Journal of Educational Sciences Vol. 10 No. 2 (Feb, 2026) 3320-3331

Journal of Educational Sciences

Journal homepage: https://jes.ejournal.unri.ac.id/index.php/JES

P-ISSN 2581-1657

E-ISSN 2581-2203

Differentiated TGT on Mathematics Learning Outcomes and Problem-Solving Skills of Elementary Students

Laelu Rafika*, Suriswo, Dewi Apriani

Master of Pedagogy Program, Graduate School, Universitas Pancasakti Tegal, Tegal, 52122, Indonesia

ARTICLE INFO

Article history:

Received: 28 Jan 2026
Revised: 14 Feb 2026
Accepted: 17 Feb 2026
Published online: 25 Feb 2026

Keywords:

Differentiated Instruction;
Elementary Students;
Mathematics Achievement;
Problem-Solving Skills;
Teams Games Tournament

* *Corresponding author:*

E-mail: lelurafika1610@gmail.com

Article Doi:

https://doi.org/10.31258/jes.10.2.p.3320-3331

ABSTRACT

Mathematics learning in elementary school plays an essential role in developing students' logical reasoning and problem-solving skills; however, many students still experience difficulties in solving non-routine mathematical problems, particularly in heterogeneous classrooms. This study examined the effect of a differentiated Teams Games Tournament (TGT) cooperative learning model on mathematics achievement and problem-solving skills of elementary students. A quantitative quasi-experimental method with a nonequivalent control group design was employed. The participants were fifth-grade students of SD Negeri 01 Kebondalem, Pemalang Regency, Indonesia, divided into an experimental group receiving differentiated TGT instruction and a control group taught using conventional methods. Data were collected through pretests and posttests measuring mathematics achievement and problem-solving skills based on Polya's stages. The results showed that the experimental group achieved higher learning outcomes and demonstrated better problem-solving skills than the control group. These findings indicate that integrating differentiation principles into the TGT model effectively improves mathematics achievement and problem-solving skills in elementary education.

1. Introduction

Mathematics instruction in elementary education plays a fundamental role in developing students' logical reasoning, analytical thinking, and structured problem-solving abilities from an early stage. These competencies are essential not only for academic success but also for equipping learners with higher-order thinking skills required to address authentic real-life problems. However, empirical evidence indicates that elementary students' mathematical problem-solving abilities remain relatively low, particularly when they encounter contextual and non-routine problems. Students frequently struggle to interpret problem situations, determine appropriate strategies, implement procedures systematically, and evaluate the validity of their solutions (Abdul Wahab et al., 2024). This condition reflects a persistent gap between the intended goals of mathematics education and the realities of classroom instruction, where learning often emphasizes procedural practice rather than conceptual understanding and reflective thinking.

The challenge becomes more complex in heterogeneous classrooms characterized by diverse readiness levels, learning profiles, and learning paces. Conventional teacher-centered approaches tend to deliver uniform instruction that does not sufficiently accommodate these differences. Research shows that high levels of mathematics anxiety are associated with decreased confidence and motivation in mathematics learning, contributing to lower achievement and disengagement in the classroom (Smith et al., 2025). Such instructional mismatches contribute to widening achievement gaps and limit equitable learning opportunities. Recent studies published in Journal of Educational Sciences highlight the urgency of implementing innovative and student-centered instructional designs to enhance engagement and learning effectiveness in elementary education (Utami et al., 2025; Ardiana et al., 2025).

Previous research on mathematical problem-solving has examined influencing factors such as metacognitive awareness and the implementation of Polya's problem-solving stages (Huda et al., 2025). These studies consistently indicate that effective problem-solving depends not only on conceptual mastery but also on instructional environments that promote active participation, collaborative reasoning, and reflective thinking. Cooperative learning approaches have therefore been widely recommended because they foster interaction, teamwork, and shared responsibility in solving academic tasks (Khayyirah et al., 2024). Through structured collaboration, students are encouraged to articulate their reasoning, negotiate solution strategies, and construct deeper conceptual understanding.

In parallel, differentiated instruction has emerged as a strategic approach to addressing learner diversity. Grounded in Tomlinson's framework, differentiation involves adjusting content, process, and product according to students' readiness, interests, and learning profiles. Empirical findings indicate that differentiated instruction can enhance students' academic achievement and engagement in mathematics learning (Salazar & Gumanoy, 2025; Manuel & Mempin, 2025). Nevertheless, many existing studies apply differentiation in a general or isolated manner without systematically embedding it into structured cooperative learning models. This indicates a need for instructional innovation that integrates differentiation within a well-defined collaborative framework.

