ENHANCING MATHEMATICAL PROBLEM-SOLVING ABILITIES THROUGH THE TGT LEARNING MODEL ASSISTED BY MEDICA

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ARTICLE INFO	ABSTRACT

Based on preliminary study results, it was found that students' mathematical problem-solving abilities were still low. This study aims to determine the improvement of mathematical problem-solving skills through the application of the Teams Games Tournament (TGT) learning model assisted by MEDICA. This research is a quantitative experimental study with a pre-experimental design. The research design used is the one group pretest-posttest design. The population in this study consists of fourth-grade students at SD Negeri Pati Wetan 01, with a total sample of 31 students selected using a census (total sampling) technique. Data collection techniques include interviews, observations, tests, and documentation. Data analysis techniques involve normality tests and N-Gain tests. The N-Gain test analysis results show an overall improvement score of 0.66, which falls into the medium category. Thus, it can be concluded that the use of the TGT learning model assisted by MEDICA can improve students' mathematical problem-solving abilities. These findings indicate that the application of the TGT learning model assisted by MEDICA is effective in enhancing students' mathematical problem-solving skills. This study suggests using the TGT learning model assisted by MEDICA as an effective strategy to improve elementary students' mathematical problem-solving abilities.

Berdasarkan hasil studi pendahuluan, ditemukan bahwa kemampuan pemecahan masalah matematika siswa masih rendah. Penelitian ini bertujuan untuk mengetahui peningkatan kemampuan pemecahan masalah matematika melalui penerapan model pembelajaran Teams Games Tournament (TGT) berbantuan MEDICA. Penelitian ini merupakan penelitian eksperimen kuantitatif dengan desain pre-eksperimen. Bentuk penelitian ini adalah one group pretest-posttest design. Populasi dalam penelitian ini adalah siswa kelas IV SD Negeri Pati Wetan 01, dengan sampel menggunakan sensus (sampling total) sebanyak 31 siswa. Teknik pengumpulan data meliputi wawancara, observasi, tes, dan dokumentasi. Teknik analisis data menggunakan uji normalitas dan uji N-Gain. Hasil analisis uji N-Gain menunjukkan nilai keseluruhan peningkatan sebesar 0,66 yang termasuk dalam kategori sedang. Dengan demikian, dapat disimpulkan bahwa penggunaan model pembelajaran TGT berbantuan MEDICA dapat meningkatkan kemampuan pemecahan masalah matematika siswa. Temuan ini menunjukkan bahwa penerapan model pembelajaran TGT berbantuan MEDICA efektif dalam meningkatkan kemampuan pemecahan masalah matematika siswa. Penelitian ini menyarankan penggunaan model pembelajaran TGT berbantuan MEDICA sebagai strategi yang efektif untuk meningkatkan kemampuan pemecahan masalah matematika siswa di sekolah dasar.

1. INTRODUCTION

Mathematics is a mandatory subject studied at every level of education starting from elementary school. This is clarified by the Republic of Indonesia Law No. 20 of 2003 on the National Education System Article 37, which explains that mathematics is one of the subjects that must be studied by students in elementary and secondary schools. Mathematics is also considered one of the subjects perceived as difficult. According to Aprilia & Fitriana (2022), mathematics is considered a difficult and complicated subject because it is always related to calculations, formulas, and numbers. This is also conveyed by Cahyani, Kironoratri & Ermawati (2023) that mathematics, in the view of students, is a subject filled with many formulas that they must understand. This negative perception causes students' performance in mathematics to be less than optimal. This can be seen based on the results of the 2018 Programme for International Student Assessment (PISA), which showed that in mathematics and literacy, Indonesia ranked 74th out of 79. Therefore, mathematics education requires more attention from various parties (Meirina, Riswari & Kironoratri, 2024).

