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The effect of STAD learning model using the finger-counting method on students' multiplication skills

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Abstract

Students may encounter difficulties when solving basic multiplication problems. They proficiently recalled the entire multiplication table but struggled to locate specific results without reciting the whole table. Those interconnected challenges highlight the importance of implementing comprehensive teaching strategies. This study aims to support fourth-grade students' multiplication skills at SDN 3 Sindangkasih by applying the STAD learning model and finger-counting method. This study employed a quasi-experimental design with both control and experimental groups. Results show that the experimental class's average score improved significantly from 57 to 73 after treatment, while the control class's score increased slightly from 62 to 62.5, indicating no significant change. The significance value of the Wilcoxon test for the control group's pretest and posttest scores is 0.763, greater than 0.05, indicating no significant difference in average scores before and after the class. In contrast, the analysis for the pretest and posttest scores of the experiment class reveals a significant difference in scores ($p = 0.000 < 0.05$), indicating that the STAD learning model combined with the finger-counting method significantly improves students' multiplication skills. The findings suggest that the finger-counting method effectively supports students' multiplication abilities by providing a tangible and interactive approach to learning.
Keywords: cooperative learning, elementary education, finger-counting method, multiplication skills, STAD

INTRODUCTION

In recent years, the need for effective teaching strategies in mathematics has become increasingly important, particularly in enhancing students' multiplication skills. Students proficiently recalled the entire multiplication table but struggled to locate specific results without reciting the whole table (Oanh, 2016, as cited in Duyen & Loc, 2021). Their inability to perform direct references highlighted a lack of efficient retrieval skills. Students may encounter difficulties when solving basic multiplication problems due to several factors, including a lack of interest, insufficient understanding of multiplication concepts, low motivation to memorize multiplication facts from 1 to 10, inadequate counting skills, poor reading fluency, insufficient practice at home, inadequate evaluations, and unengaging teaching materials (Zain, Saputra, & Musaddat, 2022).

Those interconnected challenges highlight the importance of implementing comprehensive teaching strategies that address the cognitive and motivational aspects of learning multiplication, ultimately supporting students in developing strong mathematical foundations. Choosing the right instructional model engages learners, motivates them, and enhances comprehension of the subject matter (Hidayah, Kartono, & Suciati, 2023). Moreover, implementing diverse and interactive teaching methods addresses these gaps in retrieval skills and fosters a more profound understanding of mathematical concepts, ultimately equipping students with the tools they need for future academic success.

Fingers enable the development of various counting strategies, and finger-based counting has strong neural connections in the brain (Mutlu, Akgün, & Akkuşci, 2020). The finger-counting method can actively engage students and make learning enjoyable by incorporating a game-like element involving their fingers (Baru et al., 2023). This approach provides an easy and fun way to perform mathematical calculations using one's fingers. Research conducted by Imron and Fajriyyah (2021) also indicates that students learn more effectively and retain information in a fun and engaging environment rather than through serious lectures. The finger-counting method has been shown to help students calculate basic multiplication more easily and quickly (Bahar & Syahri, 2021).

The finger-counting method serves as a practical technique for counting (Himmah, Asmani, & Nuraini, 2021). It offers a solution to challenges in mathematics learning by fulfilling the principles of effective instruction, allowing students to perceive mathematics as both enjoyable and challenging. Furthermore, this method is effective in helping students recognize counting processes and procedures in an accessible and engaging manner. While the finger-counting method does not eliminate the concept of mathematical operations, it simplifies and accelerates the calculation process. Although it may seem primitive, this technique is easy for students to grasp and straightforward to understand. Additionally, the finger-counting method is practical, interesting, economical, and simple, as it utilizes only ten fingers. Finger methods like the "Magic Finger," or finger-counting technique, have also proven effective in improving multiplication skills among third-grade students. Pabon, Dagansan, and Pingot (2023) reported a significant improvement in post-test scores from 35.75% to 96.25% after implementing this method.

The cooperative learning theory forms the foundation of the STAD model, emphasizing the importance of collaboration among students to achieve common goals. As advocated by Vygotsky, social constructivism highlights that social interaction is crucial for learning, allowing children to acquire cultural knowledge collaboratively rather than individually (Yusnani, 2018). By working in teams, students can support each other's learning, which is particularly effective in mastering foundational skills such as multiplication. Constructivism posits that learners actively construct their understanding and knowledge of the world through experiences and reflection on those experiences. Integrating the finger-counting method allows students to visualize and manipulate numbers, aligning with constructivist principles and fostering a deeper understanding and retention of multiplication facts through hands-on learning. This approach enhances students' mathematical skills and encourages engagement and collaboration, making the learning process both effective and enjoyable.