One cooperative learning model that has consistently demonstrated positive effects on students' achievement and motivation is the Teams Games Tournament (TGT) model. TGT integrates collaborative team discussions with structured academic games and tournament sessions, creating a dynamic and motivating learning atmosphere that enhances students' engagement and achievement in mathematics learning (Setiana et al., 2024). Studies in Journal of Educational Sciences report that TGT supported by educational games significantly enhances students' cognitive outcomes and learning motivation (Rosyida et al., 2025). Similarly, Rizqi et al. (2025) found that TGT-based instruction improves elementary students' numeracy skills and active participation. Despite these advantages, conventional implementations of TGT typically employ uniform learning tasks and tournament questions, which may not sufficiently address differences in students' readiness levels and learning pace. As a result, some students may still experience limited cognitive challenge or insufficient support.

Based on the review of previous studies, comprehensive research that systematically integrates differentiated instruction into each phase of the TGT cooperative learning model to improve both mathematics learning outcomes and structured problem-solving skills in elementary education remains limited. The novelty of this study lies in modifying the TGT model by incorporating Tomlinson's principles, specifically the differentiation of content, process, and product based on students' readiness levels within the stages of team discussion, academic games, and tournament sessions. Such an approach aligns with recent instructional innovations emphasized in Journal of Educational Sciences, which advocate adaptive learning designs and innovative pedagogical strategies to enhance educational effectiveness (Khusnunnisa & Andriani, 2025; Oktama et al., 2026; Putri et al., 2025). Therefore, this study aims to analyze the effect of a differentiated Teams Games Tournament (TGT) cooperative learning model on elementary students' mathematics learning outcomes and mathematical problem-solving skills.

2. Methodology

This study employed a quantitative approach using a quasi-experimental method, which is widely applied in educational research when random assignment is not possible in real classroom contexts (Creswell & Creswell, 2018; Sugiyono, 2022). The research design used was a nonequivalent control group design within a quasi-experimental framework, involving an experimental class and a control class receiving different instructional treatments. Both groups were measured through pretests and posttests to determine the effectiveness of the differentiated Teams Games Tournament (TGT) cooperative learning model on students' mathematics learning outcomes and problem-solving skills. Cooperative learning models have been reported as effective in improving students' cognitive achievement and motivation in elementary school learning contexts (Adinda et al., 2025).

The research was conducted during the first semester of the 2025/2026 academic year at SD Negeri 01 Kebondalem, Pemalang Regency, Indonesia. The implementation followed the school's academic calendar and regular mathematics learning schedule to ensure that the intervention was carried out in a natural instructional setting (Fraenkel et al., 2019). The population consisted of all fifth-grade students at the school. The sample was selected using purposive sampling based on class equivalence in terms of student number, initial academic ability, and learning conditions (Sugiyono, 2022). Two intact classes were chosen, with one assigned as the experimental group and the other as the control group.

The intervention was implemented in three stages: preparation, implementation, and completion. During the preparation stage, lesson plans, differentiated learning materials, and research instruments were developed. Instrument validity and reliability were examined to ensure the accuracy of the measurement tools (Arikunto, 2019). During the implementation stage, students in both classes were given a pretest to identify baseline mathematics ability. The experimental group then received instruction using differentiated TGT based on Tomlinson's framework, emphasizing differentiation of content, process, and product according to students' readiness (Tomlinson, 2017). The differentiated TGT learning activities included team discussions, academic games, and tournament sessions adapted to students' readiness levels, while the control group participated in conventional instruction. At the completion stage, a posttest was administered to evaluate students' mathematics learning outcomes and problem-solving performance after the intervention.

Instrument

The instruments used in this study consisted of a multiple-choice mathematics achievement test and an open-ended problem-solving test. The problem-solving test was constructed based on Polya's four stages: understanding the problem, devising a plan, carrying out the plan, and reviewing the solution (Polya, 1973). Content validity was established through expert judgment involving mathematics education specialists, while reliability was estimated using appropriate reliability coefficients based on the test format (Arikunto, 2019; Fraenkel et al., 2019).

