ENHANCING ELEMENTARY STUDENTS' UNDERSTANDING OF FRACTIONS THROUGH THE APPLICATION OF THE TEAMS GAMES TOURNAMENT COOPERATIVE LEARNING MODEL

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Article history: *received 02 December 2024; revised 16 January 2024; accepted 02 February 2024* *DOI: https://doi.org/10.33751/jssah.v4i1.9951*

Abstract. Mathematics is a fundamental subject in primary education that cultivates logical, analytical, and problem-solving skills. However, the topic of fractions is often perceived as complex by elementary students due to its abstract conceptual nature. This study aims to investigate the effectiveness of the Teams Games Tournament (TGT) cooperative learning model in enhancing students' conceptual understanding and learning outcomes in fraction lessons. The research employed a classroom action research (CAR) design involving 18 second-grade students at SDS Islam Nurul Iman. Data were collected through individual tests, classroom observations, and reflection cycles conducted over two learning cycles. The implementation of the TGT model, which integrates group collaboration and academic competition, resulted in a significant improvement in students' learning outcomes. The proportion of students achieving mastery increased from 44% in the pre-cycle to 83% after the second cycle, with a mean score improvement from 64 to 85. These findings demonstrate that the TGT model fosters active participation, motivation, and peer collaboration, contributing to deeper conceptual understanding of fractions. The study concludes that incorporating cooperative and game-based learning strategies like TGT can effectively enhance mathematics achievement and engagement in early-grade learners.

Keywords: cooperative learning; Teams Games Tournament (TGT); mathematics education; fractions

I. INTRODUCTION

Mathematics plays a fundamental role in shaping students' cognitive and analytical abilities, serving as the foundation for logical reasoning and problem-solving in everyday life [1]. At the elementary level, mathematics instruction is intended to cultivate critical, creative, and systematic thinking that supports lifelong learning [2]. However, numerous studies have reported that mathematics is often perceived as an abstract and challenging subject, particularly among early-grade students whose cognitive development remains at the concrete operational stage [3], [4]. This discrepancy between abstract concepts and concrete thinking frequently contributes to students' misconceptions and low achievement in mathematics [5]. One of the most conceptually demanding topics for young learners is fractions, as it requires a shift from whole-number reasoning to part-whole relationships [6]. Fraction learning difficulties have been widely reported across countries and are often associated with limited conceptual understanding, rote memorization, and inadequate instructional methods [7]. Teachers commonly rely on traditional lecture-based strategies, which result in passive learning and minimal student engagement [8]. To address this issue, educators are encouraged to adopt innovative pedagogical approaches that emphasize collaboration, interaction, and experiential learning [9].

Cooperative learning has been widely recognized as an effective instructional model for enhancing students' engagement, achievement, and interpersonal skills [10]. Within this framework, the Teams Games Tournament (TGT) model—developed by Slavin integrates teamwork, competition, and game-based elements to create a more dynamic and participatory classroom atmosphere [11]. The TGT model encourages students to work collaboratively, support peers, and compete in structured academic games that reinforce learning outcomes [12]. Such active learning environments not only improve cognitive outcomes but also enhance students' motivation, confidence, and social interaction [13]. Recent empirical studies have demonstrated that the TGT cooperative model can significantly improve mathematics performance and conceptual understanding in primary education settings [14], [15]. Research conducted by Rahmadani (2019) and Yulianti & Sunarsih (2021) confirmed that TGT effectively increases student achievement and critical thinking in mathematics classrooms [16], [17]. Similarly, Tagorumbu et al. (2025) and Irfan et al. (2023) found that combining TGT with digital and visual media can further enhance conceptual retention and student participation [18], [19]. These findings suggest that integrating game-based cooperative learning strategies can transform mathematics instruction from teacher-centered delivery to an engaging, student-centered process.

Despite these advancements, studies focusing on early-grade learners (Grades I–III) remain limited, particularly regarding the application of TGT in fraction learning. Young learners require tactile and visual experiences to grasp fractional relationships effectively [20]. Therefore, this study aims to investigate the effectiveness of the Teams Games Tournament cooperative learning model in improving elementary students' understanding and learning outcomes of fraction material. The findings are expected to provide pedagogical insights into the integration of cooperative and game-based approaches for mathematics instruction in early childhood education.

