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The Application of Realistic Approach to Improve the Mathematical Problem Solving Abilities of Grade VIII at SMP Negeri 2 Tebing Tinggi

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Abstrak. *The aim of this research is to improve mathematical problem solving ablity with realistic approach in the students of grade VIII at SMP Negeri 2 Tebing Tinggi. The design of this research is Class Action Research (PTK) that consists of 2 cycles. The material used in this research is probability material. The object of this research is students' mathematical problem solving ability by applying realistic approach to probability material. The subject ini this research were 36 students of grade VIII-7 at SMP Negeri 2 Tebing Tinggi. The results of this research are: (1) In the initial test, only 1 student (2,2%) achieved the classroom mastery and the average score of students' ability is in the very low category. (2) In the Cycle I, there was an improvement, with 18 students (50%) achieved the classroom mastery and the average score of students' ability is 64,5 with a level of ability in the low category. (3) In the Cycle II, there was further improvement, with 32 students (88,9%) achieved the classroom mastery and the average score of students' ability is 83,1 with a level of ability in the high category. Thus, it can be concluded that the application of realistic approach can improve the mathematical problem solving ability.* [THE APPLICATION OF REALISTIC APPROACH TO IMPROVE THE MATHEMATICAL PROBLEM SOLVING ABILITIES OF GRADE VIII AT SMP NEGERI 2 TEBING TINGGI] ***(Jurnal Fibonaci, 05(2): 53 - 61, 2024)***

Keywords: Problem solving ability; realistic approach; probability

Introduction

Education is a learning process that involves the acquisition of knowledges, the development of skills, and the formation of values to shape individual character in living life. As defined by Law Number 20 of 2003 of the Republic of Indonesia on the National Education System, the purpose of national education is to cultivate abilities and mold the character and civilization of a respected nation, guiding individuals towards a life of faith and devotion to God. The ultimate goal is to develop individuals with noble character, physical health, comprehensive knowledge, creativity, independence, and the ability to participate in democracy responsibly. This aligns with Kairuddin & Sinaga (2023), who assert that education is a basic need and a state responsibility to create a society capable of performing life functions and improving over time.

The development of a strong education system is the key to achieving progress for a country. The progress of a country is intricately linked with educational factors (Arimurti et al., 2019). The importance of education as the main focus is a crucial foundation in building a competitive and scientifically oriented society. This is in line with Herawati & Nurhayati (2019) assertion that mathematics education holds immense importance in enhancing the quality of individuals.

Mathematics is a universal science vital to human existence, serving as the foundation for modern science, technology, and various disciplines while advancing human thinking (Permendikbud, 2014). It remains relevant across all educational levels and is closely intertwined with life (Handayani, 2021). As a core subject in education, mathematics is crucial for improving the quality of education in Indonesia, with students' grasp of mathematical concepts and problem solving proficiency being primary benchmarks for assessing the educational system's effectiveness. Cultivating advanced problem-solving skills is crucial for students to tackle mathematical challenges effectively. Khotimah et al. (2022) noted that addressing mathematical problems requires deeper thinking methods and stages. The objective of learning mathematics, as outlined by Depdiknas (2006), includes understanding the problem, designing a solution model, solving the model, and providing

an appropriate solution, which aligns with the National Council of Teachers of Mathematics (NCTM, 2000) emphasis on the importance of students' problem solving abilities in mathematics learning.

Reys et al. (2009) stated that a problem in mathematics is something without a routine procedure for solving it; if a student immediately knows the answer, it isn't truly a problem. Nurfatanah et al. (2018) noted that mathematical problems help students develop thinking abilities and basic problem solving ability applicable to both mathematics and everyday life. Problem solving ability is a strategic competency involving the capacity to recognize, formulate, and solve problems using various methods and approaches (Lubis et al., 2017). In mathematics learning, this ability includes understanding the problem's context, formulating relevant mathematical models, and interpreting solutions comprehensively. Problem solving ability are critical in everyday life, fostering creativity and critical thinking in addressing mathematical challenges and real-life situations. The Programming for International Student Assessment (PISA) results highlight a deficiency in problem solving abilities among Indonesian students, with the 2022 survey ranking Indonesia 63rd with a score of 366. Nur & Palobo (2018) observed that PISA mathematics questions assess reasoning, problem solving, and argumentation skills, revealing that 75.7% of Indonesian students perform poorly, able to solve only the simplest problems, while only 0.1% can engage in advanced mathematical modeling requiring deeper thinking and problem solving ability.