Mathematics has five basic skills that need to be developed. The National Council of Teachers of Mathematics (NCTM) states that mathematics education aims to develop five basic skills, namely problem-solving, communication, connection, reasoning, and representation (Hafriani, 2021). Among these five basic skills, one mentioned is problem-solving skills. Problem-solving is a process undertaken to overcome challenges or difficulties to achieve goals (Fauziah & Kuntoro, 2022). According to Nurhasanah & Luritawaty (2021), problem-solving skills are one of the important factors determining students' success in learning mathematics. This is also emphasized by Riswari, Septiana & Saidah (2023) that problem-solving skills are key in mathematics because this skill is essential for solving math problems. However, in reality, students still often encounter difficulties in problem-solving in mathematics. When answering questions, students prioritize the final result over the solving technique (Riswari & Ermawati, 2020).

Based on preliminary research conducted by the researcher on January 20, 2024, it was found that during mathematics lessons, many students still make mistakes in solving problems. Students remain predominantly passive during the learning process, and the classroom atmosphere feels tense. On the other hand, teachers rarely use learning models or media in the teaching process.

During the preliminary study, the researcher also interviewed Mrs. Diana Ratna Ningrum, the homeroom teacher of the fourth grade at SD Negeri Pati Wetan 01. The interview results showed that the percentage of the summative final semester results for the fourth-grade mathematics subject was still low, at only 13%. The interviewee

explained that mathematics is a subject that is difficult to achieve mastery compared to other subjects. The difficulty lies in material related to solving word problems. Most students find it difficult to find solutions to mathematical problems because they lack the ability to understand the intent of the questions, making it hard to convert word problems into mathematical sentences. When working on word problems, students often make mistakes due to lack of thoroughness, and some students get the correct answers but with incorrect processes or steps. When working on problems, they only rely on the example solutions given by the teacher without understanding the material, so when given problems different from the examples, they struggle to solve or answer them. These difficulties indicate that students' problem-solving skills in mathematics are still low.

Based on the preliminary study results, there is a need for innovations in the learning process to meet the needs of the fourth-grade students at SD Negeri Pati Wetan 01, particularly in improving their mathematical problem-solving skills. These innovations include using learning models that can meet these needs, such as: 1) engaging and attention-grabbing learning; 2) creating a relaxed learning environment; and 3) fostering motivation, improved learning outcomes, communication skills, and good cooperation among students. Therefore, the suitable solution for this problem is to apply the cooperative learning model type Teams Games Tournaments (TGT). According to Taniredja in Handayani & Kurniawati (2022), the advantage of the Teams Games Tournaments (TGT) model is that it can increase students' learning motivation and make learning material easier to understand.

The application of learning models needs to be supported by learning media that will help teachers deliver the material (Wardana, Riswari & Kironoratri, 2023). This statement is reinforced by Kironoratri (2020), who states that using learning media aids the learning process because it helps teachers convey material to students and helps students understand it. Learning media can help align students' experiences and perspectives about the learning material (Ermawati & Riswari, 2023). Based on interviews, it was found that students are more enthusiastic when teachers use media, both visual and concrete objects. Considering that today's students are familiar with digital technology like smartphones, as educators, we must adapt to these changes to create a learning rhythm that aligns with current developments. According to the issues observed, the required learning media should be 1) attractive to students; 2) technology-based; and 3) innovative. Based on these needs, the media that can be used in learning for the fourth grade at SD Negeri Pati Wetan 01 is MEDICA (Interactive Fraction Media).

Previous research conducted by Rahayu, Ritoga, and Yenti (2022) stated that the implementation of the TGT learning model assisted by Kokami media had a positive impact and created a more active and enjoyable learning atmosphere compared to the use of conventional learning models. Subsequent research conducted by Yunikasari (2023) indicated that students found it easier to understand the material presented by the teacher using the TGT learning model assisted by TTS Card Media.

Based on the problems encountered by the researcher and supported by relevant theory, a study was conducted titled "Improving Mathematical Problem-Solving Ability Through the TGT Learning Model Assisted by MEDICA," which aims to determine the

improvement in students' mathematical problem-solving abilities using the Teams Games Tournaments (TGT) learning model assisted by MEDICA.

