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Enhancing Mathematics Learning Outcomes of First-Grade Students through the STAD Cooperative Learning Model

A Classroom Action Research at a public primary school in Klaten, Indonesia

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ABSTRACT

This study aims to investigate the enhancement of mathematics learning outcomes through the implementation of the STAD cooperative learning model. Employing a classroom action research approach, the study unfolds across two cycles. The subjects consist of 29 first-grade students, comprising 10 male and 19 female students. Data collection techniques encompass observation, tests, and documentation, facilitated by observation sheets and written tests as research instruments. Data analysis involves both qualitative and quantitative descriptive analysis. Results indicate that the utilization of the STAD cooperative learning model significantly improves students' mathematics learning outcomes. This improvement is evidenced by the progressive increase in the class's average test scores across each cycle, with average scores rising from 54.48 in the pre-cycle to 70.52 in cycle I and further to 82.6 in cycle II.

Introduction

The primary goal of elementary education is to nurture students' potential across cognitive, affective, and psychomotor domains, fostering attitudes and imparting fundamental knowledge and skills necessary for life within the community and for further educational pursuits [1]-[3]. Among these foundational skills emphasized in primary education are reading, writing, and arithmetic. These abilities hold significant relevance in daily life. Mathematics, in particular, plays a crucial role in cultivating students' logical, analytical, systematic, critical, and creative thinking abilities, essential for societal integration and higher educational progression [4]-[7]. Basic arithmetic proficiency, including addition and subtraction operations, is essential for students at the primary school level. Mastery of addition and subtraction lays the groundwork for subsequent arithmetic skills, such as multiplication and division, taught in subsequent grades. Students who lack proficiency in these fundamental operations may encounter difficulties in grasping advanced mathematical concepts in later grades.

Observations conducted at a public primary school in Klaten, Indonesia reveal that the mathematics learning outcomes of first-grade students remain unsatisfactory. Students face challenges in accurately solving addition and subtraction problems, frequently struggling to correctly place digits according to their place values, resulting in incorrect answers. Thus, there arises a pressing need for a strategy to enhance students' mathematical learning outcomes.

According to Ref. [8], various factors significantly impact students' learning outcomes, among which teaching methodology plays a pivotal role. Through observations of mathematics instruction in first-grade classrooms, it becomes evident that a predominantly conventional approach prevails. This approach is characterized by teacher-centered methods, where lectures serve as the primary mode of delivering information.

Unfortunately, this traditional teaching style often falls short of actively engaging students. Instead, it frequently leads to disengagement, boredom, and passive learning behaviors. Students may find themselves struggling to maintain focus, resulting in instances of drowsiness and mere note-taking, rather than active participation and deep comprehension. This lack of engagement can have profound consequences on students' academic performance and overall attitude towards learning mathematics. Without opportunities for active involvement and interaction, students may fail to develop a genuine interest in the subject matter, hindering their motivation to learn and explore mathematical concepts further.

Given these challenges, there arises a pressing need to explore alternative teaching methodologies that prioritize student engagement and participation. Cooperative learning models, such as the Student Teams-Achievement Divisions (STAD) approach, offer a promising solution. By fostering collaborative learning environments where students work together to

solve problems and share ideas, STAD aims to enhance students' motivation, comprehension, and overall learning outcomes in mathematics [8].

Interviews with first-grade teachers further corroborate these findings, indicating a reliance solely on textbooks without incorporating engaging teaching aids. This lack of variety results in diminished enthusiasm and boredom among students during lessons. Ref. [9] suggests, mathematics comprises abstract ideas conveyed through symbols, necessitating a concrete understanding of mathematical concepts before symbol manipulation. Thus, instructional aids tailored to students' developmental levels become imperative. Foundational arithmetic skills must be meticulously attended to by teachers, demanding greater creativity and innovation in classroom management.

To ensure effective, enjoyable, and successful learning experiences, an appropriate instructional strategy is imperative. Cooperative learning models emerge as promising strategies, with the Student Teams Achievement Division (STAD) model standing out among them [10]. According to Ref. [11], STAD represents the simplest form of cooperative learning, particularly suited for mathematics instruction and ideal for educators new to cooperative approaches. Comprising five main components – class presentation, teams, quizzes, individual progress scores, and team recognition – STAD offers a structured yet collaborative learning environment. This research endeavor aims to ascertain the efficacy of the STAD cooperative learning model as a pedagogical approach in enhancing mathematics learning outcomes, fostering a positive learning environment, and promoting essential skills among first-grade students.

