' mathematics learning outcomes through the implementation of the Student Teams Achievement Divisions (STAD) cooperative learning model.* ***Method:*** *This Classroom Action Research was conducted in two cycles, each consisting of planning, action, observation, and reflection. The participants were 38 fourth-grade students, comprising 21 boys and 17 girls. Data were collected through classroom observations, learning achievement assessments, student worksheets, and documentation and analyzed using descriptive quantitative techniques.* ***Results:*** *Students' average scores increased from 44.73 in the pre-cycle to 58.42 in Cycle I and 86.84 in Cycle II. The number of students achieving the minimum mastery criterion of 70 increased from five (13.16%) in the pre-cycle to 16 (42.11%) in Cycle I and 36 (94.74%) in Cycle II. At the indicator level, mastery of one-digit, two-digit, and three-digit multiplication reached 97.37%, 92.11%, and 89.47%, respectively, in Cycle II. Classroom observations also indicated improvements in student participation and group discussions following instructional improvements.* ***Novelty:*** *This study applies the STAD cooperative learning model to multiplication and division instruction among fourth-grade students through two cycles of classroom action research, examining overall learning outcomes and multiplication achievement indicators.* ***Conclusion:*** *The implementation of STAD was accompanied by improvements in students' mathematics learning outcomes, with the final mastery rate of 94.74% exceeding the research success criterion of 50%.*

Keywords: *Student Teams Achievement Divisions; Mathematics Learning Outcomes; Multiplication; Division; Elementary School Students; Classroom Action Research.*

INTRODUCTION

Mathematics is a fundamental subject in elementary education that plays an important role in developing students' logical, systematic, critical, and analytical thinking skills. Mastery of basic arithmetic operations, particularly multiplication and division, provides an essential foundation for understanding more complex mathematical concepts. Faujiah and Nurafni (2022) explain that elementary school students continue to experience difficulties in understanding multiplication concepts. Similarly, Sihombing et al. (2023) identify students' difficulties in understanding the procedures and concepts involved in multiplication and division operations.

These difficulties in mastering arithmetic operations were also identified in mathematics instruction at SD Negeri 008 Simpang Gaung, Gaung District. Based on the learning outcome data, students' average scores were 63.50 and 64.70, while the minimum mastery criterion was set at 70. In Grade IV mathematics instruction on multiplication and division, 24 of the 38 students had not achieved the required level of mastery. Amalia et al. (2025) identified conceptual and procedural obstacles in learning division. Marzuqo et al. (2025) also found that students experienced difficulties in solving word problems involving multiplication and division.

These conditions indicate that low learning outcomes are not solely related to students' arithmetic skills but are also influenced by the instructional approaches employed by teachers. Mathematics instruction should provide meaningful learning experiences that enable students to construct understanding through active learning activities. Saputra (2022) demonstrated that contextual learning can improve elementary school students' mathematical communication skills. Meanwhile, Purwanty and Mayasari (2025) found that using a multiplication board can improve mathematics learning outcomes. These findings highlight the importance of instructional innovations that support students' understanding of mathematical concepts.

In addition to contextual approaches, cooperative learning has the potential to increase student engagement during the learning process. Saputra et al. (2023) found that implementing the Two Stay Two Stray model influenced the learning outcomes of fourth-grade elementary school students. Pratama and Sartika (2026) specifically demonstrated that implementing the Student Teams Achievement Divisions (STAD) cooperative learning model could improve mathematics learning outcomes in multiplication. These findings reinforce the relevance of group-based learning in helping students understand mathematical concepts through interaction and collaboration.

Successful mathematics instruction also requires teachers to develop learning strategies and instructional media that meet students' learning needs. Ekadayanti et al. (2024) demonstrated that training teachers to create mathematics and science learning media using Canva could improve their skills in developing innovative instructional materials. Furthermore, Khuluqiyyah et al. (2026) found that implementing STAD improved fifth-grade students' learning outcomes in fraction multiplication. These findings indicate that instructional innovation and student collaboration are important aspects of improving the quality of mathematics instruction.