2. METHODS

This research is a quantitative study employing a pre-experimental research design. Pre-experimental research is conducted on a single group without any other group for comparison (Emzir, 2017). The form of this research uses a one-group pre-test post-test design as follows:

Table 1. One Group Pretest Posttest Design

Pretest	Treatment	Posttest
O_1	X	O_2

Source: (Emzir, 2017)

The instruments used in the research include observation sheets, interview sheets, tests, and documentation. The data obtained in this study are quantitative data consisting of the initial abilities of the students (pretest) before the treatment and the final abilities of the students (posttest) after the treatment. The data were analyzed using a normality test as a prerequisite test and an N-Gain test to determine the improvement in the students' mathematical problem-solving abilities.

2.1. Research Subject

The population in this study includes all fourth-grade students at SD Negeri Pati Wetan 01. The sampling technique used in this research is the census technique (total sampling). The census technique is a sampling method where all members of the population are taken as samples (Jintar, 2022). Therefore, the sample in this study consists of 31 students, comprising 16 female students and 15 male students.

2.2. Data Collection

The data collection in this study used four techniques: observation, interviews, tests, and documentation. Observation was conducted to observe the subjects. Interviews were conducted with the fourth-grade homeroom teacher at SD Negeri Pati Wetan 01 to confirm the observation results and analyze problems in learning. Tests were used as a measuring tool to determine the improvement in students' abilities before and after the treatment. The tests used in this study were in the form of story questions. Finally, documentation served as a support for the completeness of the research data (Aryani, Fajrie & Kironoratri, 2023).

2.3. Data Analysis

Analysis of the data used in this research includes the analysis of pretest and posttest scores. The following formula is used to calculate these scores (Hidayat, et al., 2020):

$$\text{Score} = \frac{Score\ obtained}{Maximum\ score} \times 100$$

The criteria for completeness in pretest and posttest score analysis are as follows

Table 2. Pretest and posttest completeness criteria

Score	Qualification
≥ 70	Complete
< 70	Incomplete

The second data analysis uses the Shapiro-Wilk test for normality. The decision-making rule for this normality test is as follows: if the significance > 0.05, then the data is normally distributed; however, if the significance < 0.05, then the data is not normally distributed (Siregar, 2015).

The third data analysis uses the N-Gain analysis test. This test is conducted to determine the improvement in students' mathematical problem-solving abilities before and after the treatment. This analysis is performed using SPSS Statistic 25 and Microsoft Excel 2021. The criteria for N-Gain values are as follows (Lestari & Yudhanegara, 2017):

Table 1. N-Gain Value Criteria

N-Gain Value	Criteria
N-Gain $\geq 0{,}7$	High
$0{,}3 < $ *N-Gain* $ < 0{,}7$	Moderate
N-Gain $\leq 0{,}3$	Low

Source : (Lestari & Yudhanegara, 2017)

3. RESULTS AND DISCUSSION

3.1. Results

Based on the research results conducted by researcher in fourth-grade students at SD Negeri Pati Wetan 01 on May 28-29, 2024, obtained the pretest and posttest data results are as follows:

Table 4. Research data results

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	31	10.00	82.00	48.5161	14.36633
Posttest	31	50.00	100.00	82.3871	12.24657
Valid N (listwise)	31				

Next, the data from the pretest-posttest results was subjected to an analysis test in the form of a normality test. The purpose of the normality test is to determine whether the data is normally distributed or not. The results of the normality test are as follows:

Table 5. Normality test results

Tests of Normality

	Shapiro-Wilk		
	Statistic	df	Sig.
Pretest	.951	31	.162
Posttest	.955	31	.212

a. Lilliefors Significance Correction

Based on Table 5, the normality test results show a significance value for the pretest data of 0.162 > 0.05 and a significance value for the posttest data of 0.212 > 0.05. Therefore, it can be concluded that the pretest-posttest data are normally distributed.

