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ANALYSIS OF STUDENTS DIFFICULTIES IN MATHEMATICS PROBLEM-SOLVING ABILITY ON NUMBER PATTERN MATERIAL

Nur Mahsarah Rahadatul Aisy*, Mulyono, and Walid
Master of Mathematics Education, Postgraduate Program, Universitas Negeri Semarang, Semarang, Indonesia
*Email: nurmahsarahaisy@gmail.com

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Abstract: This research aims to analyze and describe students' difficulties in solving mathematical problem-solving abilities on number pattern material. The research method is qualitative research, with the research subjects being grade eight students in one of the schools in the city of Semarang in the academic year 2022/2023. The research instrument was in the form of a mathematical problem-solving ability test and interviews. The mathematical problem-solving ability test indicator uses the indicators proposed by NCTM, with the stages of problem-solving according to Polya. The results showed that students with the concept difficulty type could only understand the problem. The student with the principal difficulty type could carry out the strategy planning stage. Finally, the students with the conceptual difficulty type have been able to implement the stage of planning strategies in solving mathematical problems.

Keywords: *Students Difficulty, Mathematics Problem-Solving Ability*

INTRODUCTION

The implementation of good education will affect the considerations and points of view to deal with a problem faced by a person. Learning mathematics will train someone from an early age to improve various abilities. They can become the best version of individuals themselves while learning mathematics is the main focus in schools because it influences the progress of education and technology [1].

Solving mathematical problems has been one of the problems in learning mathematics since the 20th century. It was increasingly seen in 1973, mathematician George Polya revealed four stages of problem-solving, which are generally still the basis in the stages of solving mathematical problems, while stages of understanding the problem, planning strategies, implementing strategies, and looking back [2]. Then in 1990, Singapore made a policy that the core school mathematics curriculum in the country was problem-solving based. Then in 2000, in the United States, the National Council of Teachers of Mathematics (NCTM) also revealed that the mathematics curriculum focused on problem-solving [3–6]. Thus, Mathematics Problem-Solving Ability (MPSA) is in the spotlight of learning in the world.

Ironically, the level of mathematical problem-solving ability based on several previous studies is still low. The cause of low mathematical problem-solving abilities is various difficulties experienced by students, including students who did not have readiness. They were wrong in planning mathematical problem-solving, did not apply the formula correctly, and did not carry out the problem-solving process. Some solve the problem by applying the wrong concept. The difficulties experienced by students can result in errors in solving problems [7]. Students made mistakes in transforming mathematical models, doing the counting process, making wrong conclusions, and not being able to determine the settlement strategy and were wrong in compiling a mathematical model regarding the related material in the study [8-9]. It is a condition that deserves further attention.

There are many types of learning difficulties, each of which requires a different diagnosis or characteristic. Student's difficulties in mathematics are weakness in counting, difficulty in transferring knowledge, difficulty understanding language in mathematics, and difficulty in visual perception. Student difficulties can also be identified from errors in student work, generally in the form of errors in understanding symbols, place values (such as units, tens, hundreds, and so on), incorrect processes, or calculations [10].

According to Cooney, other types of difficulty classification are difficulties in using concepts, difficulties in applying principles, and difficulties related to verbal problems. Concept difficulties are indicated when students incorrectly remember names or symbols, cannot interpret statements that represent a mathematical concept and vice versa, cannot classify mathematical objects on a certain criterion, and cannot take advantage of the mathematical concepts provided to find related information. Principle difficulties are indicated when students cannot use algebraic operations and are not careful in counting, cannot find factors related to the problem that results in incorrectly abstracting patterns formed, and cannot express and apply a principle in solving mathematical problems. Verbal problem difficulties are indicated when students cannot take advantage of the knowledge that has been learned and do not know specific terms related to learning materials [11-12].

