STUDENT'S MATHEMATICAL PROBLEM-SOLVING ABILITY WITH MATHEMATICAL RESILIENCE AND METACOGNITION SKILLS: A QUANTITATIVE ANALYSIS

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Abstrak

Beberapa hasil studi menunjukkan kemampuan pemecahan masalah siswa masih rendah, sehingga diperlukan upaya guru untuk meningkatkannya. Penelitian ini memiliki fokus untuk meningkatkan kemampuan pemecahan masalah matematis siswa berdasarkan faktor dalam diri siswa sendiri, yaitu Mathematical Resilience dan kemampuan metakognisi. Penelitian ini menggunakan pendekatan kuantitatif, dengan jenis penelitian expost facto. Populasi dalam penelitian ini adalah siswa Sekolah Dasar di Kabupaten Majalengka dengan sampel 30 orang siswa kelas V SDN Jatipamor I Kecamatan Panyingkiran. Instrumen pengumpulan data dalam penelitian ini menggunakan soal tes dan angket. Data yang telah terkumpul selanjutnya dianalisis dengan menggunakan analisis of varian. Hasil penelitian menunjukkan bahwa kemampuan pemecahan masalah siswa yang memiliki Mathematical Resilience dan metacognition skill tinggi lebih baik dibandingkan siswa yang lain. Dengan demikian dapat disimpulkan bahwa Mathematical Resilience dan metacognition skill memiliki pengaruh yang sangat besar terhadap kemampuan siswa dalam memecahkan masalah-masalah matematika. Hasil penelitian ini berkontribusi dalam memberikan informasi terkait pentingnya ketahanan matematis dan kemampuan metakognisi siswa dalam pembelajaran matematika sehingga guru di sekolah dapat memberikan perhatian khusus terhadap kedua kemampuan ini agar siswa mampu memecahkan masalah matematika.

Kata kunci: ketahanan matematika; metakognitif; pemecahan masalah matematika.

Abstract

Several studies show that students' problem-solving abilities are still low, so teacher efforts are needed to improve them. This research has a focus on improving students' mathematical problem solving abilities based on factors within the students themselves, namely Mathematical Resilience and metacognition abilities. This study uses a quantitative approach, with the type of expost facto research. The population in this study were elementary school students in Majalengka Regency with a sample of 30 fifth grade students at SDN Jatipamor I, Panyingkiran District. The data collection instrument in this study used test questions and questionnaires. The data that has been collected is then analyzed using the analysis of variance. The results showed that the problem solving abilities of students who had high Mathematical Resilience and metacognition skills were better than other students. Thus it can be concluded that Mathematical Resilience and metacognition skills have a very large influence on students' ability to solve mathematical problems. The results of this study contribute to providing information regarding the importance of mathematical resilience and students' metacognitive abilities in learning mathematics so that teachers in schools can pay special attention to these two abilities so that students are able to solve mathematical problems.

Keywords: mathematical resilience; metacognitive; mathematical problem solving.

INTRODUCTION

Problem solving in mathematics helps students to experience how to solve problems in everyday life by applying their mathematical knowledge and skills (Osman et al., 2018). Many problems in everyday life are solved using mathematics (Aljaberi & Gheith, 2016). By teaching problem solving skills, students can develop and apply their mathematical abilities in dealing with real-life problems (Gurat, 2018).

Problem solving in mathematics is an attempt to achieve certain results by applying non-standard methods, therefore it takes a lot of effort to achieve the desired results (Schoenfeld, 2013). Problem solving is considered a fundamental aspect of education (Rott, 2020; Tambunan, 2019). Problem solving helps students in dealing with real-life situations. In learning mathematics, problem solving ability is the main goal (Surya & Putri, 2017; Wilson et al., 2011). These skills help individuals in developing logical thinking and improve decision-making skills by applying logical processes such as induction and deduction, as well as applying algorithms needed to solve everyday situations. (Taplin, 2004). According to Polya (2004) in solving a problem, there are several stages that must be passed, including (1) Understanding the problem; (2) Planning a settlement strategy; (3) Implementing the settlement; (4) Re-examine the results obtained. These four stages are interrelated links. When students have difficulty at one stage it will be difficult to do the next stage.

Students need to have the ability to solve mathematical problems because it is a necessity in mathematics curricula around the world (Liljedahl et al., 2016). Problem solving abilities can help students overcome the difficulties they face to achieve the expected goals (Putri et al., 2019; Sumartini, 2018). Therefore, in mathematics learning activities the teacher needs to introduce students to mathematical problems, because by facing problems students will be required to think intensively and creatively in solving the problems they face (Elita et al., 2019).