Method

The research conducted in this study is Classroom Action Research (CAR). CAR involves investigating a group of subjects, in this case, students, to improve the classroom learning situation to enhance the quality of education (Arikunto, 2010: 10). The subjects of this research are 29 first-grade students, comprising 10 male and 19 female students. The research object is the mathematics learning outcomes through the implementation of the STAD cooperative learning model. Data collection techniques employed include observation, tests, and documentation. Research instruments consist of observation sheets and written tests. The success indicators in this research are the improvement in students' mathematics learning outcomes, as evidenced by test results and observation records. The success of this research is characterized by observable improvements in these outcomes. The success indicators for this classroom action research are met when students' mathematics learning outcomes reach an average score of at least 70, in line with the KKM (*Kriteria Ketuntasan Minimal* or Minimum

Completeness Score) set by the school, and achieve an 80% mastery rate among the first-grade students.

Results and Discussion

The results of the study after learning actions using the STAD-type cooperative learning model, showed an increase in students' mathematics learning outcomes from pre-action to the end of Cycle II. The mathematics learning outcomes of grade I students can be seen in Table 1.

Table 1. Mathematics learning outcomes

Score Interval	Pre-Cycle	1st Cycle	2nd Cycle	Category
≥70	31%	66%	83%	Complete
<70	69%	34%	17%	Incomplete
Total Score	1580	2045	2395	
Average	54.48	70.52	82.59	
Criteria	Worse	Good	Very Good	

Table 1 shows that the application of the STAD-type cooperative learning model can improve students' mathematics learning outcomes. The increase can be seen from the percentage of completeness of students' mathematics learning outcomes in the pre-cycle of 31% in the less category, increased to 66% in Cycle I with the sufficient category, and increased again in Cycle II to 83% with the good category.

The observations conducted at the school revealed that the mathematics learning outcomes of first-grade students were unsatisfactory. Students faced difficulties in accurately solving addition and subtraction problems, often misplacing digits according to their place values, resulting in incorrect answers. Ref. [12] defines learning outcomes as the achievements of students in numerical form after being subjected to assessments at the end of meetings, mid-terms, or final terms. To gauge the extent of students' arithmetic abilities, a pretest was conducted to gather data on their mathematics learning outcomes before any intervention was implemented. From the pretest results, it was found that the average score of the first-grade students was 54.48, with 69% of students, or 20 students, scoring below the KKM, while only 31%, or 9 students, reached the KKM.

These findings indicated that the mathematics learning outcomes of first-grade students fell into the "poor" and "suboptimal" categories. Motivated to address this issue, the researcher decided to implement an intervention aimed at improving these outcomes by employing the STAD cooperative learning model. Before initiating the intervention, the teacher meticulously planned the process by developing detailed lesson plans, preparing appropriate

teaching materials and learning media, and assembling observation instruments, including observation sheets and test questions.

The intervention was conducted over two cycles, with two meetings in each cycle. Each lesson began with the teacher greeting the students, followed by a prayer and singing the national anthem. The teacher then conducted an introduction, connecting the students' prior knowledge with the upcoming lesson, stating the learning objectives, and motivating the students to actively engage in the lesson.

In Cycle I, the instructional focus revolves around addition, a key component of Theme 7 - Objects, Animals, and Plants Around Me. The teacher adopts a structured approach using the STAD cooperative learning model, wherein students are grouped heterogeneously and guided through various activities. These include whole class presentations, group discussions with completion of Learning Activity Sheets (LKS), individual quizzes, tracking of individual progress scores, and acknowledgment of team accomplishments. Additionally, the teacher recognizes the most active group and the group achieving the highest score, fostering a sense of achievement and motivation among students. The lesson concludes with a comprehensive summary, reflection, student-led prayer, and closing remarks. Following Cycle I, post-test data on mathematics learning outcomes are collected. The results indicate that the class average score is 70.52, falling within the "sufficient" category. While 66% of students have reached the KKM, 34% have not. Despite not meeting the predetermined success indicator of the class average reaching the KKM of 80%, there is evident improvement from the pretest results. This improvement highlights the effectiveness of the teaching strategies employed during Cycle I.

Additionally, student activity during the learning process was measured using observation sheets. The average activity level in Cycle I was 44.66%, with certain indicators falling below the targeted threshold of 51%, suggesting a need for improvement. However, the teacher's performance in implementing the STAD cooperative learning model was rated highly at 86.7, indicating effective implementation.