Data Collection

Data were collected through test techniques in the form of pretests and posttests. The pretest was conducted to determine students' initial mathematics abilities prior to the learning intervention. The posttest was administered after the implementation of the differentiated TGT model to identify improvements in students' learning outcomes and problem-solving skills (Fraenkel et al., 2019). Similar quasi-experimental learning model studies have also been applied in JES publications focusing on improving elementary school achievement (Utami et al., 2025; Ardiana et al., 2025).

Data Analysis

Data analysis included descriptive and inferential statistics. Descriptive statistics were used to summarize students' mean scores, standard deviations, and score distribution. Inferential analysis involved prerequisite testing such as normality and homogeneity tests to ensure parametric assumptions were met (Field, 2018). Learning improvement was measured using the normalized gain (N-Gain), which is commonly used to evaluate the effectiveness of instructional interventions (Hake, 1999). Hypothesis testing was conducted using an independent samples t-test with SPSS software at a significance level of 0.05.

3. Results and Discussion

The differentiated Teams Games Tournament (TGT) learning model implemented in this study followed a structured cooperative procedure integrated with instructional differentiation principles. At the beginning of the learning process, students were assigned to heterogeneous teams based on their initial mathematics abilities to promote balanced peer interaction. The teacher then presented the learning objectives and core mathematical concepts using differentiated instructional materials adjusted to students' readiness levels. During team discussions, students worked collaboratively to solve mathematical problems, with higher-achieving students providing peer support and explanations, while lower-achieving students received structured scaffolding to strengthen conceptual understanding.

Following the discussion phase, students participated in academic games using mathematics problem cards designed at varying levels of difficulty. Each student then joined a tournament session, where representatives from different teams competed with peers of similar ability levels. This tournament structure ensured fairness and reduced performance anxiety, allowing all students to contribute meaningfully to their team scores. Points obtained during the tournaments were accumulated as team scores, fostering both collaboration and healthy competition. This integration of cooperative learning and differentiation enabled students with diverse abilities to remain actively engaged without feeling left behind or insufficiently challenged, representing a key pedagogical advantage of embedding differentiation within the TGT framework (Dulfer et al., 2025).

Mathematics Learning Outcomes

The descriptive analysis indicates that the initial mathematics abilities of students in the experimental and control groups were relatively comparable, as reflected in their pretest mean scores. After the instructional intervention, both groups demonstrated improvement in mathematics learning outcomes; however, the increase observed in the experimental group was substantially higher. A comparison of pretest and posttest scores for both groups is presented in Table 1.

Table 1. Descriptive Statistics of Mathematics Learning Outcomes for the Experimental and Control Groups

Group	N	Pretest (Mean ± SD)	Posttest (Mean ± SD)
Experimental (Differentiated TGT)	28	56.32 ± 8.41	82.14 ± 7.26
Control (Conventional Instruction)	28	55.89 ± 8.17	71.07 ± 7.84

As shown in Table 1, the experimental group achieved a higher posttest mean score than the control group. This finding indicates that the differentiated TGT learning model provided a more effective learning environment for enhancing students' mathematics achievement. Cooperative interaction within heterogeneous teams encouraged active participation, peer explanation, and shared responsibility for learning, which supported deeper conceptual understanding. The integration of differentiation further strengthened this effect by aligning learning tasks with students' readiness levels. Lower-achieving students benefited from structured scaffolding and peer assistance, while higher-achieving students remained cognitively challenged through more complex tasks during discussions and games. This balanced instructional approach helped minimize learning gaps and optimized learning opportunities for all students, thereby contributing to higher overall achievement in the experimental group (Dulfer et al., 2025; Manuel & Mempin, 2025).

Improvement in Learning Outcomes (N-Gain)

To examine the extent of learning improvement, a normalized gain (N-Gain) analysis was conducted. The categories of learning improvement for both groups are summarized in Table 2.

