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Analysis of Mathematical Problem-Solving Ability on Real Set

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***Abstract*:**
Finding a solution to a problem is called problem-solving, therefore learning mathematics means finding solutions to problems that arise in everyday life. The purpose of this study is to characterize students' aptitude in mathematical reasoning after completing a project related to Real Analysis. This study used descriptive techniques and was quantitative. Students' logical reasoning skills were revealed from the test results they obtained while answering questions designed based on indicators of mathematical thinking skills. Data analysis techniques used in this research include surveys, data visualization, and observation. Research on students' mathematical thinking skills showed findings with high, medium, and lesser categories.

Keywords: Mathematical, problem-solving ability, real analysis.

Introduction

According to Wahyuningsih (2019), math is a science that can be applied to all fields of study and is an integral part of today's technological advances. Until college, math is studied, not in class. Real Analysis is one of the courses that will be discussed in the college level mathematics curriculum. Algebra, sets, functions, mathematical induction, number lines, limiting functions, and continuous functions are subchapters or materials in Real Analysis (Bartlle, 2000). Real Analysis is an abstract field of mathematics that includes various numbers and algebraic ideas. (Novitasi & Pujiastuti, 2020).

Problem solving is a skill that requires a higher level of thinking and students must solve complex problems. The ability to solve math problems is part of what students must acquire in order to develop these skills along with learning mathematics. In mathematics learning, the ability to solve mathematical problems is a key skill that students need to develop other mathematics skills such as: analytical, critical, and creative thinking skills (Nurmutia, 2019). Problem solving according to Stanic and Kilpatrick (Purnamasari, 2017: 21) is a method and skill or ability. When solving problems related to skills and abilities. According to Uriah, the ability to solve problems independently (Wijayanti &; Suendarti, 2020: 244) is the ability to adapt

previously learned information to new circumstances that require more sophisticated cognitive processes.

Because the solution allows students to solve problems according to stages rather than thinking at a high level, it is explained by (Zhanty & Mathematics, 2019) that students have difficulty solving problem solving problems because they are not used to working on problem solving problems. Therefore, analyzing the students' learning process is important because the stages are well-chosen and appropriate.

Therefore, analyzing students' learning process is very important in assessing students' abilities. According to the Ministry of Education and Culture (2017: 10), "solving problems with learning objectives, especially mathematics, is a skill". However, according to Branca (Sumarni, 2010), "mathematical problem solving includes several aspects, namely procedures, strategies, and methods" and is a crucial and fundamental subject in computer science education. Problem solving also requires the use of knowledge, thinking, and mental processes. Since problem solving is the process of finding solutions, learning mathematics really means overcoming difficulties that arise in everyday life. Students' strong understanding of strategic procedural decisions and their execution demonstrates this skill. (Hendriana et al, 2017: 44).

Research Methods

Since the purpose of this study was to investigate how mathematical problem-solving skills are considered when solving problems using Real Analysis subjects, a methodological analysis qualitative approach was used in this study. The descriptive aspect of this research stems from the need for further analysis, which forces researchers to share opinions about students' aptitude in solving mathematical problems from a problem-solving point of view. This research was conducted in May 2024 at one of the YPI Deli Tua Schools in grade 11 mathematics subjects. This research only involved one class, namely grade 11 which consisted of 23 students.

Table 1. Problem Solving Ability Assessment Rubric

Rated aspect	Reaction to Problems/Issues	Score
Understand it	1. No response at all	0
	2. Understand the problem better and write the known model/models incorrectly. Otherwise, you will not understand it at all.	3
	3. Fully understand the problem	4
Designing a solution to the problem	1. Use the appropriate model or formula to get the correct answer.	4
	2. Using the correct strategy or visual model, but the problem solving is incomplete or the answer is wrong.	2
		4

Rated aspect	Reaction to Problems/Issues	Score
	3. Give the correct solution steps	
To solve this problem	1. There is no solution at all	0
	2. Use the correct specific rules and correct results	4
	3. Applying a rule if a particular rule is true, but the answer is wrong or partially wrong due to miscalculation.	2
Check the resolution results	1. Incorrectly editing the conclusion or process overview, or incorrectly editing only the conclusion or process overview	1
	2. Can explain questions and answers	4
	3. Can explain, but not exactly as said	2
	4. Cannot explain the answer	0

