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Analysis Mathematical Resilience Relationship With Mathematical Problem Solving Ability in Functions Derivative Material

(A case study at the Eleventh Grade of SMAN 1 Klari in teh Academic Year 2022/2023)

Nurhayati*
Mathematics Education Department, Faculty of Educations and Teacher's Training, Universitas Subang
nurhayati@unsub.ac.id
*corresponding author

Abstrak

This study is a correlational research aimed at exploring the relationship between mathematical resilience and problem-solving skills in mathematics. Conducted at a senior high school in Karawang, the research involved a sample of 36 students. The method employed was ex post facto, with purposive sampling to select participants based on specific criteria. The instruments used included a test on mathematical problem-solving abilities focused on derivative functions and a scale measuring mathematical resilience. Findings revealed a significant correlation of 0.819 between mathematical resilience and problem-solving abilities, while a correlation of 0.181 was attributed to other factors like conceptual understanding. Students with strong resilience and a solid grasp of concepts typically find it easier to tackle mathematical problems. Conversely, those with weaker resilience and limited understanding of the concepts struggle to comprehend the questions and develop effective strategies, leading to lower problem-solving capabilities. In conclusion, a notable relationship exists between mathematical resilience and students' ability to solve mathematical problems.

Keywords: *Mathematical Problem Solving Ability; Mathematics Resilience*

Abstract

Penelitian ini adalah studi kualitatif yang bertujuan untuk menggambarkan hubungan antara resiliensi matematis dan kemampuan pemecahan masalah matematis. Dilaksanakan di salah satu SMA di Karawang, penelitian ini melibatkan 36 siswa sebagai sampel. Metode yang digunakan adalah ex post facto, dengan pemilihan sampel melalui teknik purposive sampling, yang memungkinkan peneliti memilih berdasarkan pertimbangan tertentu. Instrumen yang digunakan meliputi tes kemampuan pemecahan masalah pada materi turunan fungsi dan kuesioner resiliensi matematis. Hasil penelitian menunjukkan adanya hubungan signifikan sebesar 0,819 antara resiliensi matematis dan kemampuan pemecahan masalah siswa, sementara nilai 0,181 dipengaruhi oleh faktor lain seperti pemahaman dan penguasaan konsep. Siswa yang memiliki resiliensi tinggi dan pemahaman konsep yang baik tidak mengalami kesulitan dalam menyelesaikan soal matematika. Sebaliknya, siswa dengan resiliensi yang lebih rendah dan kurangnya penguasaan konsep akan kesulitan memahami soal, sehingga sulit menentukan strategi yang tepat untuk menyelesaikannya. Hal ini mengakibatkan mereka tidak mampu menyelesaikan masalah matematika sesuai dengan langkah-langkah yang benar, yang berarti kemampuan pemecahan masalah mereka rendah. Kesimpulannya, terdapat hubungan signifikan antara resiliensi matematis dan kemampuan pemecahan masalah matematis siswa.

Kata Kunci: *Kemampuan Pemecahan Masalah Matematis; Resilience Matematis*

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INTRODUCTION

The current focus of Indonesian education is on enhancing character education. This approach aims to strengthen students' character by harmonizing aspects of the heart (ethics and spirituality), feelings (aesthetics), the mind (literacy and numeracy), and physical activity (kinesthetics), all in line

with the Pancasila philosophy. Character education is viewed as a solution for equipping students with 21st-century skills, such as critical thinking and problem-solving. Mathematics, in particular, plays a key role in developing problem-solving abilities, aligning with Orton's view that problem-solving is a crucial objective in mathematics education, especially in tackling non-routine problems.

Problem-solving skills are a central focus in the Indonesian mathematics curriculum. This is evident from the 2016 national senior high school mathematics exam, where 75% of the questions involved problem-solving. Mathematics at the senior high school level is more complex than at the kindergarten, elementary, and junior high levels because students at this stage have entered the formal operations phase of thinking. This phase enables higher-level thinking, which requires strong problem-solving skills. However, despite this emphasis, the national exam results for senior high schools (SMA/MA) in 2016 showed a decline, with the average score dropping from 61.29 to 54.78.

Another notable fact is the average score of 35.84 in the 2022/2023 national exam for mathematics at a senior high school in Karawang, which falls far below expectations. According to a mathematics teacher, many students struggle with mathematical problem-solving tasks. Their difficulties are evident in the errors made during the problem-solving process. Students face various challenges, including trouble understanding the problem, identifying known and unknown elements, translating situations into mathematical language, selecting strategies, and executing those strategies. These issues indicate that students' mathematical problem-solving abilities are quite low.