Student Teams-Achievement Division (STAD) learning model has been widely implemented across various subjects. Previous studies have demonstrated the effectiveness of STAD in fostering collaborative learning and improving academic outcomes. For instance, Putri (2024) highlighted that STAD effectively enhances students' mathematical abilities through structured group collaboration and individual evaluations. Similarly, Simamora (2024) found that students taught using STAD achieved a better conceptual understanding of mathematics.

In STAD cooperative learning, students collaborate in groups and take responsibility for their teammates (Kusuma, Prananosa, & Yuneti, 2023). Achievement emotions, influenced by factors like motivation and engagement, are crucial outcomes in mathematics education, especially in cooperative learning models like STAD (Pekrun, 2006; Pekrun & Perry, 2014, as cited in Putwain, 2021). The finger-counting method complements this by providing a tactile and visual tool that aids in understanding and retaining multiplication facts.

This study aims to investigate the implementation of the STAD (Student Teams-Achievement Divisions) learning model integrated with the finger-counting method in enhancing multiplication skills among Class IV students at SDN 3 Sindangkasih Purwakarta. Specifically, this study seeks to evaluate the impact of this combined approach on students' ability to solve multiplication problems involving numbers 1-10, and compare the increase in learning outcomes between experimental and control groups.

The innovation of this study lies in its dual approach: it explores the synergistic effects of cooperative learning through the STAD model while incorporating practical techniques such as finger counting to accommodate various learning styles. This integrated strategy aims to address gaps in traditional mathematics instruction by fostering collaborative learning and providing a tactile, visual tool for understanding multiplication concepts. Through this investigation, the study seeks to contribute valuable insights into effective teaching strategies in elementary mathematics education, particularly in enhancing students' multiplication skills through innovative and engaging methods that combine structured group collaboration with hands-on learning technique.

RESEARCH METHOD

This study employs a quasi-experimental design with both control and experimental groups to investigate the effect of the STAD learning model combined with the finger-counting method on students' multiplication skills. The quasi-experimental design utilized in this study aligns with previous research that underscores its effectiveness in evaluating educational interventions. By using this method, this study aims to determine whether integrating STAD with finger-counting can significantly enhance students' multiplication skills compared to conventional teaching methods. Through this investigation, we seek to contribute valuable insights into innovative pedagogical practices that can address the challenges faced by students in mastering fundamental mathematical concepts.

This study was conducted at SDN 3 Sindangkasih, Purwakarta Regency, West Java, Indonesia. The subjects of the study include students from two different classes: an experimental group that received instruction using the STAD learning model combined with the finger-counting method, and a control group that received traditional instruction without this method. The sampling technique used is non-random selection, which is common in quasi-experimental designs, meaning that participants were assigned to either group based on pre-existing classes.

The control class, Class 4A, consists of students who are generally more engaged and competent during learning activities, particularly in mathematics. Their higher competency level than the experimental class (Class 4B), which received several treatments, may influence the results. In Class 4A, students exhibit high learning motivation and curiosity, which drives them to achieve better academic outcomes. This positive learning culture fosters an environment where students support and motivate each other. Their active participation is evident through their willingness to ask questions and engage with the material, contributing to their overall competence and superiority compared to Class 4B.

In this study, the control and experimental classes were involved in an educational experiment designed to assess the impact of different teaching methods on student performance. The control class comprised high-achieving students, resulting in higher average pretest scores than the experimental class. This situation presents a potential threat to internal validity, as internal validity ensures the soundness of research by confirming that study outcomes are attributable to manipulated variables. The degree of internal validity can vary based on potential threats to accuracy (Kaluza, 2023). The inherent characteristics of the control group could skew results, making it challenging to attribute differences in outcomes solely to the teaching methods employed.

Identical 10-question pretest and posttest were administered to both groups. The questions focus on simple multiplication problems involving the numbers 1 through 10. These questions are essential for determining whether the applied methods and models have been effective. Table 1 illustrates the research flowchart detailing the systematic process followed in this study to assess the effects of the STAD learning model combined with the finger-counting method on students' multiplication skills.

Table 1. Research Stages

Step	Description
Selection of Participants	Two classes were selected; one as a control, one as an experimental
Pretest Administration	10-question multiplication test was given to both groups
Intervention	The experimental group was taught using STAD + finger counting; the control group was taught conventionally.
Posttest Administration	The same test as the pretest was administered to both groups
Data Analysis	Paired Sample T-test or Wilcoxon test was used to figure out the difference or increase of students’ multiplication skills before and after the treatment.

