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Improving Students' Mathematical Problem-Solving Skills through the Means Ends Analysis (MEA) Learning Model

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ABSTRACT

Mathematical problem-solving skills are an important competency that students must have in learning mathematics. However, the reality is that this ability is still relatively low due to the dominance of conventional learning that does not involve students' high-level thinking activities. This research aims to improve students' mathematical problem-solving skills through the application of the Means Ends Analysis (MEA) learning model. This research is a Class Action Research (PTK) with a design by Kemmis and McTaggart, which is carried out in two cycles. The subjects of the study were 17 students of grade VIII MTs Muhammadiyah 10 Gresik. Data collection techniques include tests, observations, and questionnaires, while data analysis uses descriptive statistics. The results showed that the average mathematical problem-solving ability of students increased from 64.41 in the first cycle to 80.24 in the second cycle, with an increase of 15.83 points. In addition, student activities and learning implementation have also increased, and student responses to MEA learning are in the positive category. Thus, the application of the MEA learning model is effective in improving students' mathematical problem-solving skills.

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1. Introduction

Mathematical problem-solving skills are essential competencies that must be developed in mathematics learning. This ability includes the skills of understanding problems, planning solution strategies, implementing appropriate procedures, and evaluating the solutions obtained (Polya, 1973). The National Council of Teachers of Mathematics emphasizes that problem-solving is at the core of mathematics

learning and needs to be developed through learning that emphasizes the process of thinking, reasoning, and the relationship of concepts to real context (NCTM, 2014). However, various research results show that students' mathematical problem-solving skills in Indonesia are still relatively low. The results of the Programme for International Student Assessment (PISA) in 2022 show that the mathematical literacy achievement of Indonesian students is still below the OECD average, especially in the aspects of reasoning and non-routine problem-solving (OECD, 2023). This condition is in line with the findings of Hidayat and Sariningsih (2018) who stated that junior high school students have difficulty in solving problems that require mathematical problem-solving skills and high-level thinking.

The low mathematical problem-solving ability is inseparable from the practice of mathematics learning in schools which is still dominated by conventional and teacher-cantered approaches. Learning that emphasizes more on the delivery of procedures without actively involving students in the thinking process causes students to tend to be passive and less trained in analysing and solving mathematical problems independently (Mulyasa, 2017). On the other hand, the development of the digital era, social media, and popular culture demands mathematics learning that is more creative, contextual, and relevant to students' lives to increase learning engagement and motivation (Hidayatullah, 2018; Mustakim, Shoffa, & Hidayatullah, 2019). A variety of innovative learning models have been developed to improve students' mathematical problem-solving skills. Afrida and Handayani (2018) reported that the application of the ARIAS model was able to improve students' mathematical problem-solving skills and curiosity. Open-ended learning has also been proven to be effective in developing the mathematical problem-solving skills of junior high school students (Hidayat & Sariningsih, 2018). In addition, the culturally based realistic mathematics education approach can form character and improve students' understanding of concepts through more contextual learning (Efendi & Syarifuddin, 2021).

One of the learning models that specifically emphasizes the systematic process of analysis and problem-solving is Means Ends Analysis (MEA). The MEA model is a heuristic learning model that directs students to break down the final goal of a problem into simpler sub-goals, thus helping students design problem-solving steps in a structured and logical manner (Huda, 2015). Research by Holisin, Mursyidah, and Isnainiyah (2019) shows that the application of the MEA model can improve students' mathematics learning outcomes through strengthening analytical thinking processes and problem solving. Although various studies have examined the effectiveness of innovative learning models, including MEA, most studies still focus on improving learning outcomes in general and have not specifically examined the improvement of mathematical problem-solving skills in the context of Classroom Action Research (PTK) at the Madrasah Tsanawiyah level. In addition, studies that emphasize the improvement of the learning process in a reflective and sustainable manner through the implementation of the MEA are still relatively limited (Ihad & Haris, 2022; Julaeha & Erihardiana, 2022).

Based on this description, the novelty of this research lies in the systematic application of the Means Ends Analysis (MEA) learning model within the framework of Classroom Action Research to improve the mathematical problem-solving ability of grade VIII students of Madrasah Tsanawiyah. This research is not

only oriented towards improving learning outcomes, but also on improving students' thinking processes in solving mathematical problems through structured stages of objective and sub-objective analysis. Thus, this research is expected to make a practical contribution for teachers in developing effective mathematics learning as well as a theoretical contribution in strengthening problem-solving-based learning studies.

2. Method

This research is a Classroom Action Research (PTK) which aims to improve students' mathematical problem-solving skills through the application of the Means Ends Analysis (MEA) learning model. The research design refers to the Kemmis and McTaggart model, which emphasizes the process of continuous learning improvement through cycles of planning, action execution, observation, and reflection (Kemmis & McTaggart, 2014). The research was carried out in two cycles, where each cycle was designed based on the results of reflection from the previous cycle. This research was carried out at MTs Muhammadiyah 10 Gresik in the even semester of the 2024/2025 academic year. The subjects of the study were 17 grade VIII students who were selected based on the results of initial observations which showed that students' mathematical problem-solving abilities were still below the Minimum Completeness Criteria (KKM). The selection of research subjects is based on the consideration of class characteristics and suitability with the research objectives, as commonly used in class action research (Arikunto, 2013).

