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# Students' mathematical problem solving ability on the subject of function limits

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**Abstract.** This research is a qualitative descriptive study. The research subjects were three students of class XI MA Ibad Arrahman Pandeglang Regency consisting of students who have high, medium and low abilities. The purpose of this study is to analyze the students' mathematical problem-solving abilities on material limit functions. This ability is expected to be mastered by students to solve mathematical problems correctly and adequately. Data collection is done through the provision of problem-solving tests and observations then triangulation techniques are carried out to obtain valid data. The results of this study are students who are highly capable of having good mathematical solving abilities. Students who are capable of being mathematical problem-solving abilities are quite good. It's just not thorough or errors in the operation of numbers. In contrast, students with low ability have poor mathematical problem-solving skills because they cannot solve problems completely.

## 1. Introduction

"Mathematics problems are really difficult. I did not know how to do it. That's why I did not finish it. I don't like Maths". These statements are quite familiarly heard when students are inquired about their homework. They seem to be struggling with their homework, especially on mathematics problem-solving. Mathematics problem solving is not a topic, but a process underlies the whole mathematics programmes which contextually helped concepts and skills to be learned. Many mathematics skills were involved in problem-solving. However, large numbers of students have not acquired the basic skills they need in mathematics. As a result, many students were reported to face difficulties in mathematics, particularly in mathematics problem-solving. If the teaching and learning process is not equally effective for all students, the challenges in acquiring mathematic skills by the students could get worsen. Understanding students' difficulties in mathematics skills needed in problem-solving are one of the ways to assist this group of students [1].

Problem-solving ability is also one of the mathematical ability standards set by The National Council of Teachers of Mathematics (NCTM), in addition to communication, connection, reasoning, and representation [2]. This also shows that problem-solving ability is the focus of education [3].

Based on observations in the field, mathematics subjects are still less desirable by students, because there is still a suspicion that mathematics is a difficult subject and its learning is less fun for students, so students are reluctant to study mathematics deeper. So making mathematics in the school was feared and even hated by students [4]. However, on the other hand, problem-solving is a part of mathematics



learning that cannot be separated just like that [5], so we need to know which students are lacking mathematical problem-solving abilities and need to be improved.

Problem-solving is a central method of instruction in mathematics education [6], due to its importance in today's increasingly interconnected world [7]. Collaborative learning stimulates curiosity and interest and promotes pupils' creative and critical thinking and problem-solving skills, as well as their ability to understand different perspectives and phenomena [8–10]. While solving problems, the student argues, reason, and make conclusions and new inventions about mathematical contents [11]. Problem solving is categorized into two aspects, namely: how the problem is delivered-linguistic (using words) or nonlinguistic (using graphics or problem-based), and illuminating the problem-information structure, objectives and action plans [12]. There are two main procedural steps in problem-solving: transforming the problem into mathematical sentences, and computation of the operations involved in the mathematical sentences [13]. Polya stated that the steps in solving mathematical problems consist of four steps, namely: Understanding the Problem, planning the solution, solving the problem according to the plan and checking again [14]. Among the problem-solving strategies include: working backwards, finding patterns, adopting different points of view, solving problems that are simpler or analogous, considering extreme cases, making drawings, estimates and intelligent testing [15,16].

Word-problem is one of the mathematical problems that are difficult for students to solve. This is not only happening in Indonesia but also students in other countries. This happens because word-problems require students to read and understand them [17–19]. This shows that the awareness of reading comprehension is an ongoing process and continues to develop according to what the reader thinks [20]. Problem-solving requires a reading process, namely understanding reading and using mathematical knowledge, as well as the use of mathematical operations [21]. In addition, by giving students to reflect on students' learning styles when students face obstacles in mathematical Problem solving is one possible way.

One of the materials related to daily life is the function limit. Students are trained to solve a problem that has a relationship with the area and circumference of a circle, for example, students are given a problem how to find out a value of the limit of a function close to a certain value or even infinity. Most students assume the function limit material is challenging material because the material limit function is abstract material and material that has the conditions and methods to solve it.

Based on the observation of researchers at MA Ibad Arrahman Pandeglang Regency that the ability to solve the dramatic problems of students at the school is still very low. In general students at MA Ibad Arrahman do not understand the problem presented, because there are limitations in students working on routine problems. In addition, there are some students who can understand the problem and work according to the steps but do not check again, so the results are less precise. This is consistent with what was said that the ability of Indonesian students to solve problems that require the ability to examine, reason, and communicate effectively, and to answer and interpret problems in various situations is still lacking [22]. The difficulty of students in solving mathematical problems, especially in questions that require higher-level thinking is influenced by many interrelated factors, both within students and (internal) and from outside students (External). Based on the background that has been disclosed above, the researcher intends to analyze the students' problem-solving abilities based on their initial abilities on the subject of function limits.