Table 2. N-Gain Values and Improvement Categories

Group	**Mean N-Gain**	**Category**
Experimental	0.63	Moderate–High
Control	0.38	Moderate

The data in Table 2 indicate that students who learned through the differentiated TGT model experienced greater learning improvement than those who received conventional instruction. The experimental group reached a moderate–high improvement category, while the control group remained in the moderate category. This difference demonstrates that the differentiated TGT model not only improved students' final achievement but also enhanced their learning growth more effectively. The higher N-Gain achieved by the experimental group can be attributed to the synergistic effects of cooperative learning and differentiation. The tournament element created a motivating learning atmosphere that encouraged students to prepare, participate actively, and apply mathematical concepts during competitive yet supportive activities. Meanwhile, readiness-based differentiation ensured that each student could progress from their initial level of understanding, making learning more meaningful and sustainable. A comparison of N-Gain values between groups is illustrated in Figure 1, reinforcing the superior learning growth achieved by students in the differentiated TGT class (Rizqi et al., 2025).

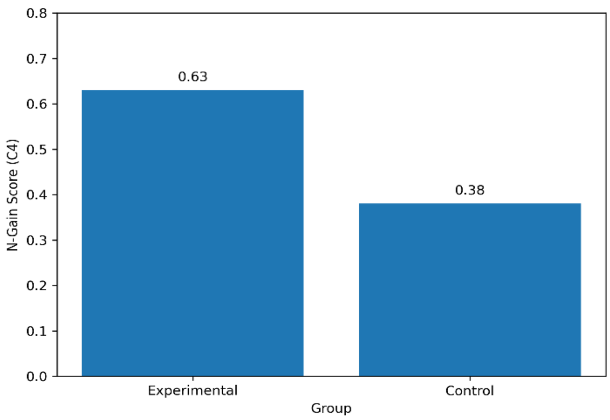

Figure 1. Comparison of N-Gain Values Between Groups

Mathematical Problem-Solving Skills

Students' mathematical problem-solving skills were analyzed based on Polya's four indicators: understanding the problem, planning a solution, implementing the solution, and evaluating the solution. The mean scores for each indicator in both groups are presented in Table 3.

Table 3. Mean Scores of Mathematical Problem-Solving Skill Indicators

Indicator	Experimental	Control
Understanding the problem	84.21	72.68
Planning the solution	81.79	69.46
Implementing the solution	79.64	67.14
Evaluating the solution	77.50	65.36

As shown in Table 3, the experimental group outperformed the control group across all problem-solving indicators. These results indicate that the differentiated TGT model effectively supported the development of students' mathematical problem-solving processes. During team discussions, students were encouraged to articulate their reasoning, compare solution strategies, and receive immediate feedback from peers, which strengthened their ability to understand problems and plan appropriate solutions.

Furthermore, tournament sessions required students to apply problem-solving skills independently under motivating conditions, reinforcing procedural fluency and higher-order thinking. Differentiated tasks ensured that students with lower readiness levels could focus on mastering fundamental problem-solving steps, while higher-achieving students were challenged to evaluate and refine solutions more critically. The comparison of problem-solving skill indicators is visually presented in Figure 2, illustrating the consistent superiority of the experimental group across all indicators (Ardiari et al., 2023; Meisari et al., 2025).

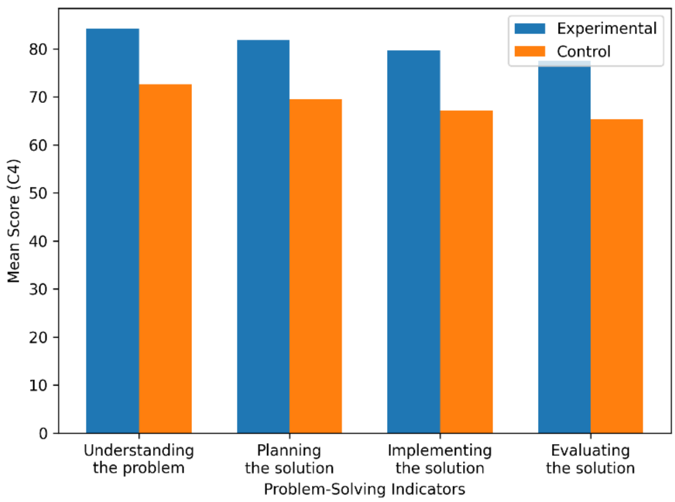

Figure 2. Comparison of Mathematical Problem-Solving Skill Indicators

Hypothesis Testing and Discussion

The results of the independent samples t-test revealed a statistically significant difference between the experimental and control groups in both mathematics learning outcomes and mathematical problem-solving skills ($p < 0.05$). Therefore, the research hypothesis stating that differentiated TGT instruction has a significant effect on students' mathematics achievement and problem-solving performance is accepted.