The planning stage includes the preparation of learning tools in the form of Learning Implementation Plans (RPP) based on the MEA model, Student Worksheets (LKPD), and research instruments. The instruments used in this study include mathematical problem-solving ability tests, learning implementation observation sheets, student activity observation sheets, and student response questionnaires. The test instrument is prepared based on indicators of mathematical problem-solving ability and has gone through a content validation process through expert judgment to ensure the suitability and clarity of the aspects measured (Sugiyono, 2021). The implementation of actions is carried out by applying the MEA learning model to the material of straight-line equations. Learning begins with the presentation of contextual problems, then students are directed to identify the final goals and sub-objectives, determine solution strategies, and solve problems gradually through group discussions. Teachers play the role of facilitators who guide students in the thinking process and encourage active involvement during learning, as is the characteristic of student-centered learning (Huda, 2015).

Observation is carried out simultaneously with the implementation of actions to observe the implementation of learning and student activities during the learning process. Observation data was collected using observation sheets that had been prepared in advance and analyzed to determine the level of achievement in the implementation of the MEA model and the activeness of students in learning (Arikunto, 2013). The reflection stage is carried out at the end of each cycle by analyzing the results of the mathematical problem-solving ability test, observation data, and student responses. The results of reflection are used as a basis for planning learning improvements in the next cycle, both in terms of learning strategies, classroom management, and the use of time so that learning goals can be achieved optimally (Kemmis & McTaggart, 2014).

The data analysis in this study was carried out in a quantitative descriptive manner. The data of the mathematical problem-solving ability test was analyzed to determine the average score and percentage of student learning completeness. Data on the observation of the implementation of learning and student activities were analyzed in the form of percentages, while student response questionnaire data was analyzed to determine the tendency of students' attitudes towards applied learning. This research is declared successful if the average student score reaches the KKM, classical completeness is at least 75%, and student activities and responses are in the good category (Sugiyono, 2021). This research was carried out by paying attention to the ethical principles of educational research, which include the consent of the school, the involvement of subject teachers, and the confidentiality of student identities. All data obtained is used solely for academic purposes and improving the quality of learning.

3. Results and Discussion

Research Results

This classroom action research was carried out in two cycles with the aim of improving students' mathematical problem-solving skills through the application of the Means Ends Analysis (MEA) learning model. Problem-solving ability is measured through tests at the pre-action, cycle I, and cycle II stages. The results of the analysis showed that the average mathematical problem-solving ability of students gradually increased. In the pre-action stage, the average student score was 58.53**,** which indicates that most students have not reached the Minimum Completeness Criteria (KKM). After the application of the MEA model in cycle I, the average score increased to 64.41**,** but classical completeness has not been achieved optimally. Learning improvements were then carried out in the second cycle with an emphasis on strengthening sub-objective analysis and group discussions, so that the average student score increased significantly to 80.24**.** Overall, the increase in students' mathematical problem-solving skills from pre-action to cycle II reached 21.71 points, which shows that the application of the MEA model has a positive impact on students' ability to solve mathematical problems.

Research Stages	***Grade Point Average***
Pre-Actions	58,53
Cycle I	64,41
Cycle II	80,24

Figure 1. Improved Average Students' Mathematical Problem-Solving Ability

The graph in Figure 1 shows a consistent upward trend in each study cycle. The most significant improvement occurred in cycle II, which showed that learning improvements made based on the results of reflection in cycle I succeeded in increasing the effectiveness of the application of the MEA model. In addition to the increase in test results, student activities during learning also showed a positive increase. In the first cycle, student activities were in the category of quite active, especially in group discussion activities. In cycle II, student activities increased from active to very active categories, characterized by student involvement in analysing problems, expressing opinions, and presenting the results of group discussions. The

implementation of learning by teachers has also increased and is in the very good category in cycle II. The results of the student response questionnaire showed that most students responded positively to learning using the MEA model. Students stated that learning became easier to understand, challenging, and helped them solve problem-solving problems systematically.

Discussion

The improvement of students' mathematical problem-solving skills in this study shows that the Means Ends Analysis (MEA) learning model is effective in helping students understand and solve mathematical problems in a gradual and structured manner. The MEA encourages students to identify the end goal, break it down into sub-objectives, as well as determine logical completion steps. This process is in line with the stages of mathematical problem-solving, namely understanding problems, planning strategies, implementing strategies, and evaluating results. A significant improvement in cycle II shows that students are beginning to become accustomed to the analytical thinking patterns applied in the MEA model. Intensive group discussions also provide space for students to exchange ideas, clarify understanding, and correct misconceptions. This reinforces the finding that student-cantered learning and emphasizing thought processes can improve mathematical problem-solving skills. The results of this study are in line with the findings of previous research which stated that the MEA model can improve students' problem-solving skills and mathematics learning outcomes because it leads students to think systematically and in a directed manner. Thus, the application of the MEA model not only has an impact on improving grades, but also on the quality of the learning process and active involvement of students. Overall, the results and discussion of this study confirm that the application of the Means Ends Analysis learning model is an effective learning strategy to improve students' mathematical problem-solving skills at the secondary school level.

4. Conclusions

The application of the Means Ends Analysis (MEA) learning model has proven to be effective in improving the mathematical problem-solving ability of grade VIII students of MTs Muhammadiyah 10 Gresik. The increase was shown by an increase in the average student score from 58.53 in the pre-action stage, to 64.41 in the first cycle, and a significant increase to 80.24 in the second cycle**.** These results show that MEA learning can help students understand problems systematically through solving the final goal into simpler sub-objectives. In addition to improving learning outcomes, the application of the MEA model also has a positive impact on student activities and involvement in the learning process. Students become more active in discussing, analysing problems, and conveying ideas and solution strategies in a sequential manner. Students' responses to MEA learning are also in the positive category, which shows that this model can create a more interesting and meaningful learning atmosphere. Based on these results, the Means Ends Analysis learning model can be used as an alternative mathematics learning strategy to improve students' mathematical problem-solving skills, especially in materials that require analytical and systematic thinking skills.

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