However, several studies reveal the fact that students' mathematical problem solving abilities are still not satisfactory. Problem solving in mathematics has provided difficulties and frustrations for a large number of students (Bluman, 2004; Sharp & Shih Dennis, 2017; Verschaffel & De Corte, 1993). This condition was revealed from several previous research results, including research conducted by Arta et al. (2020), Amaliah et al. (2019) Kristianto & Rahayu (2020), Lestari et al. (2020), Nikmah et al. (2020), Psycharis & Kallia (2017), Saygılı (2017), Sejati & Koeswanti (2020), and Sintawati et al. (2020). Several studies have been conducted to seek to improve students' problem-solving abilities, including by applying appropriate learning models or strategies, such as problem-based learning (Marlina et al., 2018) (Noviantii et al., 2020) (Sariningsih & Purwasih, 2017), Realistic Mathematical Education (Febriyanti & Irawan, 2017), Creative Problem Solving Learning Model (Muhammad et al., 2018), Discovery learning model (Jana & Fahmawati, 2020), and Guided Discovery Method (Qamardhani & Surya, 2018). Other research also seeks to improve problem-solving abilities through development research, including the development of problem-based mathematics learning tools (Nasution et al., 2017) (Yustianingsih et al., 2017), Development of ethnomathematics-

based e-modules (Utami et al., 2018), Development of HOTS-based Teaching Materials (Anisah & Lastuti, 2018), and Discovery Learning-Based Mathematics Learning Device Development (Rahmiati et al., 2018).

If examined further, previous studies have made more efforts to improve mathematical problem-solving abilities by paying attention to external factors, such as the application of models, strategies, or the development of tools and learning, while internal factors have not become the attention of researchers. Even though there are many factors from within students that affect students' ability to solve mathematical problems, factors from within students include Mathematical Resilience and metacognitive abilities.

In dealing with mathematical problems, in addition to having to think at a high level, students are also required to work hard, don't give up easily, and have self-restraint. Students who have self-restraint tend to avoid feelings of anxiety and fear. Therefore, it is necessary to be diligent and tough in learning mathematics or called mathematical resilience (Johnston-Wilder & Lee, 2014). A student needs to have the ability to overcome, and improve himself from the mathematics anxiety he faces. A student needs to have Mathematical Resilience in order to be able to survive the mathematical problems they face. Having good Mathematical Resilience skills will lead to different beliefs about mathematics (Young-Loveridge, 2010).

Another aspect that students need to have to be able to solve mathematical problems is metacognition ability. Peña-Ayala & Cárdenas (2015) explained that cognition means to know, and elaborated on this by suggesting cognition involves an individual's perception and comprehension of the world, and how he/she behaves in that context. Metacognition is a form of ability to look at himself so that what he does can be controlled optimally (Abrar, 2018; Iskandar, 2014; Wicaksono & Akhdinirwanto, 2013). With this kind of ability, it is possible for a person to have a high ability to solve problems. The success of students in solving problem solving, among other things, really depends on their awareness of what students know and how to do it (Pujiank et al., 2016). Students with good metacognitive abilities can know themselves as individuals who learn and how they control and adjust their behavior. Students need to be aware of their strengths and weaknesses.

RESEARCH METHODS

This study uses a quantitative approach, namely the scientific approach used to view a reality that can be classified, concrete, observable and measurable, the relationship of the variables is causal where the research data is in the form of numbers and the analysis uses statistics. This research is ex post facto, because in the study no treatment or manipulation was made on the research variables, but only the symptoms that had occurred to the respondents before this research was conducted. In other words, in this study no experimental class was given treatment, but students were directly given a test to measure the research variables, namely mathematical problem solving ability, mathematical resilience, and metacognition ability.

The population in this study were elementary school students in Majalengka Regency. The sample in this study was selected randomly by purposive sampling technique. With this sampling technique, the sample in this

study was 30 students of class V at SDN Jatiapmor I, Panyingkiran District.

Data collection techniques used in this study were tests and questionnaires. The test is given to students in the form of non-routine description questions to determine students' ability to solve mathematical problems. The questionnaire was given to students to find out the mathematical resistance and cognitive abilities of students. The data from the questionnaire results of mathematical endurance and students' cognitive abilities were classified into three categories of high, medium, and low. The data on the results of the mathematical problem solving ability test were analyzed based on the level of mathematical resilience and metacognition skills using the analysis of variance.

RESULTS AND DISCUSSION

The data from this study were obtained from the score of the problem-solving ability test through the provision of questions. Problem solving ability test questions are designed to use contextual problems to measure students' ability to solve non-routine

problems. Before analyzing the results of non-routine problem tests, students are first distributed based on the level of mathematical resilience and metacognition skills, namely high, medium, and low levels. Based on the measurement results of mathematical resilience and metacognition skills, data on the number of students was obtained based on the level of mathematical resilience and metacognition skills in high, medium, and low categories as can be seen in Table 1.

Table 1. The number of students based on the level of mathematical resilience and metacognition skills

Variabel	Level	N
Mathematical Resilience	high	9
	medium	10
	low	11
Metacognition s skill	high	8
	medium	13
	low	9

The results of the mathematical problem solving ability test, based on each level of mathematical resilience and metacognition skills, are descriptively presented in Table 2.