After the prerequisite test, an N-Gain analysis test was conducted to determine the improvement in the use of the TGT learning model assisted by MEDICA on students' mathematical problem-solving abilities. The results of the N-Gain test, using the SPSS Statistic 25 program, are as follows:

Table 6. N-Gain Test Results

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
N_Gain_Score	31	.19	1.00	.6611	.20925
Valid N (listwise)	31				

Table 6 shows that the overall N-Gain value is 0.66. This improvement value falls into the moderate improvement category. The researcher then analyzed the increase in problem-solving ability scores per indicator as follows:

Table 7. N-Gain Results for Mathematical Problem-Solving Skills Indicators

Problem-Solving Indicators	Average		N-Gain Score	Category
	Pretest	*Posttest*		
Understanding the Problem	28,82	92,26	0,88	High
Planning the Problem	85,48	95,58	0,55	Moderate
Solving the Problem	65,59	85,16	0,56	Moderate
Reviewing the Answer	15,48	52,58	0,36	Moderate

Based on the table above, it can be seen that the results for each indicator of problem-solving ability improved after the treatment was applied. Therefore, it can be concluded that using the Teams Games Tournaments (TGT) learning model with MEDICA assistance can enhance the problem-solving skills of fourth-grade students at SD Negeri Pati Wetan 01.

3.2. Discussion

In this study, the researcher used a sample of 31 students from grade IV at SD Negeri Pati Wetan 01. The study was conducted over two meetings. The first meeting took place on Tuesday, May 28, 2024. The material for this study was addition and subtraction of

fractions. The first meeting began with a pretest to assess initial ability, followed by the treatment. The second meeting occurred on Wednesday, May 29, 2024, where the treatment was continued and concluded with a posttest. Based on the pretest and posttest results, the average pretest score was 48.51, with the lowest score being 10 and the highest score being 82. The average posttest score was 82.28, with the lowest score being 50 and the highest score being 100.

After obtaining the pretest and posttest data, a prerequisite test was conducted using a normality test. The normality test in this study used the Shapiro-Wilk test because the sample size was less than 50 (Setianingsih, 2020). Based on Table 3.1, the normality test results showed a significance of 0.162 for the pretest data and a significance of 0.212 for the posttest data. According to the decision criteria, if sig < 0.05, then the data is normally distributed (Radya, Fajrie & Riswari, 2023). Therefore, it can be concluded that the pretest and posttest data are normally distributed.

The pretest and posttest data were then analyzed using the N-Gain test to determine the improvement in students' mathematical problem-solving skills in grade IV at SD Negeri Pati Wetan 01 after being treated with the TGT model assisted by MEDICA. Based on the N-Gain output in SPSS Statistic 25, the value obtained was 0.66. According to the N-Gain value criteria, the mathematical problem-solving ability of grade IV students on fraction material improved with a moderate category. It is categorized as moderate because the N-Gain value of 0.66 falls within the range of 0.3 < N-Gain < 0.7.

After determinining the overall improvement in mathematical problem-solving ability, an analysis of improvement per indicator was performed.

Table 7 shows that the first indicator, understanding the problem, had an average pretest score of 28.82 and an average posttest score of 92.26. The N-Gain score for this indicator was 0.88 with a high category. Before the treatment, many students solved problems by directly writing formulas and completing the solution. Some students even copied their classmates' answers by only writing the answers without including the formulas. This is consistent with Novianti, Yuanita & Maimunah (2020), who stated that many students make mistakes in understanding problems because they are used to solving routine questions. However, after the treatment, many students understood problem identification better, with the percentage of students who could identify problems increasing from 61.29% to 83.87%. This improvement occurred because during the treatment, students were given explanations and asked to understand the problem by accurately identifying what was known and what was being asked. The researcher explained that identifying what is known and what is being asked is key to determining a problem-solving plan. If errors occur in this first indicator, it will affect the subsequent indicators.