Although previous studies have demonstrated the effectiveness of the STAD cooperative learning model in improving mathematics learning outcomes, its implementation may produce different results depending on grade level and subject matter. Anggraini et al. (2025), through a systematic review, found that STAD contributes to improvements in learning outcomes, motivation, and students' social skills. Dewanti and Khaerunnisa (2025) also identified a positive influence of STAD on mathematics learning outcomes. However, research specifically examining the implementation of STAD for both multiplication and division operations simultaneously among fourth-grade students at SD Negeri 008 Simpang Gaung remains an area that warrants further investigation.

Based on these problems and the identified research gap, this study applies the Student Teams Achievement Divisions (STAD) cooperative learning model as an approach to improving mathematics instruction. The novelty of this study lies in implementing STAD to improve students' learning outcomes in both multiplication and division operations simultaneously, while considering the actual instructional conditions at the research site. Therefore, this study aims to improve the mathematics learning outcomes of fourth-grade students at SD Negeri 008 Simpang Gaung, Gaung District, through the implementation of the STAD cooperative learning model.

METHODS

This study employed Classroom Action Research (CAR) using a descriptive quantitative approach to improve mathematics learning outcomes through instructional improvement. The research was conducted in two cycles, each consisting of four stages: planning, action, observation, and reflection. The study took place at SD Negeri 008 Simpang Gaung, Gaung District, Indragiri Hilir Regency, Riau Province, Indonesia, from May 2 to 16, 2026. The instructional interventions were conducted on May 6, 2026, for Cycle I and May 13, 2026, for Cycle II.

The research participants comprised all 38 fourth-grade students at SD Negeri 008 Simpang Gaung, consisting of 21 boys and 17 girls. All students were included as research subjects using a total sampling technique because the entire class constituted the target population for the instructional intervention. The students demonstrated diverse levels of ability, understanding, and academic achievement, indicating the need for instructional improvements to enhance mathematics learning outcomes, particularly in multiplication and division operations.

The research instruments included teacher and student activity observation sheets, student worksheets, assignment sheets, and objective-format learning achievement tests. Data were collected through classroom observations and documentation of students' learning outcomes. The research procedures began with preparing an instructional improvement plan, providing learning media and research instruments, implementing the instructional interventions, conducting observations by Supervisor II, and carrying out reflections with a colleague. These stages were implemented across two cycles, with instructional improvements made based on the reflection

findings from the preceding cycle. Cooperative learning activities and instructional media were used to support students' understanding of multiplication and division operations.

Data were analyzed descriptively and quantitatively using the learning outcomes of the 38 students at the pre-cycle, Cycle I, and Cycle II stages. Individual mastery (IM) was calculated by dividing each student's obtained score by the maximum possible score and multiplying the result by 100%. Classical mastery (CM) was determined by calculating the percentage of students who achieved the Minimum Mastery Criterion (KKM) relative to the total number of students. Student absorption capacity was calculated by dividing the number of correct answers by the total number of questions and multiplying the result by 100%. Learning outcomes were subsequently classified into mastered and not-mastered categories based on the modified assessment guidelines of the 2004 Curriculum issued by the Indonesian Ministry of National Education (Depdiknas). All calculations used the same sample size of 38 students as the basis for determining the frequencies and percentages reported in the study.

RESULTS AND DISCUSSION

RESULTS

1. Implementation of Instructional Activities

This classroom action research was conducted in a fourth-grade mathematics class at SD Negeri 008 Simpang Gaung, Gaung District, focusing on multiplication and division operations. The study involved 38 students and was carried out in two cycles, with each cycle consisting of two meetings. Cycle I was conducted on May 6 and 9, 2026, while Cycle II took place on May 13 and 16, 2026. The instruction employed the Student Teams Achievement Divisions (STAD) cooperative learning model through material presentation, heterogeneous group formation, group discussions using task sheets, presentation of discussion results, and learning outcome assessments.

In Cycle I, group-based learning activities had been implemented; however, the instructional process was not yet optimal. Several students were not actively involved in group discussions, the classroom atmosphere remained somewhat disruptive, and some students tended to rely on their peers' work. Observation findings indicated that the teacher had not fully optimized the use of instructional media, reinforcement, opportunities for students to ask questions, lesson summarization, and rewards for individual students or groups. At the end of Cycle I, students completed an assessment consisting of 10 essay questions within 35 minutes.

