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Mathematical Reasoning of Class VII Students in terms of Mathematical Resilience in TAI Learning with the RME Approach Aided by Graphic Organizer

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Abstract

This study aims to describe students' mathematical reasoning abilities of grade VII based on mathematical resilience in TAI learning with the RME approach assisted by a graphic organizer. The research method used in this study is a mix method with sequential explanatory models. The population in this study were students of class VII MTs Ma'arif 1 Blora academic year 2020/2021 with a sample of class VII C and class VII B as the experimental class and the control class. The research subjects were two students each with high mathematical resilience, moderate mathematical resilience, and low mathematical resilience. The data collection techniques used in this study were tests, documentation, questionnaires, observations, questionnaires, and interviews. The quantitative data were tested by means of the average test, the proportion test, the average difference test and the different proportions test, while the qualitative data were tested with data validity, data reduction, data presentation and conclusion mean The results showed that students in the high mathematical resilience category were able to master all indicators of mathematical reasoning. Students in the mathematical resilience category are less able to make and test mathematical guesses. Students in the mathematical resilience category are unable to make and test mathematical guesses, perform mathematical manipulations and draw conclusions from a statement or fact logically.

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INTRODUCTION

Mathematics is one of the subjects that students must study, through a series of activities in learning, so that students can develop a way of thinking to find strategies for dealing with everyday problems. NCTM (Izzatul, 2017) states that one of the objectives of learning mathematics is that students learn to reason mathematically.

The objectives of learning mathematics from NCTM are in line with the standard content of the 2013 curriculum as outlined in Permendikbud Number 64 of 2013 (Kemendikbud, 2013) for class VII-VIII SMP / MTs, it is stated that one of the skills students must master is reasoning in the concrete and realm realms. abstract related to the development learned in school independently and being able to use methods according to scientific principles.

According to NCTM (Fonseca, 2018) mathematical reasoning is a habit of thinking that must be developed consistently in many contexts. Pereira & Ponte (2017) mathematical reasoning requires students to be involved in various thinking processes and sense-making. The reasoning indicators according to Wardhani (2010) are: (1) submitting written mathematical statements, (2) proposing conjectures, (3) performing mathematical manipulation, (4) drawing conclusions from a statement, (5) checking the validity of an argument, and (6) find patterns or properties of mathematical phenomena to make generalizations. Meanwhile, NCTM (Thompson et al., 2012) states that the standard of mathematical reasoning is if students are able to (1) explore reasoning as a basic aspect of mathematics; (2) making and testing mathematical assumptions; (3) develop and evaluate mathematical arguments; (4) selecting and using various types of reasoning. The indicators in this study include: (1) making and testing mathematical assumptions, (2) performing mathematical manipulation, (3) developing and evaluating mathematical arguments, and (4) drawing conclusions from a statement or fact logically.

Tujuan pembelajaran matematika dan This basic mathematical ability has not been fully realized because based on the results of a preliminary study at MTs Ma'arif 1 Blora, it was revealed that as many as 68% of students mistakenly worked on reasoning problems in the form of stories or applications. These mistakes are due to errors in counting, use of inappropriate concepts, lack of understanding of prerequisite materials, and lack of student fighting power in learning mathematics. This strong fighting power is called mathematical resilence or mathematical resiliience (Yeager & Dweck, 2012).

In particular, mathematical resilience is the quality of several mathematical approaches to students who confidently produce success for their full efforts, perseverance in facing difficulties, willingness to discuss, reflect and research (Hall & Keynes, 2015). Meanwhile, according to Sumarmo (2015) mathematical resilience is a positive attitude to overcome anxiety, fear in facing challenges and difficulties in learning mathematics including hard work and good language skills, self-confidence, and diligence in facing difficulties. Anxiety refers to feelings of anxiety or fear that interfere with math performance. Mathematical resilience enables students to overcome obstacles in mathematics performance.