Hilyani et al. (2020) noted that students have low problem solving abilities, primarily due to teaching methods that emphasize theoretical concepts rather than practical application and a lack of contextual approaches linking mathematics to real-world situations. This situation is exacerbated by students' minimal involvement in the learning process, which can lead to decreased motivation to develop problem solving abilities. Silaban & Darhim (2023) emphasize the need for improving mathematics problem solving abilities, following Polya's (1973) four steps: understanding the problem, devising a plan, carrying out the plan, and reviewing the solution.

Difficulties in problem solving are evident in grade VIII at SMP Negeri 2 Tebing Tinggi, as shown by pre-research involving teacher interviews and classroom observations on January 15, 2024. It was found that students often fail to understand what is asked in problems and struggle to identify the necessary information. also revealed students' passive involvement and the use of conventional teaching methods, contributing to their difficulties. An initial test on January 17, 2024, showed that 20 students (95.2%) of the 21 assessed students fell into the "very low" category,with only one student (4.8%) classified under the "medium" category for problem solving ability, highlighting the significant challenge of low mathematical problem solving abilities among the students.

Addressing challenges in students' problem solving abilities requires effective and sustainable solutions, such as employing a realistic approach in mathematics education. This approach emphasizes applying mathematical concepts to real-life situations, allowing students to connect mathematical principles with everyday problems (Munir & Sholehah, 2020). By presenting contextualized learning, the realistic approach encourages students to understand real problems, develop solution strategies, and communicate their solutions effectively. This method aims to improve students' problem solving abilities and increase their interest in mathematics by demonstrating its relevance to their daily lives, aligning with Dewi et al. (2018), who argue that realistic mathematics learning motivates students to tackle problem solving tasks.

Based on the background problems that have been described, then researchers took a research entitled "The Application of Realistic Approach to Improve The Mathematical Problem Solving Abilities of Grade VIII at SMP Negeri 2 Tebing Tinggi". This research seeks to discover how the realistic approach can improve mathematical problem-solving abilities and classroom mastery among grade VIII students at SMP Negeri 2 Tebing Tinggi. The objectives are to describe the improvement in students' problem solving abilities and to achieve classroom mastery following the application of this approach.

Theoritical Framework

Mathematics

Mathematics is defined as the study of numbers, relationships between numbers, and operational procedures used in problem-solving, as well as a language of symbols that involves deductive reasoning and logical structures. It encompasses various aspects such as precision, systematic organization, and knowledge of quantitative facts, shapes, and patterns.

Mathematics learning involves students actively constructing their mathematical knowledge by integrating prior knowledge with new concepts. Effective mathematics learning requires active student engagement and teacher support to create an environment that caters to diverse abilities. The objectives of mathematics learning include understanding mathematical concepts, using reasoning for patterns and

properties, solving problems, effectively conveying ideas through various media, and appreciating the practical significance of mathematics. Overall, mathematics is both a practical tool and a framework for developing cognitive skills and structured thinking (Suherman, 2003; Depdiknas, 2006).

Mathematical Problem Solving

In the Big Indonesian Dictionary (KBBI), ability is defined as proficiency and strength, while Poerwadarminta (1966) describes it as an inherent aptitude or skill. Greenberg (2013) expands on this by defining ability as a combination of mental and physical capacity to complete various tasks, including cognitive abilities like problem solving and analysis, and physical abilities like strength and agility. Thus, ability is a blend of an individual's mental and physical proficiency in performing tasks.