The reflection on Cycle I provided the basis for improving instructional practices in Cycle II. The teacher improved the use of instructional media, communicated learning objectives and motivation, guided group discussions, and provided opportunities for students to ask and answer questions. Each group received instructional media and task sheets to complete collaboratively. Although some students continued to make noise during discussions, classroom activities generally became more organized, and student participation increased. The Cycle II assessment also consisted of 10 essay questions completed within 35 minutes.

2. Learning Achievement by Indicator

Learning achievement was analyzed at the end of each cycle based on three multiplication indicators, using the same number of participants, namely 38 students. The analysis distinguished between students who achieved mastery and those who had not achieved mastery for each indicator. The percentage was calculated by dividing the number of students in each category by the total number of students. The results are presented separately for Cycle I and Cycle II to provide a clearer picture of changes in students' achievement and identify the indicators that required further instructional improvement.

Table 1. Learning Mastery by Multiplication Indicator in Cycle I

No.	Indicator	Mastered (Students)	Mastered (%)	Not Mastered (Students)	Not Mastered (%)
1	Performing one-digit multiplication	24	63.16	14	36.84
2	Performing two-digit multiplication	22	57.89	16	42.11
3	Performing three-digit multiplication	18	47.36	20	52.63
	Number of students per indicator	38	100.00	38	100.00

Based on Table 1, the number of students who achieved mastery in Cycle I had not reached the entire class in any of the three indicators. The highest mastery rate was found in one-digit multiplication, with 24 students (63.16%) achieving mastery and 14 students (36.84%) not achieving mastery. In two-digit multiplication, 22 students (57.89%) achieved mastery, while 16 (42.11%) did not. For three-digit multiplication, 18 students (47.36%) achieved mastery, whereas 20 (52.63%) did not. Thus, three-digit multiplication had the highest number of students who had not achieved mastery.

The distribution of students' achievement across the three multiplication indicators in Cycle I is further illustrated in Figure 1. The figure compares the number of students who achieved mastery with those who did not for one-digit, two-digit, and three-digit multiplication. This comparison highlights the differences in students' achievement across the indicators and shows that three-digit multiplication remained the most challenging indicator during the first cycle.

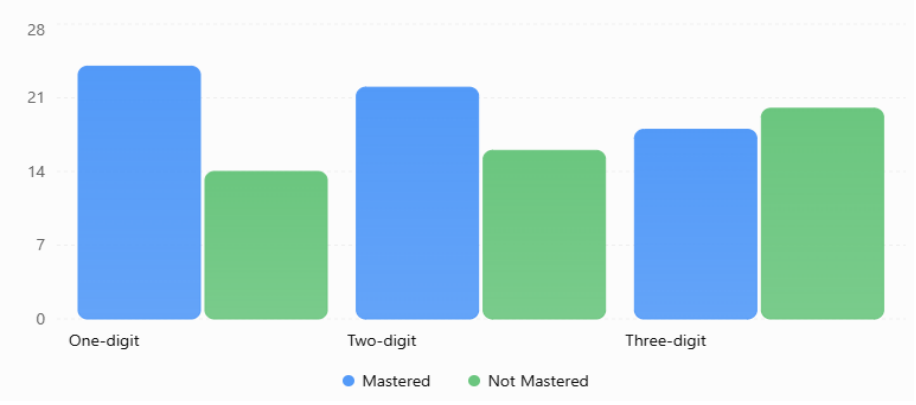


Figure 1. Learning Mastery by Multiplication Indicator in Cycle I

Table 2. Learning Mastery by Multiplication Indicator in Cycle II

No.	Indicator	Mastered (Students)	Mastered (%)	Not Mastered (Students)	Not Mastered (%)
1	Performing one-digit multiplication	37	97.37	1	2.63
2	Performing two-digit multiplication	35	92.11	3	7.89
3	Performing three-digit multiplication	34	89.47	4	10.53
	Number of students per indicator	38	100.00	38	100.00

Based on Table 2, the number of students who achieved mastery in Cycle II increased across all indicators, while the number who had not achieved mastery decreased. In one-digit multiplication, 37 students (97.37%) achieved mastery, while one student (2.63%) did not. In two-digit multiplication, 35 students (92.11%) achieved mastery and three (7.89%) did not. Meanwhile, in three-digit multiplication, 34 students (89.47%) achieved mastery, whereas four (10.53%) did not. The highest mastery rate remained in one-digit multiplication following the instructional improvements.