Mathematical problem-solving is a crucial skill that students need to master in mathematics education. Branca, as cited by Hendriana, explains that mathematical problem-solving encompasses methods, procedures, and strategies, which are the core of the mathematics curriculum and fundamental skills in learning math. This skill enables students to think analytically, critically, creatively, and enhances other mathematical abilities. While some experts refer to problem-solving strategies as indicators, others argue that these are actually steps in mathematical problem-solving, as a single indicator cannot fully represent the entire skill. The steps of mathematical problem-solving are: 1) Understanding the problem (identifying known and unknown elements, creating mathematical models); 2) Choosing a strategy; 3) Applying the strategy; and 4) Verifying the solution.

Recent research has linked both cognitive and affective factors in mathematics teaching, particularly in relation to problem-solving. Affective factors that have been specifically noted include interest, motivation, pressure, anxiety, stress, and perseverance. Generally, the affective elements that influence problem-solving activities are confidence, attitudes, and emotions. Students must believe that their abilities are not fixed and can improve. Attitude plays a significant role in mathematics learning—what students think about mathematics affects their feelings and, in turn, their actions. Students with a negative attitude toward mathematics or its instruction tend to resist and avoid math-related tasks. On the other hand, a positive attitude fosters interest, satisfaction, perseverance, and curiosity. Emotions such as anxiety and frustration during math lessons can affect learning outcomes. Since the 1980s, Charles and Lester have observed that successful problem-solving activities require low levels of motivation-related stress and anxiety for solutions to progress effectively.

Research by Kooken J., Mccoach D.B., and Weish M.E. suggests that mathematical resilience plays a more significant role than other factors in learning mathematics. Mathematical resilience refers to a positive, adaptive mindset and determination to persist in learning math, even when faced with difficulties or obstacles. Students with strong mathematical resilience tend to develop perseverance and persistence when encountering challenges, while those with low resilience may easily give up. According to Sumarmo, the indicators of mathematical resilience include: a) Demonstrating diligence, confidence, hard work, and persistence in facing problems, failures, and uncertainties; b) Showing a willingness to socialize, assist others, discuss with peers, and adapt to the environment; c) Generating new ideas and seeking creative solutions; d) Using failures as a source of self-motivation; e) Displaying curiosity, reflection, research, and utilizing various

resources; and f) Having language skills, self-control, and emotional awareness. Based on this, the objectives of this study are: 1) To analyze the relationship between mathematical resilience and problem-solving ability in mathematics, and 2) To examine the difficulties students face when solving problems related to derivative functions. The study aims to provide an overview of the correlation between mathematical resilience and problem-solving abilities among senior high school students, as well as to identify the causes of their difficulties in solving mathematical problems.

METHODS

This research was conducted at SMAN I Klari Karawang with a sample of 36 students from class XI science. The research procedure involved several stages: planning, implementation, data collection and analysis, and reporting. In the planning stage, the researcher developed a mathematical problem-solving ability test consisting of six items, created a mathematical resilience scale with 40 statements, and tested the instruments. During the implementation phase, students took the problem-solving ability test and completed the mathematical resilience questionnaire. The next stage involved collecting and analyzing the data, followed by drawing conclusions based on the results. The final step was to compile a written report of the findings.

This research is correlational in nature, using an ex post facto method. The sample was selected through purposive sampling, allowing the researcher to choose participants based on specific criteria. To examine the relationship between mathematical resilience and students' problem-solving abilities, a correlation test was conducted. Additionally, the analysis of students' difficulties in solving mathematical problems was carried out by reviewing and describing their answer sheets.