The second indicator, planning the problem, showed that the average pretest score was 85.48 and the average posttest score was 95.58. The N-Gain score for this second indicator was 0.55 with a moderate category. During the initial ability test before the treatment (pretest), only 51.61% of students were able to plan the problem accurately. This relates to the first indicator, where students did not yet fully understand the problem, causing confusion in formulating a plan or writing the required formulas. This is consistent with Sari & Subekti (2023), who stated that errors in problem planning are partly due to a

lack of understanding in problem identification. Many students still made mistakes in planning whether the problem used addition or subtraction formulas. After the treatment with the TGT model assisted by MEDICA, 64.51% of students were able to write problem plans accurately. However, two students, CTT and JA, still had less accurate answers and had the lowest scores on this problem planning indicator.

The third indicator is problem-solving. Table 7 shows that the average pretest score of students was 65.59, and the average posttest score was 85.16. The N-Gain score for this indicator is 0.56, which falls into the medium category. Before the treatment, only one student, CRA, was able to solve problems correctly and accurately, while other students either made mistakes or were less precise in their problem-solving. Some students completed only half of the problems, and others were not meticulous in their calculations, leading to correct procedures but incorrect results. Additionally, students had difficulty with mixed fractions and regular fractions, as they did not fully understand the concept (Zalima et al., 2020). After the treatment, many students were able to solve problems correctly. Initially, only one student could solve problems correctly, but after the treatment, ten students could solve problems accurately, while others still struggled with precision. This was due to students not paying attention during the learning process.

The fourth indicator is rechecking answers. Table 7 shows that the average pretest score was 15.48, and the average posttest score was 52.58. The N-Gain score for this indicator is 0.36, which is the lowest increase among the other indicators. This is because rechecking answers was considered an unimportant step. Before the treatment, only 38.70% of students rechecked their answers, while others did not. This was because students were not accustomed to rechecking their answers. According to Amanda & Ruli (2022), students are not used to explaining their problem-solving results and directly submit their answers after completing the questions. After the treatment, 80.64% of students rechecked their answers, though some answers were still inaccurate. During the treatment, the researcher emphasized the importance of reviewing steps and checking if the results matched the problems solved.

From the overall N-Gain scores and per-indicator N-Gain scores for mathematical problem-solving abilities, it can be seen that there was an improvement after the treatment with the application of the TGT (Teams Games Tournaments) learning model. This improvement occurred because the classroom environment became more enjoyable. The use of the TGT model made the classroom more engaging as it involved group activities. The TGT model is also easy to apply and suits the characteristics of fourth-grade students at SD Negeri Pati Wetan who enjoy playing. Solikhah, Nursanti, & Qodim (2023) stated that enthusiasm for playing, group learning, and hands-on activities are typical traits of elementary school students. Therefore, the TGT model is very suitable for teaching. Khaerunisah & Rini (2024) found that the TGT model, supported by media, can improve problem-solving skills. In the TGT model application process, students compete to solve problems or questions through problem-solving stages.

The improvement in students' mathematical problem-solving abilities is not only due to the TGT model but also because of the appropriate media used. This study used MEDICA as a learning media. The use of MEDICA made students more enthusiastic about learning. This was evident as students were very eager when working on games in MEDICA and

were excited about quizzes to win tournaments. According to Wardana, Riswari, & Kironoratri (2023), students are more active and enthusiastic in the learning process when accompanied by the use of learning media.

Based on the explanation above and in line with the research by Yandri & Nailah (2019), which indicates that the TGT learning model improves problem-solving skills compared to lecture-based models, it can be concluded that there is an improvement in students' mathematical problem-solving abilities before and after the application of the TGT model assisted by MEDICA.

4. CONCLUSION

Based on the data and analysis presented, it can be concluded that the implementation of the TGT (Teams-Games-Tournaments) learning model assisted by MEDICA can enhance students' mathematical problem-solving skills. This is evidenced by the average pretest score of 48.51 and an average posttest score of 82.28, indicating an average difference of 33.57 between the pretest and posttest scores. The N-Gain analysis yielded a value of 0.66, indicating a moderate improvement. Therefore, the TGT learning model assisted by MEDICA has a positive impact on students' mathematical problem-solving abilities and can serve as an alternative method for teachers to improve students' problem-solving skills. The researcher suggests that when using this TGT learning model, the researcher should be able to control the classroom environment to prevent disruptions during the tournaments.

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