Before conducting statistical tests on the pretest and post-test data from the control and experimental classes, normality and homogeneity tests were carried out to determine the statistical tests that would be used. To compare or determine whether there are significant differences before and after treatment, the independent sample t-test is used if the data is normally distributed, or the Wilcoxon test is used if the data is not normally distributed. This comprehensive analysis provides valuable insights into the effectiveness of combining instructional strategies to enhance students' multiplication skills while highlighting the limitations of traditional methods in achieving similar outcomes.

FINDINGS & DISCUSSION

On the first day, students in the experimental class struggled with math problems related to the multiplication of numbers 1 to 10, as evidenced by incorrect answers and frequent cross-outs during a 10-minute pretest. By the second day, they were introduced to the finger-counting method for multiplication of numbers 1 to 5. Although initially challenging, students were attentive and eager to learn. Finger counting is a proven strategy that aids young learners by providing a tangible way to understand numerical concepts, enhancing arithmetic skills and number sense (Gajbhiye, 2024). The tactile experience of finger counting supports the retention and internalization of mathematical concepts and increases engagement and motivation, making learning more interactive and effective (Mutlu, Akgün, & Akkuşci, 2020). While initial difficulties are common, continued practice with the finger-counting method can significantly improve understanding and performance in multiplication tasks (Sutton, 2024).

Several factors emerged that influenced the learning process during the implementation of multiplication instruction for numbers 1 to 5. Some students chatted with their classmates, while others became anxious and cried when asked to come forward. Conversely, some students were enthusiastic about participating. On the third day, the experimental class was divided into small groups of four to five students to learn multiplication for numbers 6 to 10. Despite these efforts, some students continued to struggle with the method. To address this, peers who had mastered the method were encouraged to assist their classmates while researchers supported each group. Collaborative learning has been shown to improve academic performance and foster positive attitudes toward mathematics by promoting peer support and reducing anxiety (Siller & Ahmad, 2024).

On the fourth day, students in the experimental class engaged in a match-making game within their groups to reinforce learning. Gamification strategies like this have been found to enhance engagement, motivation, and understanding of mathematical concepts by creating interactive and enjoyable learning environments (Attah, Ogunlade, & Otemuwiya, 2024).

Tables 2 and 3 present the results of preliminary statistical analyses to determine the appropriate statistical tests for comparing the experimental and control groups. Table 2 displays the results of the Kolmogorov-Smirnov normality test, which examines whether the pretest and posttest score data from both groups follow a normal distribution. Table 3 shows the results of Levene's test for homogeneity of variances, which assesses whether the variances between the experimental and control groups are equal. These analyses are fundamental prerequisites for selecting the appropriate statistical methods for subsequent group comparisons.

Table 2. Result of the Normality Test

	Kolmogorov-Smirnov[a]		
	Statistic	**Df**	**Sig.**
Control Group_Pretest	.110	20	.200*
Control Group_Posttest	.203	20	.031
Experimental Group_Pretest	.146	20	.200*
Experimental Group_Posttest	.199	20	.037

The normality test results indicated that the significance value for the control and experiment group's pretest score data was 0.200, greater than 0.05. This suggests that the pretest score data for the control and experiment groups is normally distributed. In contrast, the significance value for the control and experiment group's posttest score data was 0.031 and 0.037, respectively, which is less than 0.05. This indicates that the post-test score data for the control and experiment groups is not normally distributed.

Table 3. Result of Homogeneity of Variance Test

		Levene Statistic	**Sig.**
Posttest	Based on Mean	.085	.772

The significance value of 0.772, greater than 0.05, indicates that the posttest score data for the experimental and control groups exhibit homogeneity of variance. This conclusion suggests that the variances of the two groups are similar, allowing for valid comparisons between their post-test results.

The control and experiment group's posttest score data was found to be not normally distributed, leading to the use of the Wilcoxon test for comparisons within that group. This statistical test assesses whether a significant difference exists between the means of two measurements taken from the same subjects, specifically students' scores before and after the intervention. The result of the Wilcoxon test is presented in Table 4 below.

Table 4. Pretest and Posttest on Control and Experiment Group

	Pretest	**Postest**	**Asymp. Sig. (2-tailed)**
Control Group	62	62.5	.763
Experiment Group	57	73	.000

Changes were observed from the pretest, where the average score of the control group was 62, to the posttest, where the average score increased slightly to 62.5; however, this increase was not statistically significant. The significance value for the control group's pretest and posttest scores was 0.763, greater than 0.05. This indicates no significant difference in average scores before and after the intervention, suggesting that traditional teaching methods did not lead to meaningful improvements in multiplication skills. In contrast, the pretest and posttest score of the experiment class increases from 57 to 73. In addition, the analysis for the pretest and posttest scores of the experiment class revealed a significant difference in scores ($p = 0.000 < 0.05$), indicating that the STAD learning model combined with the finger-counting method effectively improved students' multiplication skills.