Muhith (2018) defines a problem as an obstacle requiring resolution, highlighting the difference between current conditions and desired outcomes. Suharso (in Jauhari et al., 2021) views problems as hindrances to achieving goals, necessitating solutions. Hence, problems require careful analysis and strategy to bridge the gap between current conditions and expectations.

Problem solving, essential for students, involves identifying, analyzing, and resolving issues through a systematic thought process, including gathering information, evaluating solutions, and implementing decisions (Akbar et al., 2018). Polya (1985) and Solso (in Mawaddah & Anisah, 2015) describe it as a purposeful effort to overcome difficulties, using logical reasoning, creativity, and past experiences. Effective problem solving involves managing emotions, patience, perseverance, and adapting strategies over time.

Muslim (2017) defines mathematical problem solving ability as students' capability to address non-routine problems through critical thinking and logical reasoning. It involves not only solving problems using formulas but also simplifying, modeling, and using concepts creatively. Developing mathematical problem solving abilities enables students to identify known and unknown factors, construct mathematical models, and apply strategies effectively.

Polya's four steps of problem solving—understanding the problem, devising a plan, carrying out the plan, and looking back—serve as essential indicators (Polya, 1985). Understanding the problem involves identifying its core, devising a plan requires strategizing, carrying out the plan involves executing and verifying each step, and looking back involves re-examining the solution to ensure accuracy and applicability for future problems.

Learning Approach

Learning approaches are methods or strategies teachers use to facilitate the teaching-learning process, including techniques designed to help students understand material, solve problems, and develop abilities. According to Sanjaya (2010), a learning approach is a perspective on the learning process that is general in nature and underlies learning methods within a specific theoretical framework. Therefore, a learning approach can be seen as the method teachers apply to deliver material, aiming to achieve learning objectives.

Realistic Approach

The realistic approach is a learning theory that uses real-world contexts, introduced in the Netherlands by Freudenthal to develop students' activities in learning mathematics (Aqib, 2002; Rahman, 2018). This approach emphasizes learners' creativity in mathematical activities, viewing mathematics as a human activity and empowering students to solve contextual problems, formulate models, and explore mathematical concepts (Haji & Abdullah, 2016). It concludes that the realistic approach in mathematics education emphasizes understanding mathematical concepts through contextual situations to highlight the relevance of mathematics in daily life.

According to Rahman (2018) and Lange (in Soviawati, 2011), the realistic approach has five characteristics: using real-world contexts for presenting problems, creating self-made models, actively producing knowledge, interaction in the learning process, and intertwining mathematical concepts. These characteristics aim to engage students in mathematics contextually. Gravemeijer (in Widyastuti & Pujiastuti, 2014) outlines three principles: guided reinvention, didactical phenomenology, and self-developed models, enabling students to discover mathematical concepts through contextual problems.

Hobri (in Ningsih, 2014) describes steps for the realistic approach: understanding contextual problems, explaining them, solving them, discussing answers, and summarizing the learning process. Rahman (2018) states that Indonesian realistic mathematics education provides a framework for implementing the realistic approach, involving introduction, exploration, and summarizing phases.

The realistic approach has advantages such as connecting mathematics to everyday life, encouraging active learning, and promoting creativity in problem solving (Suwarsono in Ningsih, 2014; Rusman, 2010). However, it also has disadvantages, including the need for a paradigm shift, difficulty finding suitable contextual

problems, and challenges in large classes (Hobri in Ningsih, 2014; Rusman, 2010).

Research Method

Location and Time Research

The location of the research was at SMP Negeri 2 Tebing Tinggi. This school was situated at Jalan Tuanku Imam Bonjol No.46, Tebing Tinggi Lama, Kec. Tebing Tinggi Kota, Tebing Tinggi City, North Sumatra. The research was conducted in the even semester of the 2023/2024 academic year.

Type of Research

This research uses Classroom Action Research (CAR). Mualimin & Cahyadi (2014) state that classroom action research involves observing learning activities in a classroom setting where actions are deliberately introduced and occur collectively among students.