Students solving mathematical problems must be done systematically and structured, which will help improve students' thinking levels because the higher a student's thinking level, the student's problem-solving ability will also increases [13]. Learning habits that

focus on problem-solving improve mathematical problem-solving ability and other mathematical abilities, such as critical thinking [14]. That learning habits will also help students to find solutions well because the thinking process and student work results are clear and will focus on the problem to be solved. So, it takes teaching and habituation in the learning process to solve mathematic problems. It is because the students have been taught about problem-solving, but in practice, generally, students only use one solution strategy for various problems [15].

Based on the description above, the researcher is interested in researching the analysis of students' difficulties in mathematics problem-solving ability on number pattern material.

RESEARCH METHOD

The research method used is qualitative research with a grounded theory approach, meaning that the research aims to explain a series of processes, events, actions, activities, and educational interactions within a certain time span [16]. The research subjects are class VIII students in one of the public junior high schools in Semarang City for the 2022/2023 academic year. The technique of taking research subjects used a purposive sampling technique, taking and selecting subjects based on certain considerations or goals. Three students had difficulty with the highest percentage for each type of difficulty. The classification of types of difficulties that will be analyzed further is the type of concept difficulty, principle difficulty, and verbal problem difficulty.

Data collection techniques are in the form of tests and interviews. The test is in the form of 6 essay questions which are arranged based on indicators of problem-solving ability according to NCTM, which are: (1) constructing new knowledge based on mathematical problem solving; (2) solving problems in mathematics and other fields; (3) apply and adapt related to various mathematical problem-solving strategies; (4) apply the process of mathematical problem-solving stages. Based on the MPSA test, the students with the highest percentage of difficulties will be analyzed, and the students with the most difficulties will be analyzed further. The interviews have conducted to clarify the difficulties experienced by students in solving mathematical problems [4].

The data analysis technique used in the study is reducing, presenting, and concluding or verifying research data [17]. The stage of reducing research data is summarizing, sorting, and focusing on the important things to find themes from research data that are useful for classifying data. At this stage, an examination of the results of student work is carried out, identifying the types of difficulties experienced by students, conducting interviews with students who experienced the highest level of difficulty percentage for each type of difficulty, and coding the subject with a symbol or initials of the name of the research subject. Presenting research data is done by describing in the form of a description of students' difficulties and students' mathematical problem-solving abilities. Summarizing or verifying research data aims to get answers to problems in research.

RESULT AND DISCUSSION

A test of MPSA was given to the research class. Then the test results continued to be analyzed, and selected research subjects with the highest percentage level for each type of difficulty were. This study's percentage level of student difficulty is as follows [18].

$$P = \frac{n}{N} \times 100\%$$

Description:
P: Percentage of difficulty;
n: the number of difficulties experienced by students;
N: The highest number of difficulties in problem-solving.

The following is a recapitulation of the MPSA test results given to one research class based on the type of difficulty shown in Table 1 and the number of students' percentage based on difficulty type in solving mathematic problems shown in Figure 1.

Table 1 shows that the highest percentage of difficulty in the type of concept difficulty is in question number 4, with the indicator of mathematical problem-solving ability being to apply and adapt related to various strategies for solving mathematical problems. The lowest percentage of difficulty is in question number 2, with an indicator of mathematical problem-solving ability in solving problems in mathematics and other fields. The principle difficulty type obtained the highest percentage of difficulty in question number 5 with the indicator of mathematical problem-solving ability to apply the process of mathematical problem-solving stages. The lowest percentage of difficulty in problem number 1, with an indicator of mathematical problem-solving ability, is constructing new knowledge based on mathematical problem-solving. The type of verbal problem difficulty obtained the highest percentage of difficulty in question number 6 with an indicator of mathematical problem-solving ability is to apply the process of mathematical problem-solving stages, and the lowest percentage of difficulty in question number 1 with indicators of mathematical problem-solving ability are questions number 2 and 3, for the indicator of question number 2 is solving problems in mathematics and other fields. The indicator of question number 3 is to apply and adapt related to various strategies to solve mathematical problems. Thus, it will be analyzed further for the three questions with the highest difficulty percentage based on the type of difficulty, with the selected research subjects being the subjects experiencing the percentage level of difficulty in solving mathematical problems.