FINDINGS AND DISCUSSION

The research was carried out in the Eleventh Accounting class from March to May 2023. As mentioned in the previous chapter, this study utilized a case study approach to explore the relationship between mathematical resilience and students' problem-solving abilities in the topic of derivative functions. The results were based on scores obtained from the mathematical problem-solving ability test and the mathematical resilience scale. The sample consisted of 36 students. To determine the relationship between mathematical resilience and problem-solving ability, a correlation test was conducted using SPSS 23, as detailed below:

Table 1: Correlation Test Results
Mathematical Resilience to Students' Mathematical Problem Solving Ability

		Mathematical Resilience	Mathematical Problem Solving Ability
Mathematical Resilience	Person Correlation	1	,819**
	Sig. (2-tailed)		,000
	N	36	36
Mathematical Problem Solving Ability	Person Correlation	,819**	1
	Sig. (2-tailed)	,000	
	N	36	36

hypothesis:

H_o : There is not relationship between mathematical resilience and students' mathematical problem solving ability

H_a : There is a relationship between mathematical resilience and students' mathematical problem solving ability

To test the hypothesis by determining a significant level $\alpha = 0.05$ and 2-tailed test the correlation criteria as follows [10]:

If sig > 0.05 then H_o is accepted

If sig < 0.05 then H_o is rejected

The table shows that "N" represents a total sample of 36 participants. The significance value (Sig. 2-tailed) is 0.000, which is less than 0.05, meaning the null hypothesis (Ho) is rejected. This indicates that there is a significant relationship between mathematical resilience and students' mathematical problem-solving ability. The strength of this relationship is shown by the Pearson Correlation coefficient, which is 0.819**. This suggests a strong and significant correlation of 0.819 between mathematical resilience and students' problem-solving abilities.

The relationship between mathematical resilience and mathematical problem solving ability affects the process of mathematical problem solving. Students who have strong resilience can solve the problems faced correctly. Conversely, students who have resilience that is not optimal (not strong) will have difficulty in mathematical problem solving. The difficulties of students in mathematical problem solving can be described by looking at students' answer sheets.

For example, in solving problem number 1, the steps taken by the students include sketching the scenario presented in the question, identifying the known and unknown elements, creating a mathematical model, applying the relevant concepts or formulas to find a solution, and then verifying the accuracy of the obtained answer.

Picture 1. Answers of students who give up

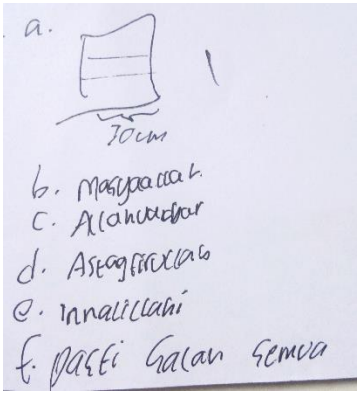

Figure 1 illustrates students with weak resilience, as evidenced by their negative attitudes when confronted with mathematical problems. These students often display rejection and avoidance behaviors, particularly when faced with questions that require reasoning and problem-solving skills. Their responses indicate feelings of frustration and a tendency to give up on the tasks. As a result, they struggle to identify the known and unknown elements and fail to determine appropriate strategies for solving the problems. Therefore, students who experience quitting, stress, and frustration face difficulties in mathematical problem-solving. In summary, students with low mathematical resilience also exhibit low problem-solving abilities.

Picture 2. Answer students who have difficulty

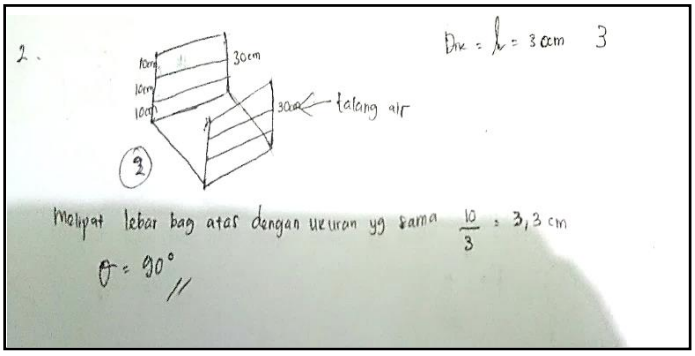

Figure 2 depicts students who exhibit suboptimal resilience but maintain a positive attitude by attempting to identify the known and unknown elements, sketching the scenario presented in the question, and determining a solution strategy. However, their answers are still incorrect. This can be attributed to their lack of understanding of the problem and insufficient preparation for the exam. Without a solid grasp of the concepts being tested, they perceive the problems as difficult to solve, leading to inappropriate problem-solving steps. Consequently, for students with limited resilience and a lack of mastery over the tested material, their mathematical problem-solving abilities remain low, as they struggle to arrive at correct solutions.