Cooperative learning has emerged as one of the most effective pedagogical frameworks for enhancing academic achievement, fostering teamwork, and developing social interaction among students [16]. Rooted in constructivist theory, it emphasizes active participation and shared responsibility, where students construct knowledge through collaboration and peer exchange [17]. Slavin's foundational model of cooperative learning outlines several approaches such as Student Teams Achievement Divisions (STAD), Jigsaw, and Teams Games Tournament (TGT) each incorporating elements of teamwork, accountability, and positive interdependence [18]. In mathematics education, cooperative learning supports conceptual understanding by allowing learners to discuss problem-solving strategies, justify reasoning, and confront misconceptions in a collaborative context [19]. Recent meta-analyses reveal that cooperative learning methods consistently outperform traditional lecture-based instruction in improving students' mathematical reasoning, motivation, and retention [20]. Moreover, studies indicate that students exposed to cooperative environments show higher self-efficacy and reduced anxiety toward mathematics [21].

The TGT model, originally designed by DeVries and Edwards, combines cooperative group learning with competitive game-based activities. Each team member contributes to group success, which fosters both accountability and social bonding [22]. The integration of game elements creates an engaging learning environment that transforms abstract topics, such as fractions, into interactive experiences that promote motivation and enjoyment [23]. Research in primary classrooms has demonstrated that TGT enhances students' understanding of complex mathematical concepts by linking cognitive engagement with affective stimulation [24]. A study by Wulandari and Rosdiana (2024) showed that students participating in TGT sessions developed better collaboration and communication skills, alongside improvements in mathematical problem-solving [10]. Similarly, Irfan et al. reported that the hybridization of TGT with multimedia and concrete manipulatives strengthened both conceptual comprehension and long-term memory retention [9]. These findings reinforce the premise that game-based cooperative learning can act as a bridge between abstract reasoning and concrete experience, a crucial need for learners in the early grades.

Despite substantial evidence supporting the benefits of cooperative learning, its implementation remains inconsistent in early-grade mathematics classrooms, especially within the context of fractions. Teachers often express difficulty in designing appropriate competitive activities that balance cognitive demand and playfulness [25]. Furthermore, previous studies have been limited to upper elementary or secondary levels, leaving a gap in empirical data regarding young learners' cognitive and social responses to the TGT framework. The present study addresses these gaps by examining the application of the Teams Games Tournament model in second-grade classrooms to determine its impact on conceptual understanding and mathematics achievement. This approach aligns with contemporary educational priorities emphasizing learner engagement, inclusivity, and evidence-based pedagogy for foundational mathematics learning.

II. RESEARCH METHODS

This study employed a Classroom Action Research (CAR) design to systematically investigate the implementation of the Teams Games Tournament (TGT) cooperative learning model in improving elementary students' understanding of fractions. The CAR approach was chosen because it enables teachers to reflect upon and enhance instructional practices in real classroom contexts [26]. The research was conducted at SDS Islam Nurul Iman, involving 18 second-grade students aged 7–8 years. The study was structured into two iterative cycles, each consisting of four phases planning, acting, observing, and reflecting following the model proposed by Kemmis and McTaggart [27]. Each cycle lasted for three instructional sessions of 35 minutes each. Data were collected using a combination of achievement tests, observation sheets, and teacher reflective journals to ensure triangulation and validity of findings. Quantitative data from tests were analyzed using descriptive statistics to identify improvements in student performance between cycles, while qualitative observations provided insights into engagement, collaboration, and motivation. Learning success criteria were determined based on mastery levels ($\geqslant$ 70 %) and classroom participation indicators. Ethical considerations were maintained by securing informed consent and ensuring confidentiality throughout the study. The methodological design thus provided both empirical rigor and pedagogical relevance, aligning with the study's objective to enhance learning outcomes through cooperative, game-based instruction.