Subject and Object of Research

The subjects in this study were students from grade VIII at SMP Negeri 2 Tebing Tinggi during the even semester of the 2023/2024 academic year. One class was selected from the 10 available classes, specifically the VIII-7 class, which consisted of 36 students. The object of this study was the application of a realistic approach to improve the mathematical problem-solving abilities of these grade VIII students at SMP Negeri 2 Tebing Tinggi.

Research Design

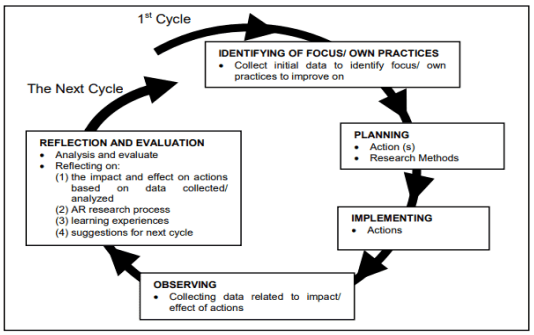


Figure 1. *Flow of classroom action research*

The classroom action research model used in this study is the adaptation of Lewin"s (1946) and Laidlaw"s (1992). In Hwa (2014) it is stated that the classroom action research model developed by Lewin"s and Laidlaw"s consists of five components, namely (1) planning; (2) implementation; (3) observation; (4) evaluation and (5) reflection. Of the five components there is an interrelationship that shows a cycle. This research will be designed in two cycles where each cycle consists of 1 meeting. The stages involved in classroom action research can be seen in the following chart.

Research Procedure

Observations were conducted to obtain a direct behavior, interactions, and events in the classroom. The observation sheet was used to collect data on various aspects of the learning process, including teacher activities, such as presenting contextual problems, providing assistance, encouraging group work, facilitating discussions, and guiding students to conclude mathematical procedures. Students' activities were also observed, including their understanding of the problem, collaboration in completing the task, and presentation of solutions. In addition, observations also focused on evaluating students' ability to solve problems through understanding the problem, developing a plan, implementing the plan, and reflecting on the solution. At the end of learning in each cycle, students will be given a test.

Data Analysis Technique

Data reduction simplifies and organizes collected data to enhance understanding and analysis. This process involves categorizing and removing irrelevant data to obtain meaningful information. For the student problem-solving ability test, scores were categorized based on Polya's problem-solving steps: understanding the problem, planning strategies, implementing strategies, and drawing conclusions. This method aids in evaluating students' progress.

Data display involved using an observation sheet with a Likert scale to analyze teacher and student activities descriptively and qualitatively, with results converted into qualitative values based on percentage intervals (Sudjana, 2010:133).

Description:

$$SR = \frac{Total\ Score\ of\ Teacher\ or\ Student\ Activity}{Maximum\ Score} \times 100\%$$

SR = Average presentation of teacher or student activity

Table 1. Teacher and student activity category intervals

Interval SR	Category
$90\% \leq SR \leq 100\%$	Very Good
$80\% \leq SR \leq 90\%$	Good
$70\% \leq SR \leq 80\%$	Medium
$60\% \leq SR \leq 70\%$	Less
$SR < 60\%$	Very Less

(Sudjana, 2010)

To determine students' mathematical problem-solving abilities, individual scores were calculated using Trianto's formula and categorized into levels (very high, high, medium, low, very low) based on percentage.

$$SKPM = \frac{T}{T_t} \times 100\%$$

Description:
%SKPM : Problem solving ability score
T : The score obtained by the student
T_t : Total Score

Table 2. Problem solving ability level

Mastery Level (%)	Category
$90 \leq NP \leq 100$	Very high
$80 \leq NP \leq 89$	High
$65 \leq NP \leq 79$	Medium
$55 \leq NP \leq 64$	Low
$0 \leq NP \leq 54$	Very low

(Nurcancana, 1992)