Overall, the findings demonstrate that integrating differentiation into the TGT cooperative learning model enhances both students' achievement and problem-solving abilities. Differentiation ensured instructional accessibility for students with lower readiness while simultaneously providing enrichment opportunities for higher-achieving students. Cooperative interaction within teams promoted peer tutoring and shared responsibility for learning, which are essential for conceptual understanding. Additionally, the tournament component increased students' motivation and engagement, making mathematics learning more enjoyable and meaningful. These results are consistent with previous studies reporting the effectiveness of cooperative learning models in improving mathematics achievement and learning motivation (Roka & Khatri, 2024; Zaki et al., 2024). The distinct contribution of this study lies in the systematic integration of Tomlinson's differentiation principles at each stage of the TGT learning process, enabling equitable participation and maximizing learning outcomes for students with diverse abilities.

Beyond the statistical significance identified through the independent samples t-test, the findings of this study provide important pedagogical insights into why the differentiated TGT model generated higher improvement in both mathematics achievement and problem-solving skills. The integration of differentiation within the cooperative TGT structure allowed students to engage in learning tasks that were aligned with their readiness levels. Lower-achieving students received structured scaffolding during team discussions, which reduced learning anxiety and enhanced their confidence in solving mathematical problems. At the same time, higher-achieving students were challenged with more complex tasks during the tournament phase, preventing disengagement and promoting deeper analytical thinking. This balance between support and challenge contributed to more equitable learning opportunities in heterogeneous classrooms.

The mechanism of peer tutoring within heterogeneous teams also played a crucial role in strengthening conceptual understanding. When students explained their reasoning to peers, they reorganized their mathematical thinking, which reinforced their own comprehension. Furthermore, the tournament component increased students' intrinsic motivation through structured academic competition. Competing with peers of similar ability levels minimized performance gaps and created a psychologically safe environment, enabling all students to participate actively. This pedagogical mechanism explains the higher N-Gain and problem-solving indicators observed in the experimental group.

The results of this study are consistent with several previous studies. Research published in Journal of Educational Sciences by Rizqi et al. (2025) demonstrated that TGT-based learning significantly improved elementary students' numeracy skills and learning motivation. Similarly, Rosyida et al. (2025) reported that cooperative learning supported by educational games enhanced cognitive achievement and classroom engagement. A comprehensive meta-analysis by Fauzi et al. (2025) confirmed that cooperative learning models consistently yield significantly higher mathematics achievement among primary school students compared to conventional instruction. Furthermore, Oktavia, Asmara, and Suparman (2025) revealed that adjusting instruction based on students' readiness levels significantly improves learning outcomes in elementary mathematics. In addition, Wardhani et al. (2025) showed that differentiated instruction increases active participation and responsivity to individual learner needs in heterogeneous classrooms. The present study extends these findings by systematically integrating differentiation principles into every stage of the TGT learning process, thereby strengthening both cognitive achievement and structured problem-solving skills simultaneously.

Despite its effectiveness, several strengths and limitations of the differentiated TGT model were identified during implementation. The strengths include: (1) promoting active participation among all students regardless of ability level, (2) reducing mathematics anxiety among lower-achieving students through readiness-based tournament grouping, (3) increasing intrinsic motivation through structured academic competition, and (4) fostering peer tutoring that enhances conceptual understanding. However, this model also has several limitations. First, it requires substantial preparation time to design differentiated learning materials and multi-level problem cards. Second, effective classroom management is essential to maintain a conducive atmosphere during tournament sessions. Third, without careful monitoring, there is a potential risk of dominance by certain students during team discussions. Therefore, teacher readiness and classroom management skills are important factors in ensuring the successful implementation of differentiated TGT. Overall, the strengthened discussion demonstrates that the effectiveness of differentiated TGT is not merely reflected in statistical differences, but is rooted in clear pedagogical mechanisms involving structured cooperation, readiness-based differentiation, motivational competition, and cognitive scaffolding processes in the classroom.