Reflection on the Cycle I revealed both successes and areas for improvement. While the intervention was executed according to plan, some students struggled to adapt to the new learning model, displaying confusion and hesitancy during group activities. This adjustment period highlighted the need for additional support and clearer instructions to help students feel more comfortable and confident with the STAD cooperative learning model. Despite these challenges, there were notable positive outcomes. Students showed increased enthusiasm for arithmetic, especially when manipulatives were incorporated into lessons. The hands-on approach seemed to engage them more effectively, making abstract concepts more tangible and understandable. However, it was also observed that some students remained inactive during group discussions, indicating a need for strategies to encourage more active

participation and ensure that all students are equally involved. Overall, Cycle I provided valuable insights, demonstrating the potential of the intervention while also pointing out specific areas that required further refinement to optimize the learning experience for all students.

Based on the reflections from Cycle I, several adjustments were implemented for Cycle II to enhance the learning experience. The improvements included clearer instructions and demonstrations, ensuring that directions for each activity were straightforward to understand while providing detailed, step-by-step guidance. Enhanced guidance on manipulative use was also introduced, with additional training sessions to teach students how to use educational manipulatives properly and clear examples to illustrate their integration into various learning activities. Furthermore, active participation during group discussions was encouraged by developing strategies to foster a more engaging and inclusive environment, ensuring that all students had the opportunity to contribute. Lastly, regular reminders were given to promote a supportive classroom culture where students actively assist classmates in need, emphasizing peer assistance to help those struggling with certain concepts or tasks. These enhancements aimed to create a more effective and collaborative educational experience for all students.

In Cycle II, the instructional focus transitions to subtraction while still aligning with Theme 7 - Objects, Animals, and Plants Around Me. The learning process in Cycle II closely mirrors that of Cycle I, with modifications implemented based on insights gained from the initial cycle. Similar to Cycle I, the teacher continues to utilize the STAD cooperative learning model, ensuring students are grouped heterogeneously and engaged in various cooperative learning activities. These activities may include whole class presentations, group discussions with completion of Learning Activity Sheets (LKS), individual quizzes, monitoring of individual progress scores, and recognition of team achievements. However, in Cycle II, adjustments are made to optimize learning outcomes. These adjustments may involve refining the pacing of activities, providing additional support or challenges tailored to individual student needs, incorporating more interactive learning tools or technologies, and enhancing strategies for promoting collaborative problem-solving and critical thinking skills. Furthermore, based on feedback and assessment data from Cycle I, the teacher may also introduce new instructional approaches, resources, or interventions to address areas of improvement and build upon students' existing knowledge and skills in subtraction.

Overall, while the structure and framework of Cycle II remain consistent with the first, the iterative nature of the teaching process allows for continuous refinement and enhancement of instructional practices to better meet the diverse learning needs of students and maximize learning outcomes. After Cycle II, posttest data revealed a significant improvement in

mathematics learning outcomes, with an average class score of 82.59, falling into the "good" category. Furthermore, 83% of students reached the KKM, representing a notable improvement from the previous cycle. Student activity during Cycle II also improved, with an average activity level of 59%, and the teacher's performance was rated highly at 95.6.

The results of Cycle II surpassed the predetermined success indicators, demonstrating a marked improvement in mathematics learning outcomes, student activity, and teacher performance. Therefore, it can be concluded that the intervention to enhance mathematics learning outcomes through the STAD cooperative learning model was successful, and the research was concluded at the end of Cycle II.

Social Learning Theory, proposed by Albert Bandura, emphasizes the role of observation and modeling in learning [13]. In the STAD cooperative learning model, students learn not only from their own experiences but also from observing and interacting with their peers [14]. By working collaboratively in groups, students observe and model problem-solving strategies demonstrated by their peers [15]. This observational learning process helps reinforce their understanding of mathematical concepts and problem-solving techniques.

Conclusion

In conclusion, the implementation of the STAD cooperative learning model has proven to be effective in enhancing the mathematics learning outcomes of first-grade students. Through two cycles of action research, significant improvements were observed in students' mathematics learning outcomes, as evidenced by higher posttest scores and increased percentages of students achieving the KKM. The collaborative nature of the STAD cooperative learning model provided students with opportunities to construct their understanding of mathematical concepts and learn from their peers through observation and modeling. Furthermore, the intervention led to enhancements in student engagement and participation during mathematics lessons, as indicated by increased activity levels and more active involvement in group discussions and problem-solving tasks. Teachers also demonstrated high levels of performance in implementing the cooperative learning model, contributing to the success of the intervention. The findings of this study underscore the importance of employing innovative instructional strategies, such as the STAD cooperative learning model, to address challenges in mathematics education and improve student learning outcomes. Moving forward, continued efforts to integrate cooperative learning approaches into mathematics instruction, along with ongoing professional development for teachers, will be essential to sustain and further enhance the gains achieved in this study.

Conflict of Interest

The authors should declare that there is no conflict of interest.

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