## 2. Method

This research is descriptive qualitative research. Qualitative research methods are research methods used to examine the natural conditions of objects where researchers are as a key instrument [15]. Subjects/respondents in this study were students of class XI at MA Ibad Arrahman Pandeglang, namely three students with high ability, medium ability and low ability categories. These students are selected based on their level of mathematical ability obtained from previous learning outcomes. The selection of students was consulted with the mathematics teacher at the school. The instrument of this research was in the form of a problem-solving ability test item and an observation sheet. The indicators used in this research are understanding the problem, planning the solution, solving the problem according to plan and checking again [20]. Data collection techniques in this study were carried out using several techniques, namely observation in the form of student movements and expressions in solving problems

and document studies in the form of written tests and archives of students' report cards, especially on mathematics subjects to determine research subjects. Each student is given a test item, then analyzed to describe his ability to solve problems. The analysis technique used by researchers is to reduce data, explain or present data and draw conclusions. Researchers used the method of triangulation, which is a technique carried out by comparing the results of written tests about problem-solving with the results of observations.

### 3. Result and Discussion

The research took place at MA Ibad Arrahman Pandeglang with a research subject of three students to be given problems solving mathematical problems. After the subject is working on the problem, the next step is observation related to students' problem-solving abilities which are carried out directly by the researchers themselves.

Based on the results of the research subject, for the first indicator, all research subjects with a high ability (S1), moderate (S2) and low (S3) know the information contained in the problem and write it on the answer sheet, but only low-ability students do not write what is asked. Understanding the question is a crucial aspect in problem-solving. First of all, the question needs to be understood before the problem could be solved [15,23]. However, because of the long sentences and many information involved, students got confused about the objective in the problem [1]. In full can be seen in Figure 1:

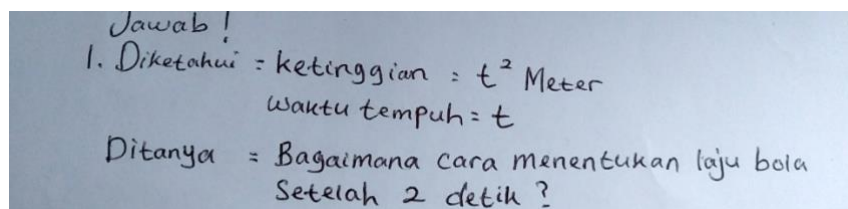


Figure 1. Indicator 1. Understand the Problem

In the second indicator, all subjects say that they plan their solution using a formula or method that has been learned, but no one writes their solution on the answer sheet. For students who have the low ability can only mention the method used to solve the problem, it's just that students cannot use the method due to lack of understanding of the material supporting the method. Low-ability students with difficulties were making decisions on how to solve the problems. Often, when the respondents have understood the problem, they still could not solve the problem [1,23,24]. In full can be seen in Figure 2:

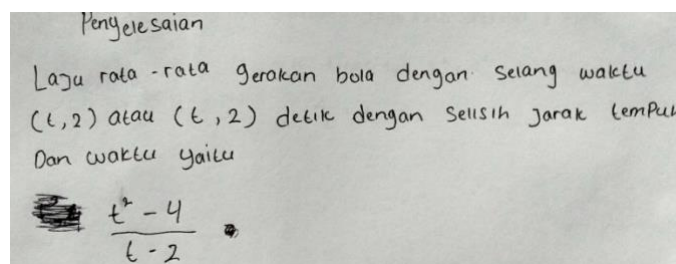


Figure 2. Indicator 2. Devising a plan

In the third indicator, students who are highly capable can solve the problem in accordance with the steps and plan for solving it. For students who are capable of being able to solve problems on the problem, it's just that there are errors in the operation of the numbers so the results are less precise. Low-ability students might also have difficulties in the third phase. During the phase, students need to organize the strategy to solve the problem and get the answer. In the process, students must be able to make correct perceptions and decisions on what to do. They need to have information skills to organize the problem-solving strategy. They must know how to organize the information given, what concepts to be used [25]. In full can be seen in Figure 3:

$$\begin{aligned} \lim_{x \rightarrow 2} \frac{t^2-4}{t-2} &= \frac{(t+2)(t-2)}{t-2} \\ &= \frac{(t+2)\cancel{(t-2)}}{\cancel{t-2}} \\ &= (2+2) \\ &= 4 \end{aligned}$$