The improvement in students' achievement across the three multiplication indicators in Cycle II is presented in Figure 2. The figure shows the number of students who achieved mastery and those who did not after the instructional improvements were implemented. The comparison illustrates that mastery increased substantially for all indicators, while the number of students who had not achieved mastery decreased to no more than four students in each indicator

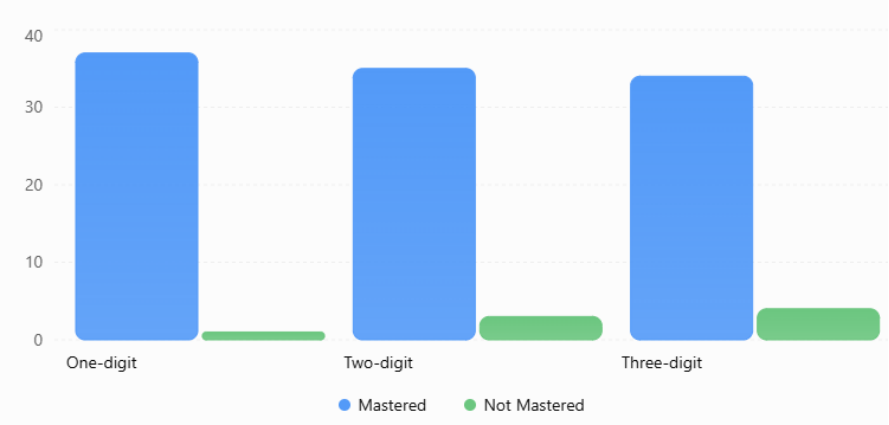


Figure 2. Learning Mastery by Multiplication Indicator in Cycle II

3. Development of Learning Outcomes from the Pre-Cycle to Cycle II

The distribution of students' mathematics learning outcomes during the pre-cycle, Cycle I, and Cycle II demonstrates changes in achievement following the implementation of the Student Teams Achievement Divisions (STAD) cooperative learning model. The scores were classified into four ranges: below 50, 50–69, 70–89, and 90–100. Each stage involved the same 38 students, ensuring consistency in the comparison. A minimum score of 70 was used as the

mastery criterion, while scores below 70 were classified as not mastered. The frequency and percentage distributions of students' learning outcomes are presented in Table 2.

Table 3. Distribution of Students' Mathematics Learning Outcomes in the Pre-Cycle, Cycle I, and Cycle II (n = 38)

Score Range	Category	Pre-Cycle n (%)	Cycle I n (%)	Cycle II n (%)
90–100	Mastered	0 (0.00%)	8 (21.05%)	28 (73.68%)
70–89	Mastered	5 (13.16%)	8 (21.05%)	8 (21.05%)
50–69	Not Mastered	15 (39.47%)	10 (26.32%)	2 (5.26%)
Below 50	Not Mastered	18 (47.37%)	12 (31.58%)	0 (0.00%)
Total	—	38 (100.00%)	38 (100.00%)	38 (100.00%)

During the pre-cycle stage, most students were classified as not having achieved mastery. A total of 18 students (47.37%) scored below 50, while 15 students (39.47%) obtained scores ranging from 50 to 69. Meanwhile, only five students (13.16%) achieved mastery within the 70–89 score range, and no students obtained scores between 90 and 100. These findings indicate that students' initial mathematics achievement required improvement through more structured and targeted instructional interventions.

Following the implementation of the STAD cooperative learning model in Cycle I, the distribution of learning outcomes showed positive progress. A total of 16 students (42.11%) achieved mastery, comprising eight students (21.05%) in the 90–100 range and eight students (21.05%) in the 70–89 range. Meanwhile, 22 students (57.90%) remained in the not-mastered category, including 10 students (26.32%) who scored between 50 and 69 and 12 students (31.58%) who scored below 50. These results indicate an improvement compared with the pre-cycle stage, although classical mastery still required further improvement through the implementation of Cycle II.