Table 2. Results of mathematical problem solving ability tests based on the level of mathematical resilience and metacognition skills

Mathematical Resilience	Metacognition skill	Mean	Std. Deviation	N
High	High	89.8000	1.30384	5
	Medium	80.5000	4.43471	4
	Total	85.6667	5.67891	9
Medium	High	83.5000	2.12132	2
	Medium	80.4000	2.19089	5
	Low	78.3333	1.52753	3
	Total	80.4000	2.59058	10
Low	High	80.0000	.	1
	Medium	78.7500	.95743	4
	Low	72.8333	3.43026	6
	Total	75.6364	4.08100	11
Total	High	87.0000	4.20883	8
	Medium	79.9231	2.72218	13
	Low	74.6667	3.93700	9
	Total	80.2333	5.82316	30

From the data presented in Table 2, it can be seen that the average result of the highest mathematical problem solving ability of 89.8000 was obtained by the group of students with high Mathematical Resilience and high metacognition skills. There is also the lowest average test result is 72.8333 obtained by the group of students with low levels in Mathematical Resilience and metacognition skills. From these results, it is known that the group of students who have high mathematical resilience and metacognitive ability with the highest score obtained high math problem solving ability test results as well. On the other hand, the group of students with low math resistance and metacognitive ability got the lowest test results. Thus, descriptively, mathematical resilience and metacognitive ability affect students' ability to solve non-routine math problems.

To determine the effect of Mathematical Resilience and metacognition skills on students' problem solving abilities, a two-way analysis of variance was performed. The results of the two-way analysis of variance data processing are presented in Table 3.

Table 3. Analisis of varian

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
resilience	113.050	2	56.525	7.984	.002
metacogition	136.585	2	68.292	9.646	.001
resilience * metacogition	70.539	3	23.513	3.321	.039

Based on Table 3, it can be seen that the mathematical problem solving ability of students with mathematical resilience obtained a p-value (sig) of $0.002 < 0.05$, so there are differences in students' mathematical problem solving abilities based on mathematical resilience levels (high, medium, and low). Students with high mathematical resilience get the highest average scores compared to medium and low levels. Thus, the problem solving ability of students with high mathematical resilience is better than that of medium and low mathematical resilience.

Students' mathematical problem solving abilities with metacognition skills obtained p-value (sig) of $0.001 < 0.05$, so there are differences in students' mathematical problem solving abilities based on metacognition skill levels (high, medium, and low). Students with high metacognition skills get the highest average scores compared to medium and low levels. Thus the problem solving ability of students with high metacognition skills is better than those with medium or low metacognition skills.

The interaction between Mathematical Resilience and metacognition skills on mathematical problem solving abilities obtained p-value (sig) of $0.039 < 0.05$, so there is an interaction between Mathematical Resilience and metacognition skills on mathematical problem solving abilities. The existence of this interaction shows that Mathematical Resilience and metacognition skills together have a significant influence on students' mathematical problem solving abilities.

From the results of the answers of students who have high Mathematical Resilience and metacognition skills, the difficulties experienced are not too

significant when compared to the answers of students who have low Mathematical Resilience and metacognition skills. Students who have high resilience and metacognition skills are able to answer mathematical problem solving ability tests well and achieve systematic steps in solving problems. They are able to explain the steps for solving problems on each question they have worked on confidently, clearly and in detail. The results of the answers of students who have low Mathematical Resilience and metacognition skills have difficulty in understanding the problems that exist in the questions and determine strategies to solve problems, this is due to a lack of understanding/mastery of concepts in the material being tested and students cannot solve these problems in accordance with the procedure. the solution. The lack of mastery of this concept causes students to fill in the formula that they think is right without thinking about whether the answer is right or wrong. They are less skilled in answering mathematical problem solving tests, this is evidenced by their lack of accuracy in answering questions, they tend to give up when faced with difficult questions and are reluctant to check again if they believe that the questions they are doing are wrong. Some questions haven't even reached systematic steps in solving problems.

From the results of the study, it was found that Mathematical Resilience had an effect on increasing students' problem solving abilities. This is because students who have self-restraint tend to avoid math anxiety so that they get better results in solving non-routine questions. This is in accordance with research conducted by Johnston-Wilder et al. (2015) which states that students who have resilience are more effective when facing difficulties in mathematics. This finding also supports research conducted by Attami et al. (2020) which states that students with high levels of mathematical resilience are able to face and overcome challenges and negative situations related to the problem solving process because they are able to train themselves. In addition, metacognition skills also affect the improvement of students' problem solving abilities. This is in accordance with research of (Alzahrani, 2021) which states that metacognition must be prioritized to increase students' awareness of the learning process. This is because conscious reflection allows students to develop the ability to choose the most appropriate strategy for solving mathematical problems. This finding also supports the results of research by Anandaraj & Ramesh (2014), (Kozikoğlu, 2019) and (Sümen & Çalışıcı, 2016) which states that metacognitive skills have a close relationship with mathematical problem solving abilities.

CONCLUSION AND SUGGESTION

Based on the research' results, it shows that the problem-solving abilities of students who have high mathematical resilience and metacognition skills are better than other students. It can be concluded that Mathematical Resilience and metacognition skills have a very large influence on students' ability to solve mathematical problems.

Basically there are many other factors in students that can improve the ability to solve mathematical problems, this study has not revealed all of these factors. Therefore, suggestions for further research is to conduct research on other factors in students that can affect mathematical problem solving abilities.

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