4. Conclusion

This study concludes that the differentiated Teams Games Tournament (TGT) cooperative learning model effectively enhances elementary students' mathematics learning outcomes and mathematical problem-solving skills. The research objective was successfully achieved, as the integration of differentiation principles within the structured stages of the TGT model provided learning experiences that accommodated students' varying readiness levels. The implementation of differentiated tasks within cooperative teams, academic games, and tournament activities fostered active participation, equitable engagement, and deeper conceptual understanding. Students were able to apply systematic problem-solving strategies more confidently, while the inclusive learning design ensured that both lower- and higher-achieving students received appropriate support and academic challenge. These findings demonstrate that integrating differentiated instruction into cooperative learning models represents a successful pedagogical innovation for heterogeneous elementary classrooms. The study confirms that adaptive and collaborative instructional approaches can improve both cognitive achievement and structured problem-solving competence in mathematics. Future studies are recommended to examine the application of differentiated TGT across different mathematical topics, grade levels, and technology-enhanced learning environments to further validate and expand its implementation.

Acknowledgement

The authors would like to express their sincere appreciation to the principal, teachers, and fifth-grade students of SD Negeri 01 Kebondalem, Pemalang Regency, for their cooperation and support during the research implementation. Gratitude is also extended to all parties who contributed to the completion of this study.

References

Abdul Wahab, A., Kusuma, Y. S., Juandi, D., Turmudi, T., Buhaerah, B., & Syaiful, S. (2024). Understanding students' struggles in solving mathematical problems: A systematic literature review using Polya's framework. *Jurnal Pendidikan Progresif,* 14(3), Article 118. https://doi.org/10.23960/jpp.v14.i3.2024118

Ardiana, R., Putri, S. A., & Lestari, D. (2025). Cooperative learning strategies to improve student engagement in mathematics classrooms. *Journal of Educational Sciences*, 9(5), 4301–4315. https://doi.org/10.31258/jes.9.5.p.4301-4315

Ardiari, N. P. A. E., Wibawa, I. M. C., & Asril, N. M. (2023). Improving elementary students' science problem-solving ability with HOTS-based LKPD. *Thinking Skills and Creativity Journal*, 6(2), 134–144. https://doi.org/10.23887/tscj.v6i2.62166

Arikunto, S. (2019). Prosedur penelitian: Suatu pendekatan praktik. Rineka Cipta.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.)*. SAGE Publications.

Dulfer, N., Saito, T., & McKernan, A. (2025). Differentiated instruction: An investigation into the effect of class compositional factors on teaching processes. *Asia Pacific Education Review*, 26, 1041–1054. https://doi.org/10.1007/s12564-025-10065-y

Field, A. (2018). *Discovering statistics using IBM SPSS statistics (5th ed.)*. SAGE Publications.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2019). *How to design and evaluate research in education (10th ed.)*. McGraw-Hill.

Fauzi, M., Rahmawati, D., & Hidayat, T. (2025). The effect of cooperative learning toward mathematics achievement of primary school students: A systematic review using meta-analysis. *Social Sciences & Humanities Open, 12*, 102247. https://doi.org/10.1016/j.ssaho.2025.102247

Huda, N., Syaiful, T., Gustiningsi, T., & Nofverma. (2025). Students' metacognitive ability in solving mathematical problems based on information processing theory. *Edumatica: Jurnal Pendidikan Matematika*, 15(2). https://doi.org/10.22437/edumatica.v15i2.44689

Khayyirah, S., Anwar, M., & Putra, D. (2024). Cooperative learning to foster collaboration and responsibility in mathematics learning. *International Journal of Instruction,* 17(1), 233–248. https://doi.org/10.29333/iji.2024.17113a

Khusnunnisa, M., & Andriani, A. E. (2025). Development of interactive multimedia assisted by augmented reality for human hearing sense material. *Journal of Educational Sciences*, 9(5), 4370–4387. https://doi.org/10.31258/jes.9.5.p.4370-4387

Manuel, P. J., & Mempin, J. R. (2025). A meta-synthesis of the effectiveness of differentiated instruction strategies on students' academic performance in mathematics. *International Journal of Research and Innovation in Social Science*, 9(8), 1767–1775. https://doi.org/10.47772/IJRISS.2025.908000148

Meisari, E., Herpratiwi, H., & Oktaria, S. D. (2025). The impact of the problem-based learning model on the mathematical problem-solving skills of students. *Jurnal Teknologi Pendidikan*, 10(3), 538–546. https://doi.org/10.33394/jtp.v10i3.15552

Oktama, Z., Yulastri, W., & Kharisma, A. (2026). Interactive media development using augmented reality applications to improve student learning outcomes in mathematics learning in grade V elementary school. *Journal of Educational Sciences*, 10(1), 143–152. https://doi.org/10.31258/jes.10.1.p.143-152

Oktavia, W., Asmara, A. S., & Suparman, T. (2025). Differentiated instruction strategies to improve mathematics learning outcomes in elementary school. *Journal of Honai Math, 8*(2), 115–126. https://doi.org/10.30862/jhm.v8i2.588

Polya, G. (1973). *How to solve it: A new aspect of mathematical method (2nd ed.*). Princeton University Press.