Students are declared to have been able to solve mathematical problems if the problem solving ability score (%SKPM) obtained has reached the minimum completeness criteria (KKM) set by the school is ≥70 in the medium category

Determining individual learning completeness can be used the formula described by Trianto (2009), which is as follows.

$$KB = \frac{T}{T_t} \times 100\%$$

Description:
KB: Learning Score
T : Total Score obtained by students
T_t : Total score
With Criteria:
$70\% \leq KB \leq 100\%$: Students have completed learning
$0\% \leq KB \leq 70\%$: Students have not completed learning

Each student is said to have completed its learning (individual completeness) if the proportion of correct student answers is of ≥ 70% (in Tritanto, 2009 : 241).

Determining classical learning completeness used the formula described by Winarti (2013). Depdikbud (in Trianto 2009 : 241) stated a class is said to have completed learning if in the class there are 85% who have reached KB ≥ 70%.

Result and Discussion

Research Result

The research results described in this section include the test results that consist of initial tests, cycle I problem solving ability tests and cycle II problem solving ability tests.

a. Description of Initial Ability Test

Score (%)	Ability Level	Number of Students	Percentage of Students	Average of Student Ability
90 – 100	Very High	0	0%	48,5 (Very Low)
80 – 89	High	0	0%	
65 – 79	Medium	1	4,8%	
55 – 64	Low	0	0%	
0 – 54	Very Low	20	95,2%	
Total of Students		21	100%	

Overall, the level of students' ability to solve problems in the initial test of problem solving ability was 48,5% with very low level of ability. The number of students who have reached mastery is 1 student out of 21 students or 4,8%, while the number of students who have not reached mastery is 20 students out of 21 students or 95,2%.

b. Description of Research Result in Cycle I

Score (%)	Ability Level	Number of Students	Percentage of Students	Average of Student Ability
90 – 100	Very High	0	0%	64,58 (Low)
80 – 89	High	5	14%	
65 – 79	Medium	15	41,5%	
55 – 64	Low	6	16,5%	
0 – 54	Very Low	10	28%	
Total of Students		36	100%	

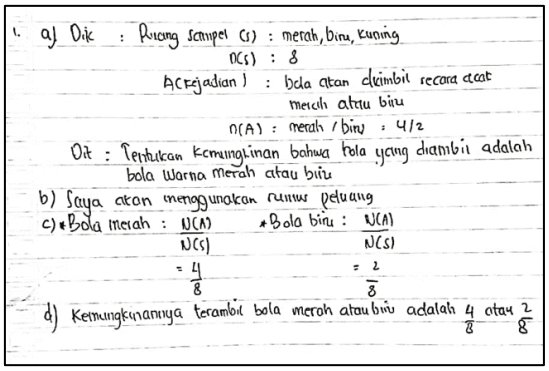
Overall, the level of students' ability to solve problems on the mathematical problem solving ability test I was 64.58%% with a low level of ability. The number of students who have reached mastery is 18 students out of 36 students or 50%, while the number of students who have not reached mastery is 18 students out of 36 students or 50%.

c. Description of Research Result in Cycle II

Score (%)	Ability Level	Number of Students	Percentage of Students	Average of Student Ability
90 – 100	Very High	8	22,3%	83,1 (High)
80 – 89	High	15	41,5%	
65 – 79	Medium	10	28%	
55 – 64	Low	2	5,5%	
0 – 54	Very Low	1	2,7%	
Total of Students		36	100%	

Overall, the level of students' ability to solve problems on the mathematical problem solving ability test I was 64.58%% with a low level of ability. The number of students who have reached mastery is 18 students out of 36 students or 50%, while the number of students who have not reached mastery is 18 students out of 36 students or 50%.