Increasing students' mathematical reasoning abilities and mathematical resilience (fighting power) in solving mathematical problems in a real-world context requires innovative cooperative learning. According to Slavin (Puspitasari & Purwoko, 2018) Team Assisted Individualization (TAI) learning is a teaching model that combines cooperative skills and individual teaching, emphasizing the social effects of cooperative learning and solving problems in teaching programs. Tinungki (2015) application of the TAI learning model provides opportunities for students to discuss and interact with one another so that students' mathematical abilities improve and student character is better when compared to other cooperative models (Purnomo et al., 2019).

In addition to the learning model, the learning approach is also very important in the effort to deliver material to students. According to Sagala (Darwis & Akib, 2017) the learning approach is a path that will be taken by teachers and students in achieving instructional goals for a particular instructional unit. One approach that is oriented in learning mathematics is the Realistic Mathematic Education (RME) approach. In realistic mathematics learning starts from real or real problems so that students can be involved in a more meaningful learning process

(Nolaputra et al., 2018). Lange (Murdani et al., 2013) suggests that the process of mathematicalization of mathematical ideas or concepts in the RME approach begins in the real world and ultimately reflects the results obtained in mathematics back to the real world. The process of mathematicalizing mathematical ideas / concepts can be stated in a graphic organizer.

Zollman (2012) argues that a graphic organizer is a tool for organizing information and developing a thought about relationships with concepts, as in Figure 1 below.

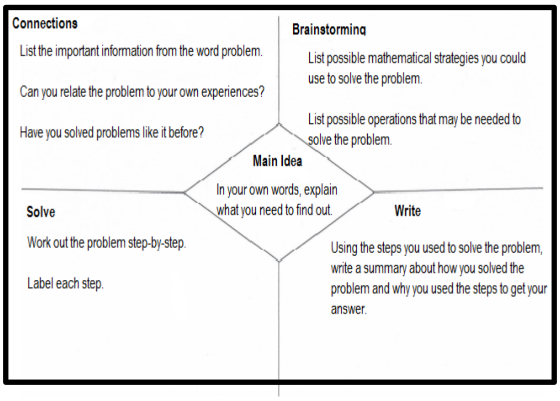

Figure 1. Four Corners and A Diamond Graphic Organizer Type.

This four corners and a diamond type graphic organizer Zollman (2012) is an adjustment from Gould & Gould (Sian et al., 2016) and embedded the four-step principle of Polya's mathematical problem solving which includes the main idea (determining information from the problem given in the student's own language), connect (determine the relevance of the information with the concept of the material being studied), brainstorm (determine and design the completion procedure), solve (solve the problem according to the chosen completion procedure) and write (write down the reasons at the completion stage and conclude the results of the answers obtained).

Based on the above background, the purpose of this study is to describe students' mathematical reasoning abilities of grade VII based on mathematical resilience in TAI learning with the RME approach assisted by a graphic organizer.

METHOD

The research method used in this study is a mixed method with a sequential explanatory model. The design used in this study was the posstest control group design. The population in this study were students of class VII MTs Ma'arif 1 Blora in the academic year 2020/2021. The samples in this study were students of class VII C as an experimental class who were given treatment in the form of team assisted individualization learning with a graphic organizer with the RME approach, and the control class, namely class VII B students who were given treatment in the form of team assisted individualization learning. This sampling is based on cluster random sampling technique. The research subjects were two students each with high mathematical resilience, moderate mathematical resilience, and low mathematical resilience.

Data collection methods in this research are test methods, documentation, questionnaires, observation sheets and interview guidelines. Quantitative data analysis techniques began with item analysis, preliminary data analysis, then hypothesis testing. Initial data analysis was to determine whether the two sample groups had the same initial ability, and it was found that the students' initial abilities of both classes were the same. While the hypothesis testing includes individual completeness test, classical completeness test, proportional difference test, and average difference test. Before testing the hypothesis, a prerequisite test is carried out including the normality test using the Kolmogorov-Smirnov test and the homogeneity test using the Levene test with the help of SPSS 25.0. The qualitative data analysis technique was carried out by using qualitative descriptive methods including data validity, data reduction, data presentation and conclusion means.