In Cycle II, students' learning outcomes improved substantially. A total of 36 students (94.74%) achieved mastery, consisting of 28 students (73.68%) who scored between 90 and 100 and eight students (21.05%) who scored between 70 and 89. Meanwhile, only two students (5.26%) remained in the not-mastered category, with scores ranging from 50 to 69. No students scored below 50. The classical mastery rate of 94.74% exceeded the research success criterion of 50%. Therefore, the classroom action research was concluded after Cycle II because students' mathematics learning outcomes had met the established success criterion.

Overall, the distribution of learning outcomes demonstrates a shift in student achievement from the not-mastered category toward the mastered category throughout the instructional intervention. This improvement is reflected in the increase in the number of students scoring between 90 and 100, from none in the pre-cycle stage to 28 students in Cycle II. Conversely, the number of students scoring below 50 decreased from 18 to none by the end of the intervention. These changes provide an overview of the development of students' mathematics learning outcomes following the implementation of the STAD cooperative learning model. To illustrate the

comparison more clearly, the distribution of students' achievement across the three research stages is presented in Figure 3.

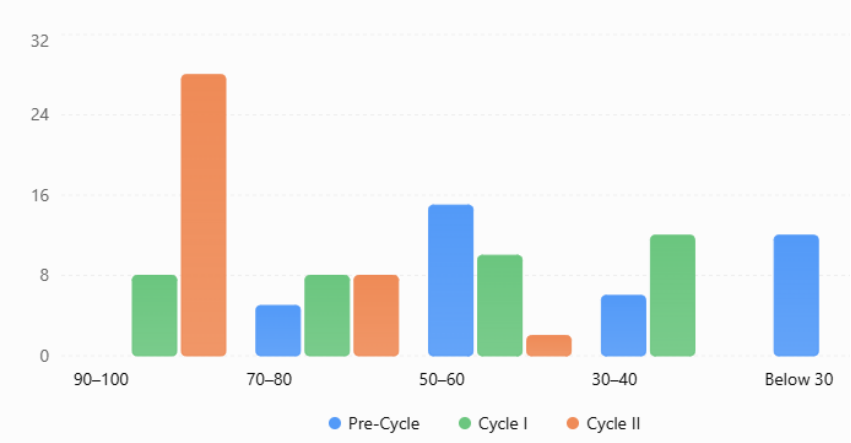


Figure 3. Comparison of Students' Mathematics Achievement Across Research Stages

DISCUSSION

The improvement in learning outcomes from the pre-cycle to Cycle II indicates that implementing the STAD cooperative learning model can support improvements in fourth-grade mathematics instruction. This progress is reflected in the increase in students' average scores and classical mastery after participating in learning activities involving heterogeneous groups, discussions, and collaborative assignments. These findings are consistent with Aningsih et al. (2023), who reported improvements in elementary students' mathematics learning outcomes following the implementation of STAD. Agustini et al. (2023) also found that STAD could improve mathematics learning outcomes through systematically implemented instructional interventions. These similarities suggest that cooperative learning provides opportunities for students to engage actively in understanding mathematical concepts rather than merely receiving explanations from the teacher.

In terms of the instructional process, changes between cycles highlight the importance of managing group interactions. In Cycle I, some students were not accustomed to working collaboratively, contributed minimally to discussions, and tended to wait for answers from their peers. These conditions indicate that forming heterogeneous groups does not automatically produce effective collaboration. Teachers must provide clear guidance on role distribution, ensure that every member participates, and monitor individual understanding. Tahir et al. (2024) explained that implementing STAD in mathematics instruction can create a more active and collaborative learning environment. Depari et al. (2022) also demonstrated the relevance of STAD to mathematics learning outcomes, although their research involved different subject matter and participant characteristics.

The instructional improvements implemented in Cycle II demonstrate that the use of learning media needs to be accompanied by appropriate guidance and support. Media provided to groups can serve as concrete learning resources that help students understand the procedures involved in solving arithmetic problems. However, media-based activities may also create

classroom disruptions when students do not fully understand their learning objectives and group-work procedures. These findings suggest that the effectiveness of instructional media depends not only on its availability but also on how teachers integrate it into learning activities. Farda and Amaliyah (2023) found that combining STAD with puzzle-based media could support mathematics learning outcomes. Lestari et al. (2026) also examined the integration of educational board games with STAD to support elementary students' mathematical problem-solving skills.