Table 1. Recapitulation of the Percentage of Students Identified as Having Difficulty Types

Difficulty Type	Recapitulation Students Based on Difficulty Type											
	Question Number 1	%	Question Number 2	%	Question Number 3	%	Question Number 4	%	Question Number 5	%	Question Number 6	%
Concept	8	25	5	16	10	31	19	59	6	19	15	47
Principle	8	25	16	50	15	47	16	50	22	69	20	63
Verbal Problem	6	19	5	16	5	16	7	22	8	25	19	59

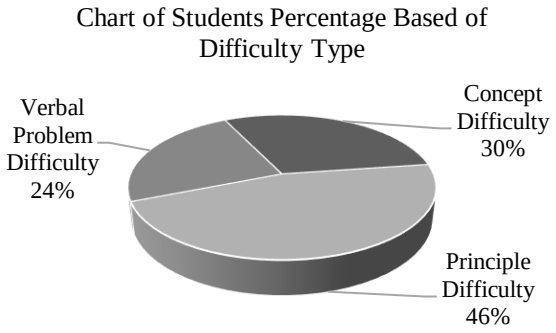


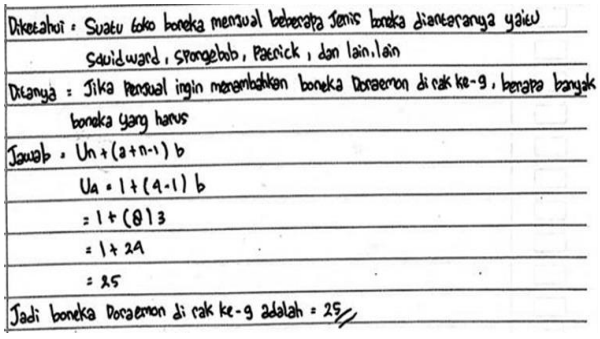
Figure 1. Chart of Students Percentage Based on Difficulty Type in Solving Mathematic Problems

Figure 1 shows that the percentage of many students based on the type of difficulty in solving mathematical problems is obtained by the principle difficulty type, by 46%. Meanwhile, the lowest percentage was obtained by the kind of verbal problem and concept difficulty, 25% and 30%, respectively.

The results and discussion based on the type of difficulty with the highest percentage at each problem-solving stage are as follows.

1. Concept difficulty types

The result of the MPSA test work for subject E-18 can be seen in Figure 2 below.



Translation into English from the Figure 2.
Given: A doll shop sells several types of dolls, including Squidward, Spongebob, Patrick, and others.
Question: If the seller wants to add Doraemon dolls on the 9th shelf, how many dolls should be
Answer : (worked using formulas and strategies chosen by the subject)
So, the Doraemon dolls on the 9th shelf are = 25.

Figure 2. Subject Work of Concept Difficulty Types

Figure 2 shows that the researchers identified the difficulties and abilities of the subject at each stage of problem-solving as follows:

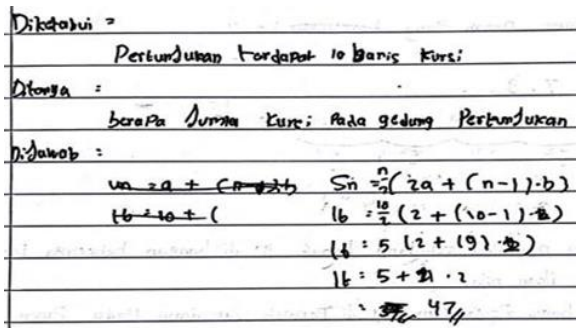
a. In the stage of understanding the problem, it was identified that students find it difficult to determine the elements of the number sequence that are known and asked. It is difficult to understand the meaning of the images presented in the problem. It is difficult to understand the meaning of the problem.
b. In the strategy planning stage, it was identified that students find it difficult to relate the information they know to the questions to be used to choose the right strategy.
c. In the strategy implementation stage, it was identified that the student could not carry out the right strategy, and the strategy chosen on the answer sheet still contained errors.
d. In the stage of looking back, it was identified that students could write down the conclusions of the strategy that the subject used even though it was still not right.