RESULTS AND DISCUSSION

Measuring the quality of learning is seen from three stages, namely the planning stage, the implementation stage, and the assessment stage. At the planning stage, validation of research instruments and learning tools has been carried out, which are presented in Table 1 bel

Table 1. The Result of Validation

Research Instruments	The Average Scores	Category
Syllabus	4.3	Sangat baik
RPP	4.4	Sangat baik
LKS	4.3	Sangat baik
TKPM items	4.2	Baik
Observation	4.2	Baik
Student Response	4.4	Sangat baik
Interview Guidelines	4.3	Sangat baik

From the above results it can be concluded that the learning tools and research instruments are included in the good and very good categories so that the learning tools and research instruments are suitable for use for research.

The quality of the implementation stage of learning is seen from the observation of the implementation of learning according to the lesson plan and student response questionnaires. The learning implementation is said to meet the requirements if the results of the observation of the implementation of the learning are at least included in the good category and at least 75% of students give a positive response. The results showed that the average score of the observation of learning implementation was 4.35, including the very good criteria. While the results of the student response questionnaire, as much as 78% gave positive responses. So it can be said that the implementation stage of quality learning.

The quality of the assessment stage is seen from the effectiveness of TAI learning with a graphic organizer with the RME approach on mathematical reasoning abilities. Prabawa & Zaenuri (2017) reveal that the effectiveness of a lesson is an indicator of the success of the learning being carried out. Before testing the effectiveness, the prerequisite test is conducted first, namely the normality and homogeneity test using SPSS 25.0. Based on this test, the data obtained came from a population with normal distribution and homogeneity. Furthermore, the results of the average completeness test used the t test, with $\alpha = 0.05$ obtained $t_{count} = 6.252> 1.688$, meaning that students who were subjected to TAI learning with a graphic organizer with an RME approach were more than 66.5. The classical completeness test with the z test obtained $z_{count} = 1.039> 1.64$, meaning that the proportion of completeness of students who were subjected to the TAI learning model with a graphic organizer with the RME approach was more than 75%. The average difference test using the t test obtained $t_{count} = 2.45> 0.063$ which means that the average mathematical reasoning ability of students in the experimental class is higher than the ability of students in the control class. The proportional difference test with the z test obtained $z_{count} = 2.160> 0.4808$, meaning that the proportion of students 'mathematical reasoning ability in the experimental class was more than the proportion of students' mathematical reasoning ability in the control class.

This shows that the success of the applied learning model is supported by the right approach and method. Tauran (2018) in his research explained that the increase in mathematical reasoning of students who received TAI type cooperative learning was better than students who received conventional learning.

Research by Febrian et al., (2016) states that learning using a realistic mathematics approach has an effect in the form of an increase in mathematical reasoning abilities. Learning that uses a realistic approach can lead to or facilitate students in the mathematical process, namely the formulation of real-world problems into mathematical problems (Nurdianasari et al., 2015). Veloo et al., (2015) show that the RME approach is effective and contributes to improving mathematical reasoning and generalization towards students.

In addition, research by Damayanti et al., (2019) states that the results of implementing the CORE learning model assisted by a graphic organizer can improve students' mathematical problem solving abilities and student responses to the application of the CORE learning model assisted by a graphic organizer are classified as positive. Other research was also conducted by Sian et al., (2016) showing that the use of graphic organizers can help overcome weaknesses in students' communication and understanding skills and provide a positive attitude and a higher level of confidence in solving story problems.

The analysis of mathematical reasoning skills taught by learning TAI with a graphic organizer with the RME approach is divided into three levels of mathematical resilience, namely high mathematical resilience, moderate mathematical resilience, and low mathematical resilience.