A noticeable comparison emerged between the experimental class and the control class. When the experimental class received treatment, there was a change in average scores; however, this was inversely proportional for the control class, which did not receive any treatment. When given multiplication questions, students successfully used the finger-counting method to answer them. The finger-counting method significantly improved students' multiplication ability in the experiment class. The average score for the experimental class increased from 57 during the pretest to 73 during the posttest after treatment. In contrast, the control class's average score slightly improved from 62 to 62.5, indicating no significant change due to the absence of treatment.

While the control class demonstrated strong pretest scores due to their superior characteristics and engagement levels, the experimental class showed significant improvement in multiplication skills after receiving targeted instruction using innovative methods. This highlights the importance of considering inherent student characteristics and instructional strategies when evaluating educational interventions. These findings underscore the effectiveness of combining the STAD learning model with the finger-counting method, suggesting that even when starting with lower baseline performance, students can achieve significant improvements through structured, innovative teaching approaches that incorporate both collaborative learning and hands-on mathematical techniques.

In this integrated approach of STAD and the finger-counting method, teachers introduce multiplication concepts using finger-counting to visually illustrate complex problems and provide a tangible way for students to grasp numerical relationships (Martignon & Rechtsteiner, 2022). Students were then divided into small heterogeneous groups where they collaboratively practiced multiplication exercises while aiding each other through hands-on engagement. This finger-counting method makes it easier for students to calculate multiplication, thereby increasing their satisfaction and motivation to improve their skills. Arithmetic techniques reduce cognitive load and enable students to master multiplication interactively and enjoyably without needing external aids (Damayanti, Zumrotun, & Sutriyani, 2024; Lestari et al., 2024). This simple method does not burden students' memory capacity; instead, it allows them to understand and calculate multiplication effectively. This method is particularly effective in early mathematics education as it helps reduce cognitive load and supports the development of number sense. Therefore, it can be concluded that the STAD learning model integrated with the finger-counting method effectively enhances students' understanding of multiplication from 1 to 10. Through this integrated approach, students displayed enthusiasm while calculating multiplication using their fingers, demonstrating that this treatment significantly aided their performance during post-tests.

Research has shown that collaborative learning environments, as the combination of the STAD learning model and the finger-counting method, foster deeper understanding and improve mathematical performance by promoting peer support and reducing anxiety (Siller & Ahmad, 2024). After a team study session, individual quizzes assess each student's understanding while maintaining accountability since collaboration is prohibited during tests. Recognition is given to teams based on their overall performance, fostering a competitive yet supportive environment that encourages improvement. This combination boosts student engagement and retention through active participation and promotes individual accountability within a cooperative learning framework, ultimately leading to a deeper understanding of multiplication concepts (Luthfi & Murtiyasa, 2024).

CONCLUSION

The research concludes that integrating the finger-counting method with the Student Teams-Achievement Divisions (STAD) learning strategy significantly enhances students' multiplication skills. This combined approach effectively addresses students' difficulties in mastering multiplication by providing a tangible and interactive method for understanding numerical concepts, which is particularly beneficial for young learners. The study found that students in the experimental class who received this dual intervention showed a significant improvement in their multiplication abilities, with an average score that improved significantly from 57 to 73 after treatment, compared to those in the control class, with average scores that only increased from 62 to 62.5. The significance value for the control group's pretest and posttest scores was 0.763, greater than 0.05. This indicates no significant difference in average scores before and after the intervention, suggesting that traditional teaching methods did not lead to meaningful improvements in multiplication skills. In contrast, the analysis for the pretest and posttest scores of the experiment class revealed a significant difference in scores with the significant value 0.000, less than 0.05, indicating that the STAD learning model combined with the finger-counting method effectively improved students' multiplication skills.

This research contributes to educational theory and practice by strengthening the social constructivist framework and demonstrating how collaborative learning combined with tactile methods can enhance mathematical understanding. The findings suggest that the tactile experience of finger counting, coupled with the cooperative learning environment fostered by STAD, boosts engagement and motivation and promotes a deeper understanding of mathematical concepts. Furthermore, this study extends the application of STAD beyond traditional subjects by successfully integrating it with concrete mathematical tools, providing empirical support for the effectiveness of multi-modal learning approaches in mathematics education.

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