III. RESULTS AND DISCUSSION

The implementation of the Teams Games Tournament (TGT) cooperative learning model yielded a significant improvement in students' mathematics achievement across two learning cycles. In the pre-cycle, only 44% of students achieved the mastery threshold (score $\geqslant$ 70). After the first cycle, this figure rose to 56%, with an average score of 64. However, mastery learning had not yet reached the desired criterion of 80%, prompting refinement in the second cycle. Adjustments included the incorporation of concrete

manipulatives, enhanced group heterogeneity, and more engaging tournament structures. Following these interventions, the second-cycle results revealed a marked increase—83% of students achieved mastery, with an average score of 85, and the lowest score improving from 40 to 60. This progression demonstrates that the TGT model had both direct effects (improved test performance) and indirect effects (increased motivation and collaboration) on students' learning outcomes [28]. Observational data indicated that students exhibited heightened participation, enthusiasm, and cooperative behavior during TGT sessions. Group-based discussions and academic games fostered active engagement and reduced mathematical anxiety, consistent with findings from Rahimi and Sajadi [21] and Huang and Chen [23]. Furthermore, the friendly competition embedded in TGT nurtured peer support and social interaction, promoting intrinsic motivation a factor critical for sustained academic improvement [29]. These results confirm that game-based cooperative structures align with constructivist learning principles, enabling learners to internalize abstract fraction concepts through shared experiences [30].

The findings also corroborate previous research by Yulianti and Sunarsih [12], who noted that the TGT model enhances students' critical thinking and collaborative competence. The observed increase in learning outcomes between cycles underscores the importance of iteration and reflection inherent in the Classroom Action Research (CAR) framework [27]. Thus, the synergy between cooperative learning theory and reflective teaching practice substantiates the effectiveness of TGT as a pedagogical innovation for elementary mathematics.

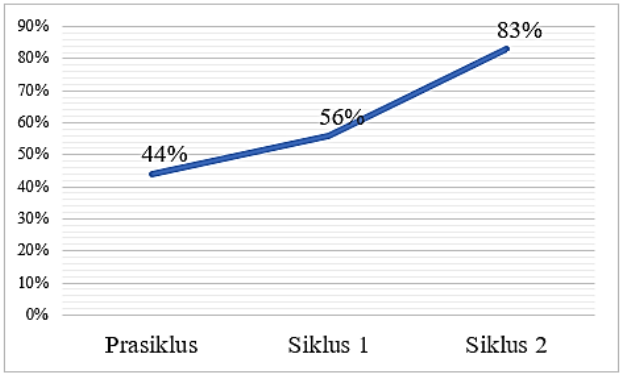


Figure 1. Percentage of Student Achievement Results Each Cycle

The results imply that integrating TGT within early-grade mathematics instruction can simultaneously enhance cognitive, affective, and social learning dimensions. Teachers should adopt adaptive strategies that balance teamwork and competition to sustain engagement and conceptual growth. Furthermore, embedding gamification within cooperative frameworks may serve as a model for fostering 21st-century learning competencies such as collaboration, communication, and problem-solving in primary education [31].

IV. CONCLUSIONS

This study concludes that the Teams Games Tournament (TGT) cooperative learning model effectively enhances students' understanding and performance in learning fractions at the elementary level. The integration of teamwork, academic competition, and game-based learning proved successful in improving both cognitive and affective outcomes. Quantitative findings demonstrated a notable increase in students achieving mastery from 44% in the pre-cycle to 83% in the second cycle while qualitative observations revealed improvements in engagement, collaboration, and intrinsic motivation. These results confirm that the TGT framework produces measurable gains through both direct effects (achievement) and indirect effects (motivation and peer interaction) on learning outcomes. The study reinforces the pedagogical value of combining cooperative learning with gamification to create engaging and inclusive mathematics instruction for young learners. Teachers are encouraged to implement TGT not merely as a competitive format but as a structured, reflective cycle that promotes conceptual understanding, teamwork, and positive classroom dynamics. The iterative reflection within Classroom Action Research (CAR) proved essential for adapting the model to diverse learning needs and maintaining effectiveness across cycles. For future research, broader investigations could examine the integration of digital platforms or adaptive technologies into the TGT model to enhance personalization and scalability in online or hybrid learning environments. Furthermore, longitudinal studies could explore the sustained impact of TGT on students' higher-order thinking, problem-solving, and emotional development across subjects beyond mathematics. Expanding research on teacher professional development related to cooperative and gamified learning models would also strengthen the practical implementation of evidence-based pedagogy in early education. Overall, the study contributes empirical evidence supporting the use of Teams Games Tournament (TGT) as an effective, student-centered learning strategy that bridges abstract mathematical reasoning with engaging, collaborative learning experiences fostering not only academic achievement but also essential social-emotional competencies for 21st-century learners.

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