Then an interview was conducted with the subject of E-18 to clarify the difficulties and abilities of students in solving mathematical problems. Based on the interviews, it was found that subject could name and state the problem by giving repeated questions to make sure the subject understood the problem. In the planning stage of the strategy, the subject still had difficulty determining the line of numbers formed based on the image on the question. During the interview, the subject realized he had used the wrong problem-solving strategy.

So, the subject experienced conceptual difficulties because the subject could not write down the information that was known and needed to be searched based on the pictures and problems related to the problem, could not determine and write symbols related to the number pattern element, was unable to substitute the number pattern element and was unable to determine and plan a solution strategy appropriately.

2. Principle difficulty types

The result of the MPSA test works for subject E-22 can be seen in Figure 3 below.



Translation into English from the Figure 3.
Given: The theater has ten rows of seats.
Question: How many seats are in the theater?
Answer : (worked using formulas and strategies chosen by the subject).

Figure 3. Subject Work of Principle Difficulty Types

Figure 3 shows that the researcher identified the difficulties and abilities of the subject at each stage of problem-solving as follows:

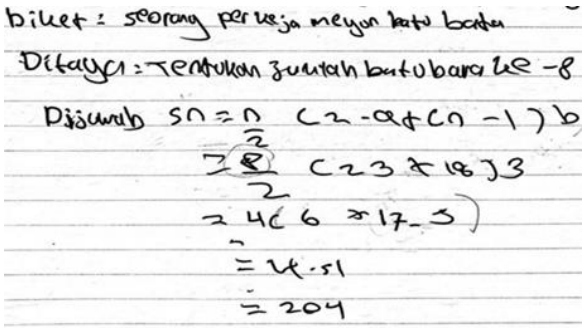
a. In the stage of understanding the problem, it was identified that the student could not write down information that was known and asked.
b. In the strategy planning stage, difficulties were identified in determining the right formula to answer the problem and the inability to correctly write or use the properties of arithmetic operations.
c. In the stage of implementing the strategy, was identified difficulties in completing and carrying out calculations. It was because the student was wrong in substituting the elements of the number sequence and known to the problem.
d. The stage of looking back was identified as not being carried out because there was an error in substituting the number sequence element, and the subject did not conclude the answers he received.

Then an interview was conducted with the subject of E-22 to clarify the difficulties and abilities of the subject in solving mathematical problems. It was found that subject had conceptual difficulties because the subject did not understand the elements of a number sequence and was able to determine the right formula to be set as a problem-solving strategy, the subject was not able to use the nature of arithmetic operations well, and not able to perform calculations with correct, unable to substitute known arithmetic sequence elements. It did not look back even though the subject had said and concluded their answers at the time of the interview.

So, the subject experienced principle difficulties because the subject made an error using the nature of arithmetic operations, was wrong in performing calculations, and could not determine the relevant factors, so they did not make a number sequence to help solve the problem.

3. Verbal problem difficulty types

The results of the MPSA test work for subject E-04 can be seen in Figure 4 below.



Translation into English from the Figure 4.
Given: A worker lays bricks.
Question: Determine the number of bricks in the 8th order.
Answer : (worked using formulas and strategies chosen by the subject).

Figure 4. Subject Work of Verbal Problem Difficulty Types

Based on the results of the work in Figure 4, the researcher identified the difficulties and abilities of the subject at each stage of problem-solving as follows:

a. In the stage of understanding the problem, it was identified that subject had not been able to write information on the questions completely and did not write down the elements of the number sequence at this stage.
b. In the strategy planning stage, it was identified that subject unable to write mathematical symbols and number pattern element symbols in the formulas chosen correctly and completely.
c. In the stage of implementing the strategy, was identified difficulties in using the nature of arithmetic operations and did not complete calculations correctly.
d. In the stage of looking back, it was identified that subject did not reread the questions, processes, and results obtained, resulting in errors in calculations in the process of solving problems. The subject also did not write down the conclusion of the answer based on the results of the settlement strategy they were working on.