d. Description of Student Answers in Cycle I



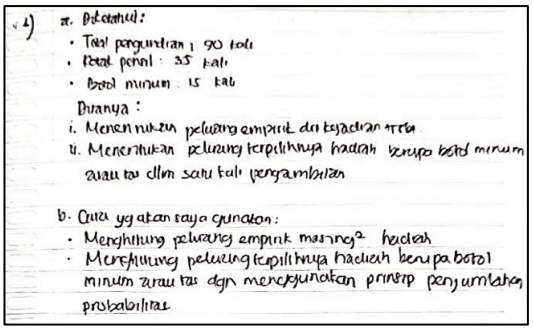
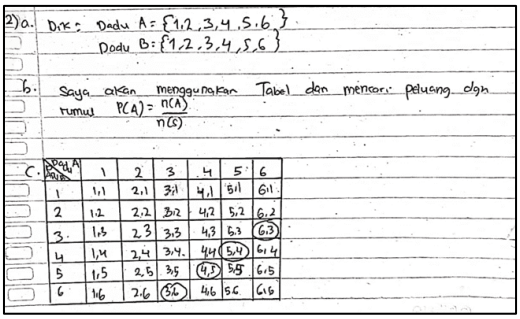
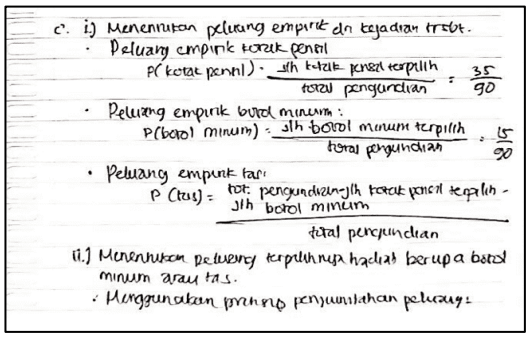


Figure 2. *Students' answers on problem number 1 Cycle I*

Students have been able to understand the problem by identifying what is known and asked in the problem, but for the next step, namely planning the solution, it appears that students can already but are not complete to write the solution plan that will be done, for the next step, namely solving the problem, students do not find the solution or answer to the problem correctly and in detail to conclude the answer, students also do not check the answers obtained and do not get the right conclusion.





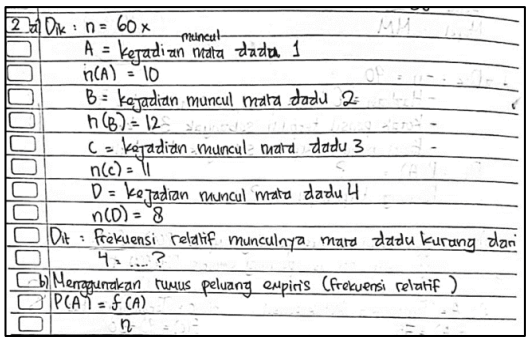


Figure 3. *Students' answers on problem number 2 Cycle I*

Students have not been able to understand the problem, especially what is asked in the problem, but for the next step, namely planning the solution, it seems that students have been able to write down the solution plan that will be carried out, for the next step, namely solving the problem, students have not been able to solve the problem properly, and for the last step, they are still not used to looking back at the solutions made.

e. Description of Student Answers in Cycle II

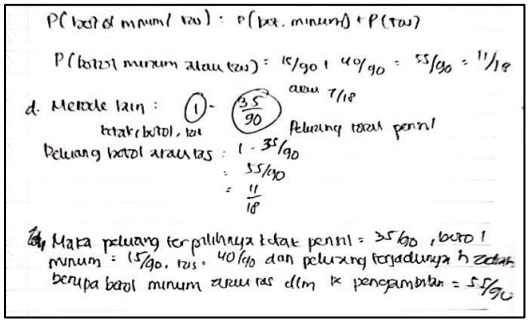


Figure 4. *Students' answers on problem number 1 Cycle II*

Students have been able to understand the problem by identifying what is known and asked in the problem, students can also write a complete solution plan and solve the problems in the problem correctly and also students have been able to look back the answers obtained.