Picture 3. Correct student answers

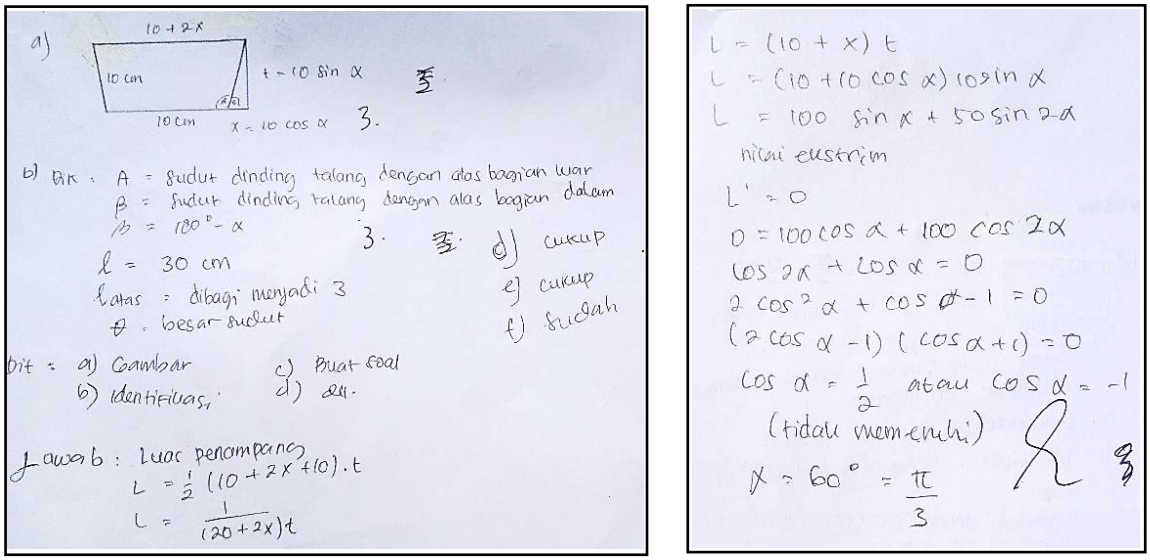

Figure 3 illustrates students with strong resilience who have a solid understanding of the concepts being tested. These students demonstrate high procedural ability and persistence when tackling the assigned problems. This is evident in their step-by-step approach to problem-solving, which includes sketching the scenario, identifying known and unknown elements, selecting an appropriate solution strategy, and applying that strategy to solve the problem. However, they do not check the accuracy of their solutions, likely due to a lack of experience in solving similar problems. This indicates that students with strong resilience and a good grasp of the material tend to excel in mathematical problem-solving.

The results indicated a significant relationship of 0.819 between mathematical resilience and students' problem-solving abilities, with an additional 0.181 attributable to other factors such as understanding and mastery of concepts. Students who possess strong resilience and a solid grasp of concepts face no difficulties in solving assigned problems. Conversely, those with weak mathematical resilience and insufficient mastery of the tested material struggle to comprehend the problems and often find it challenging to select appropriate strategies for resolution. As a result, they fail to follow the correct steps for solving the problems, leading to low mathematical problem-solving abilities.

The findings of this study align with the research conducted by Kooken et al. (2013), which suggests that mathematical resilience is influenced by how students respond to the challenges they face while learning mathematics. These difficulties can manifest in various ways, such as a lack of understanding of mathematical concepts, student boredom, embarrassment from poor performance, inadequate curriculum quality, limited supportive interactions, the belief that they can only memorize mathematical procedures, and performance anxiety during classes or exams. Johnston-Wilder and Lee (2010) identify four factors that contribute to mathematical resilience: 1) Belief in the importance of mathematics; 2) Perseverance and a willingness to learn despite challenges; 3) Confidence in the ability to improve through support from peers, resources, and experience; and 4) An attitude of persistence, determination, and consistently positive responses in mathematics learning.

CONCLUSION AND SUGGESTION

Based on research conducted at a senior high school in Karawang, it can be concluded that there is a significant relationship between mathematical resilience and students' problem-solving abilities regarding derivative functions. Students with strong resilience demonstrate high mathematical problem-solving skills. In contrast, those with suboptimal resilience tend to have lower problem-solving abilities. An analysis of the difficulties faced by students in problem-solving revealed that other factors, particularly their readiness for the exam, also contributed to their challenges. This lack of preparedness resulted in insufficient understanding and mastery of the fundamental concepts related to the material on derivative functions.

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