The improvement in mastery across one-digit, two-digit, and three-digit multiplication indicators indicates that instructional improvements were associated with students' ability to perform multiplication operations at different levels of difficulty. Although mastery increased across all three indicators, three-digit multiplication still had the lowest mastery percentage in Cycle II compared with the other two indicators. This suggests that operations involving more complex numbers require gradual practice, procedural explanations, and instructional support tailored to students' needs. Arinda et al. (2026) support the use of STAD in elementary mathematics instruction, while Rostiana and Wahyudin (2025) demonstrate the relevance of this model to improving mathematics learning outcomes. These studies provide comparative evidence that STAD can be implemented across different subject matter and grade levels.

The success of the instructional intervention was also associated with reflection between cycles. Reflection on Cycle I identified several aspects of instruction that required improvement, including student motivation, opportunities to ask questions, reinforcement of learning materials, lesson summaries, and recognition of students' work. Addressing these aspects in Cycle II indicates that improved learning outcomes are related not only to the selection of an instructional model but also to the quality of its implementation at each stage. Bahari and Ernawati (2022) reported improvements in mathematics learning outcomes following the implementation of STAD. Similarly, Sulistianingsih and Maharani (2026) examined the implementation of STAD in teaching data presentation to elementary school students. These findings suggest that cooperative learning models need to be adapted to the subject matter, student characteristics, and classroom management conditions.

From a practical perspective, this study demonstrates that STAD can serve as an alternative approach to improving arithmetic instruction in elementary schools, particularly when previous instruction has been predominantly teacher-centered. Heterogeneous grouping, group discussions, instructional media, and assessments can be used to encourage student participation while monitoring learning progress. The contribution of this study lies in implementing STAD to teach multiplication and division operations to fourth-grade students at SD Negeri 008 Simpang Gaung through two cycles of classroom action research. However, the detailed indicator data presented in this study cover multiplication operations only. Therefore, improvements in division skills cannot be examined separately based on the available indicator tables. Furthermore, because the analysis is descriptive, the observed score improvements demonstrate

changes in learning outcomes during the intervention rather than establishing a causal relationship through inferential statistical testing.

CONCLUSION

Main Findings: This study found that implementing the Student Teams Achievement Divisions (STAD) cooperative learning model was accompanied by improvements in Grade IV students' mathematics learning outcomes at SD Negeri 008 Simpang Gaung. The class average increased from 44.73 in the pre-cycle to 58.42 in Cycle I and 86.84 in Cycle II. Learning mastery also improved from 13.16% (5 students) in the pre-cycle to 42.11% (16 students) in Cycle I and 94.74% (36 students) in Cycle II. The final mastery rate exceeded the predetermined success criterion, indicating that the classroom action research target was achieved. **Research Contribution:** This study contributes to elementary mathematics education by providing classroom-based evidence of the implementation of STAD in teaching multiplication and division. Through heterogeneous group formation, collaborative discussion, task completion, and individual evaluation, STAD provides opportunities for students to participate actively, exchange ideas, and support one another in understanding mathematical concepts. **Theoretical and Practical Implications:** The findings highlight the importance of structured peer interaction, collaborative learning, and teacher guidance in supporting elementary students' mathematics achievement. Practically, teachers can implement STAD by organizing heterogeneous groups, presenting clear learning objectives, providing appropriate learning media and worksheets, facilitating group discussions, and conducting individual assessments. Continuous guidance, motivation, and reinforcement are also necessary to ensure that all students participate meaningfully. **Research Limitations:** This study was limited to 38 fourth-grade students at one elementary school and involved two classroom action research cycles. Its descriptive classroom-based design and the absence of a comparison group limit the generalizability of the findings and do not establish a causal relationship between STAD implementation and improved achievement. In addition, the detailed indicator-level analysis focused on multiplication, so improvements in division achievement could not be examined separately. **Future Research Directions:** Future studies should involve larger and more diverse student populations and examine STAD implementation across different mathematical topics and grade levels. Further research could compare STAD with other cooperative learning models and investigate its relationship with students' mathematical problem-solving skills, learning motivation, classroom participation, and conceptual understanding.

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