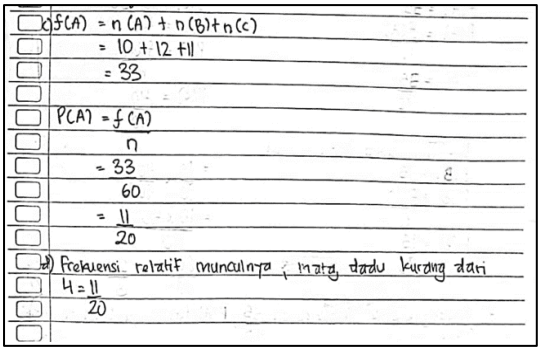


Figure 5. *Students' answers on problem number 2 Cycle II*

Students can identify the problem well, can plan the solution with the odds formula, then students can solve the problem by finding the value of f(A) first then finding the relative frequency value correctly. Students also recheck the final answer obtained.

Discussion

By applying the realistic approach in this study can improve students' mathematical problem solving abilities. This is based on the implementation of problem solving ability tested in class VIII. Before the research was conducted, students were given an initial test so that from the initial test the average student score was 48,5% with 1 student (2,8%) who had reached the level of learning completeness, while 20 students (97,2%) had not reached the level of learning completeness. These results indicated that students' problem solving abilities were still low. One of the efforts made to overcome and improve it is through learning by applying a realistic approach.

Based on the problems found in the initial test, it is necessary to make improvements by continuing in cycle I to improve students' mathematical problem solving ability. After being given action in cycle I through a realistic approach, the problem solving ability test I obtained 80,56% of students have the ability to understand the problem (indicator I), 66,67% of students have the ability to devise a plan (indicator II), 59,38% of students have the ability to carry out the plan (indicator III), and 40,97% of students have the ability to look back at the results of problem solving (indicator IV). The average student score was 64,58% with the number of students who reached the category as many as 18 students (50%).

Then, after providing action in cycle II through a realistic approach, by further emphasizing and explaining the implementation of Polya's steps to students, students' ability to understand the problem (category I) was 95,14%, students' ability to develop a plan (category II) was 88,89%, students' ability to devise a plan (category III) was 78,13%, students' ability to look back at the results of the solution (category IV) was 63,19%. The average score of students was 83,1% with the number of students who reached the category as many as 32 students (88,9%).

In the problem solving ability test I (cycle I) the average student score increased by 16,08% from the initial test and in the problem solving ability test II (cycle II) the average student score increased by 18,52% from the problem solving ability test I. Similarly, the level of learning completeness was higher in the first cycle. Similarly, the level of classical learning

completeness increased from 50% in cycle I to 88.9% in cycle II.

Closing

Referring to the research results that have been described, thus the following conclusions are obtained

1. The implementation of a realistic approach in teaching at SMP Negeri 2 Tebing Tinggi significantly improved the mathematical problem solving abilities of grade VIII students. Students showed notable advancements in the four key stages of problem solving: understanding the problem, where they became better at grasping issues and relevant information; devising a plan, where they improved in strategizing and organizing steps effectively; carrying out the plan, where their execution of methods and calculations became more accurate; and looking back, where they increasingly reviewed and reflected on their solutions, assessing their correctness and exploring alternative methods. Data from problem solving ability tests revealed substantial improvements, with students' average scores rising from 48.5% in the initial test to 83.1% in cycle II, reflecting a 33.1% increase. Specifically, students' abilities in understanding the problem improved from 80.56% to 95.14%, devising a plan from 66.67% to 88.89%, carrying out the plan from 59.38% to 78.13%, and looking back from 40.97% to 63.19%, indicating significant progress in their problem solving abilities.
2. Students' mathematics learning completeness increased through a realistic approach to probability material in grade VIII SMP Negeri 2 Tebing Tinggi. This can be seen from the increase in the number of students who completed the initial test, cycle I, and cycle II, namely from 1 (2.2%) student who completed the initial test to 18 (50%) students who completed the first cycle and to 32 (88.9%) students who completed the second cycle. Learning observation results are included in very good with an average score of 63 in cycle II.

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