To find out students' mathematical test, a 40-point mathematical resilience scale statement was used which was adopted from Sumarmo (2018). Based on the results of the mathematical resilience scale analysis of 25 students of class VII C MTs Ma'arif 1 Blora, the distribution data and the percentage of students based on mathematical resilience were obtained as presented in Table 2.

Table 2. Results of Mtahematical Resilience Levels

Category	Amounts	Percentage
High	5	20%
Moderate	13	52%
Low	7	28%
Sum	25	100%

Based on Table 2, the number of students with high mathematical resilience is 5 students with a percentage of 20%, students with moderate mathematical resilience are 13 students with a percentage of 52% and students with low mathematical resilience are 7 students with a percentage of 28%. Based on the mathematical resilience scale analysis, 6 research subjects were selected to be investigated further regarding mathematical reasoning abilities. The following is a description of mathematical reasoning abilities in terms of students' mathematical resilience in solving realistic problems with a graphic organizer.

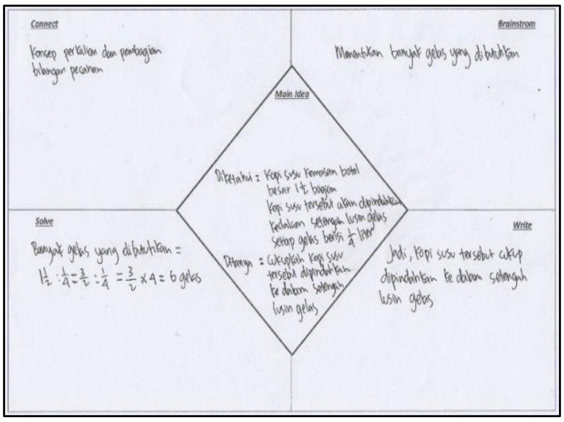

Figure 2. Examples of High Resilience Mathematical Student Work Completing TKPM Problems with a Graphic Organizer.

Based on Figure 2, it can be seen that high mathematical resilience students completed all the completion stages in the graphic organizer correctly and precisely. MRT students are able to complete the main idea stage by simplifying what is known and what is asked, able to complete the connect stage by writing down concepts / ideas that will be used appropriately, able to complete the brainstorm stage by writing a solution strategy, able to complete the solve stage by calculating correctly and able to complete the write stage by writing a summary answer even though it is too short. This is in accordance with Rahmmatiya & Miatun (2020) having high resilience being able to answer tests of mathematical problem solving abilities well and achieving systematic steps in solving problems.

Overall, high mathematical resilience students can solve reasoning problems well. This is shown by students of high mathematical resilience (1) being able to submit guesses correctly accompanied by the process of submitting correct guesses and using the right work strategies, (2) being able to perform mathematical manipulation with the right concepts, strategies and work processes, (3) able to examine the arguments given and provide reasons for the right arguments, and (4) able to provide conclusions correctly along with the correct strategy and process. High mathematical resilience students are able to understand the information on the problem and combine it with the knowledge they have, so that they get the correct work strategy. This finding is in line with the research of Kurnia et al., (2018) which states that students who have a high mathematical resilience attitude have good communication skills and research by Cahyani et al., (2018) states that mathematical resilience makes a positive contribution to mathematical understanding abilities.

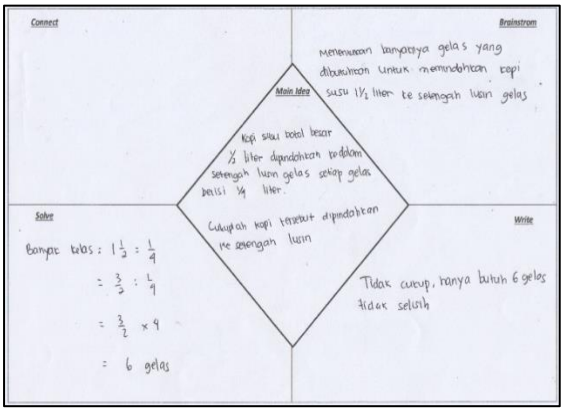

Figure 3. Examples of Mathematical Resilience Student Work Completing TKPM Problems with a Graphic Organizer.