This research examines the mathematics course taken by dual training students in the even semester from a qualitative point of view. There were 23 students used in this investigation. A mathematical problem-solving ability test and learning style questionnaire were the two instruments used in this study. This study was tested using real analysis materials. The researcher used Polya's phases of understanding the problem, planning, executing the plan, and validating the solution to help them overcome mathematical challenges. The description of research materials is usually based on exam results that measure a person's aptitude for solving mathematical problems.

The research began by asking students to research subjects, followed by a questionnaire. The researcher examined all the students' responses and classified them into three groups based on how well they could solve math problems. The groups included high, medium, and poor math problem-solving categories. Furthermore, data reduction, data visualization, and conclusion drawing were conducted.

Results and Discussions

Grade XI was chosen as the subject of the study, and the study was conducted at SMA Swasta Yayasan Pendidikan Islam Delitua. There were four students working as research staff. The mathematical thinking ability of grade XI students in the even semester of the 2023–2024 academic year was the main focus of this study. To conduct this study, questions were first asked to students, and their answers were then checked using predetermined indicators. In addition, data processing was carried out and then the results of the students' mathematical reasoning assessment criteria were analyzed.

Students solve problems in their own way and with their own understanding of set analysis in Real. Problems on sets in Real are given to measure students' mathematical abilities in solving the problems so that results are obtained based on student test results.

Upu (2003) stated that problem solving skills used to produce problem solving ability test questions are determined by four indicators. Understanding the problem, making a solution plan, implementing the plan and making conclusions are some indicators.

Table 2. Average students' mathematical problem solving ability

Test	$\overline{X}$	S	X Max	X Min
Final Test	41.31	14.51	85	16.67

Table 3. Recapitulation of Final Problem Solving Ability Test Scores

No	High Ability	Medium Ability	Low Ability
$\overline{X}$	66.49	51.34	15.01
S	7.28	5.72	0.83

Judging from the students' abilities, the average value of high ability is 66.49 with a standard deviation of 7.28, meaning that students who have the highest ability values vary. The average value of medium ability is 51.34 with a standard deviation of 5.72, meaning that students who have medium ability values are more. The average value of low ability is 15.01 with a standard deviation of 0.83, meaning that students who have low ability values vary between 15.01.

Table 4. Percentage of student answers for each question item

Question Number	Indicator			
	Understanding the Problem	Planning the Settlement	Performing Calculations	Check Back
1	40.58%	60.87 %	60.87 %	60.87 %
2	14.49 %	21.74 %	42.03 %	52.17%
3	17.39%	17.39%	37.68%	34.78%
4	11.59%	34.78%	34.78%	23.18%
5	30.43%	86.96%	86.96%	56.52%
Overall Presentation	22.89%	44.35%	52.46%	45.51%

Analysis of Student Answer Results

Highly capable students

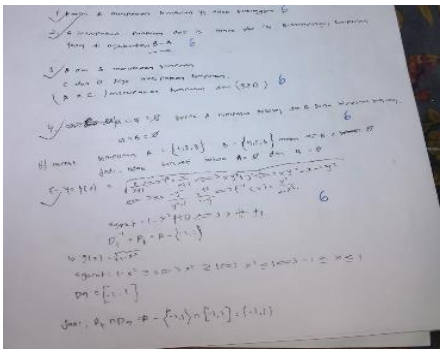

Figure 1. Student answer sheet 1

Nine students showed high ability based on the problem-solving ability test. Students who scored well on the problem-solving test had fairly good problem-solving skills. The response sheets of high-ability students, which showed that they were able to complete the task according to the size of their problem-solving capacity, showed this. Based on Figure 1, students were able to identify and understand the question as a whole and ensure that what was known and asked was in accordance with their inquiry.

Students plan solutions using logical reasoning on existing problems. Able to describe how to analyze one set and another set. So that the answers given by students get the correct results. Then students do not write conclusions and monitor the process incorrectly. The same thing is done as question number 1 in questions 2, 3, 4 and 5. Thus, it can be concluded that students are classified as very competent. Students are able to think critically about the questions given by researchers, link logic with mathematics based on the problems given so as to obtain correct results.