Putri, A. I., Maimunah, M., & Anggraini, R. D. (2025). Development of a problem based learning teaching module on the topic of comparison to facilitate mathematical reasoning skills of phase D students. *Journal of Educational Sciences*, 9(5), 4082–4091. https://doi.org/10.31258/jes.9.5.p.4082-4091

Rizqi, H. Y., Suhirno, S., & Setiawan, F. E. (2025). The Effectiveness of the Team Games Tournament (TGT) Learning Model Assisted by Fun Throw Ball on Numeracy Skills and Learning Motivation of Elementary School Students. *Journal of Educational Sciences*, 9(3), 1153-1162. https://doi.org/10.31258/jes.9.3.p.1153-1162

Roka, J., & Khatri, T. B. (2024). Impact of cooperative learning approach on students' achievement in mathematics. *Journal of Educational Research and Innovation*, 4(1), 59–67. https://doi.org/10.3126/jeri.v4i1.75790

Rosyida, U., Islami, N., & Azhar, A. (2025). The Effectiveness of Cooperative Learning Model Type Tgt Assisted by Kahoot Application to Improve Students' Cognitive Learning Outcomes Material Pressure Substance Class VIII Middle School. *Journal of Educational Sciences*, 6(4), 637-644. https://doi.org/10.31258/jes.6.4.p.637-644

Salazar, R. R., & Gumanoy, R. M. (2025). Differentiated learning activities: Effects on students' motivation and involvement in teaching mathematics. *International Journal of Research and Innovation in Social Science*, 9(8), 1707–1714. https://doi.org/10.47772/IJRISS.2025.903SEDU0131

Setiana, S., Condro Murti, R., Setiawan, E., & Sayekti, O. M. (2024). The impact of the team games tournament cooperative learning model on students' motivation and mathematics learning outcomes in elementary schools. *Jurnal Penelitian Ilmu Pendidikan*, 18(1), 1–15. https://doi.org/10.21831/jpip.v18i1.86814

Smith, J., Fotou, N., & Sharpe, R. (2025). Changes in mathematics anxiety and mathematics confidence. International Journal of Mathematical Education in *Science and Technology*, 56(4), 587–605. https://doi.org/10.1080/0020739X.2025.2475928

Sugiyono. (2022). Metode penelitian kuantitatif, kualitatif, dan R&D. Alfabeta.

Utami, S., Gagaramusu, Y. B., Rahmah, N., Azizah, A., & Nuraini, N. (2025). Application of Project Based Learning Model Assisted by Animated Video Media to Improve Student Learning Outcomes in Grade V Elementary School Elementary School. *Journal of Educational Sciences*, 9(4), 1971-1980. https://doi.org/10.31258/jes.9.4.p.1971-1980

Wardhani, R., Putri, E., Widodo, S., & Rahayu, H. (2025). Implementasi diferensiasi pembelajaran untuk mengatasi kesenjangan kemampuan belajar pada mata pelajaran Pendidikan Pancasila di kelas IV. *YASIN, 5*(6), 6764–6773. https://doi.org/10.58578/yasin.v5i6.8262

Zaki, A., Sahid, S., Nurhaliza, R., Naufal, M. A., Huda, M., & Hassan, M. N. (2024). Enhancing mathematical achievement through the Think-Pair-Share cooperative learning model with higher-order thinking skills questions. *Jurnal Riset Pendidikan Matematika*, 11(2), 106–117. https://doi.org/10.21831/jrpm.v11i2.76963

How to cite this article:

Rafika, L., Suriswo., & Apriani, D. (2026). Differentiated TGT on Mathematics Learning Outcomes and Problem-Solving Skills of Elementary Students. *Journal of Educational Sciences*, *10(2)*, 3320-3331.