Based on Figure 3, it can be seen that the mathematical resilience student work sheet is currently in the completion stage of a graphic organizer that has not been done, namely connect or a concept / idea that will be used to solve the problem. Even though the concept is the main thing that students must master (Afriyanti et al., 2018). At the brainstorm stage, mathematical resilience students are able to write down the strategies that will be used correctly so that the correct solution is also obtained at the solve stage. However, mathematical resilience students are not quite right in giving the conclusions of the answers in the write section.

Overall, students of moderate mathematical resilience are (1) able to give the correct answer in solving mathematical manipulation problems, with the right strategy and correct processing process, (2) able to examine the arguments given well and provide reasons for the right arguments, and (2) 3) able to provide correct conclusions with the right strategy and processing process. For indicators of making and testing mathematical predictions, mathematical resilience students are not yet good at it. This is because mathematical resilience students are in a hurry to understand the problem and lack understanding of the concept. As revealed in Maharani & Bernard's (2018) study to solve a mathematical problem, students must be able to understand a problem correctly. Without the correct understanding, students will experience difficulties in preparing a plan for completion.

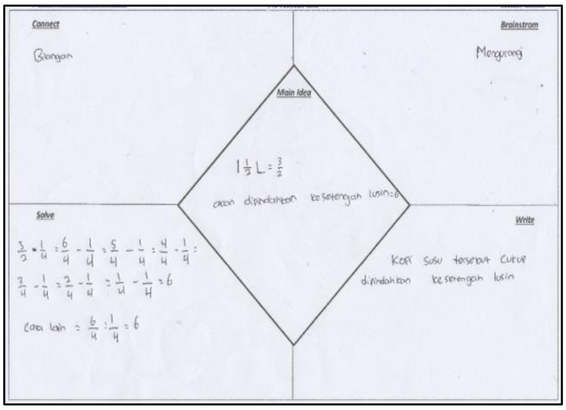

Figure 4. Examples of Low Mathematical Resilience Student Work Solving TKPM Problems with a Graphic Organizer.

Based on Figure 4, it can be seen that low mathematical resilience students completed all the stages of completion in the graphic organizer but they were not correct. Low mathematical resilience students are not able to write down known information at the main idea stage so MRR students are unable to complete other stages of graphic organizer as well. Dilla et al., (2018) stated that low mathematical resilience students tend to work on the problem as is, not even finish until the completion process because of a feeling of doubt and a lack of interest in answering questions well.

Overall, students of low mathematical resilience cannot solve reasoning problems well. This is shown by low mathematical resilience students, (1) unable to give correct guesses due to wrong working strategies and lack of understanding of concepts, (2) unable to perform mathematical manipulation because they have not mastered the basic concepts used and feel confused in doing so that it interferes with the work process, and (3) does not provide correct conclusions, because students experience deadlock in working. However, students of low mathematical resilience are sufficiently able to check the validity of the argument correctly even though they are still hesitant in mentioning the concepts or strategies to be used. This is in accordance with the research of Zhanty (2018) which states that students with low mathematical resilience consider the difficulties faced to be a burden, so that the burden is considered a threat and frustrating in doing mathematics.

CONCLUSION

Based on the analysis and discussion, the results of the description of students' mathematical reasoning abilities in terms of mathematical resilience show mixed results. The difference in students' mathematical resilience levels becomes important, especially when facing difficulties in solving realistic problems with the help of a graphic organizer. Therefore, teachers must foster and improve students' mathematical resilience in mathematics learning and it is recommended that teachers provide more practice time for students to familiarize themselves with the use of graphic organizers as a tool for solving mathematical problems.

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