**Figure 3.** Indicator 3 carry out a plan

In the fourth indicator, students do not write how to check the results obtained. They check it on other sheets/scribbles. They assume that checking the answers can be on any sheet that has important stages and the answers are correct. The fourth phase clarification of the answer and process phase), did not seem necessary to the student. For them, if they got through the first third phases, that was already a success. Nonetheless, it was not true because they might misunderstand the problem or make careless mistakes as the student stated [1]. In full can be seen in Figure 4:

$$\begin{aligned} \text{maka, } \lim_{t \rightarrow 2} \frac{t^2-4}{t-2} &= \frac{(t+2)(t-2)}{t-2} \\ &= \frac{(2+2)(2-2)}{2-2} \\ &= \frac{4(0)}{0} \\ &= 0 \end{aligned}$$

**Figure 4.** Indicator 4. Re-checking

The relationship of problem-solving abilities and the level of students' mathematical abilities can be illustrated in Table 1.

**Table 1.** Analysis of Problem Solving Abilities

Indicator of Problem solving ability	Student Activity		
	S1	S2	S3
Understand the Problem	<ol style="list-style-type: none"> <li>1. Students focus by reading in a low voice and closing the answer sheet with their heads while looking up.</li> <li>2. Students write information that is known and asked correctly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Students try to observe and understand questions repeatedly. They were seen from how to read the problem by reading the sound a little loud.</li> <li>2. Students write information that is known and asked correctly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Students look listless and confused about what to do first while scratching their heads.</li> <li>2. Students write down information that is known and asked.</li> </ol>

Indicator of Problem solving ability	Student Activity		
	S1	S2	S3
devising a plan	<ol style="list-style-type: none"> <li>1. Students seem speechless while observing by the method of whether the problem can be solved. Students scribble calculations on blank sheets.</li> <li>2. Students plan the right method or method used to solve problems.</li> </ol>	<ol style="list-style-type: none"> <li>1. The student seems to be thinking and trying to work in various ways that he knows.</li> <li>2. Students plan the method or method used to solve the problem.</li> </ol>	<ol style="list-style-type: none"> <li>1. Students look confused while scratching their heads and looking up.</li> <li>2. Students plan methods or ways used to solve problems that turn out to be inappropriate.</li> </ol>
carry out a plan	<ol style="list-style-type: none"> <li>1. Students try to start the calculation using another paper and look more enthusiastic in working on the problem.</li> <li>2. Students are able to solve problems correctly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Students try to recalculate what they have counted and occasionally their heads look up while thinking.</li> <li>2. Students are able to solve problems with the right method. It's just an error in the count operation</li> </ol>	<ol style="list-style-type: none"> <li>1. Students are out of focus and feel unable to solve the problem. Seen from his face that is a bit gloomy.</li> <li>2. Students are not able to solve problems completely.</li> </ol>
Re-checking	<ol style="list-style-type: none"> <li>1. Students examine all the steps on the answer sheet carefully and double-check their calculation results and while singing a little with a nodded head.</li> <li>2. Students check the completion steps to the results.</li> </ol>	<ol style="list-style-type: none"> <li>1. Students are trying to recalculate the low pitch to make sure the answer.</li> <li>2. Students check the completion steps to the results.</li> </ol>	<ol style="list-style-type: none"> <li>1. Students look back on the results of the calculation even though there are no definite results in the calculation.</li> <li>2. Students check the completion steps to the results.</li> </ol>

Based on the Table 1 proves that the movement provides information on actions that reflect students' mental problem-solving problems.

#### 4. Conclusion

Based on research and the results of the analysis carried out, it can be concluded that high-skilled students have good mathematical solving abilities. Students who are moderately capable also have mathematical problem-solving abilities that are quite good, it's just not thorough or mistakes in the number operations. While students with low ability have poor mathematical problem-solving skills, because they cannot solve problems completely. In addition, students must be able to adjust and organize themselves to carry out mathematical problem-solving activities that is by finding the solution strategy itself. As for the writer's suggestion that students are expected to be more careful in the parts of the

calculation of the number operations that they may be underestimated and the teacher should always provide a problem-solving ability so students are accustomed to problem based problems and the teacher should always provide stimulus to students when given problems with ask the reason.

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