Then an interview was conducted with the subject of E-04 to clarify the difficulties and abilities of the subject in solving mathematical problems. Based on the interviews conducted, it was found that subjects had difficulty with verbal problems because they did not understand the problem well. Several questions it is needed to convince the subject to understand the problem. The subject also clarified that they did not re-check, did not reread the questions, processes, and results of the work, and did not know other ways to solve problems.

Based on the analysis and description of students' difficulties and mathematical problem-solving abilities, it can be seen that students with the type of concept difficulty have not been able to solve

mathematical problems because they do not carry out every stage of solving mathematical problems. Meanwhile, at the stage of understanding the problem, the subject who has conceptual difficulties has not been able to write but can mention and identify the elements of a number sequence that are known and asked at the time of the interview, so it can be said that subject was able to understand the problem. In the planning stage of the strategy, the subject had difficulty and incorrectly identified the configuration of the object in the problem, resulting in a mistake in determining the completion plan in the stage of implementing the plan, even though using a wrong strategic plan, subject also had not been able to write and apply mathematical symbols correctly. In looking backstage, the subject has written conclusions from the results of work and reread the questions and the working process but did not work in other ways that can check the solutions to the problems they are working on. So, students with conceptual difficulties have not been able to solve problems with indicators of applying and adapting related to various strategies for solving mathematical problems. Students who are not capable of concepts are only able to determine the formula without knowing and checking whether or not the formula is appropriate as a problem-solving strategy [19]. Therefore, understanding mathematical concepts in junior high school must be considered because it will be an important prerequisite for studying mathematics at the next level of education. Understanding mathematical concepts at the junior high school level must be considered because it will be an important prerequisite for studying mathematics at the next level of education [20]. So, the students' mathematics learning process must be accustomed to using concept understanding in solving mathematical problems.

Subjects with the principle difficulty type have been unable to solve mathematical problems because they did not carry out each stage of solving them properly. At the stage of understanding the problem, the subject cannot identify, state information, and not write symbols for the elements of a number sequence that are known and asked about the problem. In the strategy planning stage, the subject has able to determine the right formula to be set as a problem-solving strategy, but this is because the subject only follows the strategy from the sample questions given by the teacher during the learning process, resulting in the subject being able to plan strategies without understanding the problem. In the stage of implementing the strategy, the subject has not been able to do this stage. This is because the subject found it difficult to apply the nature of arithmetic operations, and it was difficult to perform calculations because they incorrectly substituted the elements of a known number sequence. In looking backstage, the subject not been able to carry out this stage because it appears on the answer sheet that the subject did not write down the conclusion of the answer, and after being clarified by interviewing subject did not check the answers, processes, and results of their work. Students can plan and make strategies to solve mathematical problems but cannot implement the planned strategies [21].

Subjects with the type of verbal problem difficulty had not been able to solve mathematical problems because subjects had not carried out each stage of solving mathematical problems correctly. At the stage of understanding the problem, the subject did not write down the symbols for the elements of the number sequence related to the problem, the subject did not clearly and completely formulate the problem, and during the interview, repeated questions it is needed so that subject could explain the problem and identify the elements of the related number sequence. In the strategy planning stage, even though I could formulate a settlement plan based on clarification, it turned out that subject was only memorized without understanding the related problem. In the plan implementation stage, the subject had difficulty in the calculation process and applying the nature of arithmetic operations, which resulted in getting the wrong answer. The subject has found it difficult to re-examine because they did not know other ways or strategies to solve related problems. So, it takes initial knowledge related to number pattern material to be used to support problem-solving [22], which revealed that the initial ability that was still lacking resulted in students being less able to understand and identify mathematical problems. One of the causes of the difficulty of verbal problems is that students lack practice questions and lack of student motivation [23].

CONCLUSION

The student's difficulties in mathematics problem-solving ability on number pattern material are that students with the type of concept difficulty have been only able to carry out the understanding problem stage. Students with the principle difficulty type have been able to carry out the strategy planning stage, and students with the conceptual difficulty type have been able to implement the stage of planning strategies in solving mathematical problems.

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