Students are developing moderately

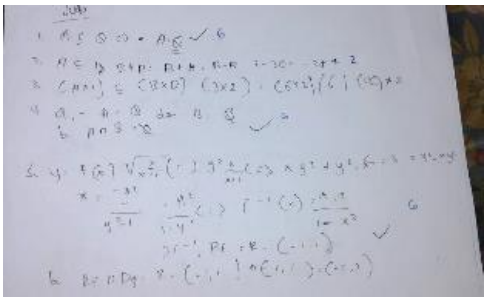

Figure 2. Student answer sheet 2

Five children scored average on the problem-solving test; Students who were able to solve problems were categorized as having the potential to grow into high-

ability students. The response sheets of gifted children showed this; although they were able to answer the questions, they failed to answer one of the questions. Based on Figure 3, students were unable to recognize and understand the questions as a whole, making their responses unable to produce the correct answer. Students then monitored the process inaccurately and failed to write conclusions. In questions 2, 3, 4, and 5, the procedures used were the same as in question number 1. Therefore, it can be said that students with ordinary ability levels are unable to plan a problem because they are unable to understand its meaning.

Low ability students

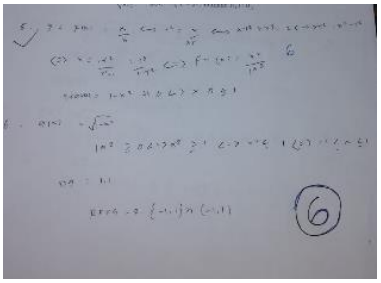

Figure 3. *Student answer sheet 3*

Nine low-ability students were categorized as weak-ability based on their performance on the problem-solving test. This can be seen from the number of questions on the answer sheet that failed to answer current problems. Based on Figure 4, students were unable to get decent grades because they did not understand the difficulties they faced and did not write down the answers to the questions on the LKS. Therefore, it can be said that weak students do not have the ability to design questions or understand the importance of the questions given to them.

Analysis of Student Response Results

Based on the results of the questionnaire filled out by students who took the written mathematical ability test, the following results were obtained.

Table 5. Student responses to question no. 1

Student response	**F**	**Score Weight**	**n_i *F_i**
Very Often (SS)	3	1	3
Often (S)	7	2	14
Rare (J)	12	3	36
Never (TP)	1	4	4
Amount	23	10	57
Average Score	2.48		

Source: data processing results

Table 5 shows that the statement "I am unable to recognize every problem in math problems on sets" received a good response from students who got an average score of 2.48. Most students said that the difficulty of analyzing sets was not uncommonly overlooked.

Table 6. Student responses to question no. 2

Student response	**F**	**Score Weight**	**$n_i * F_i$**
Very Often (SS)	7	4	28
Often (S)	10	3	30
Rare (J)	6	2	6
Never (TP)	0	1	0
Amount	23	10	70
Average Score	3.04		

Source: data processing results

With an average score of 3.04, Table 6 shows that students gave the statement "I am able to work together in solving a mathematical problem in a set" a good reaction. Most students said that they were able to collaborate to solve Frequent and Very Frequent set analysis problems.

Table 7. Student responses to question no. 3

Student response	**F**	**Score Weight**	**$n_i * F_i$**
Very Often (SS)	6	4	24
Often (S)	10	3	30
Rare (J)	4	2	4
Never (TP)	3	1	3
Amount	23	10	65
Average Score	2.83		

Source: data processing results

Table 7 shows the statement "I am able to work using logic in solving a mathematical problem on a set in real " received a positive response from students with an average score of 2.83. The majority of students stated Often and Very Often that the student was able to solve problems on the analysis of sets in real using logic.

Table 8. Student responses to question no. 4

Student response	**F**	**Score Weight**	**$n_i * F_i$**
Very Often (SS)	0	1	0
Often (S)	9	2	18
Rare (J)	10	3	30
Never (TP)	4	4	16
Amount	23	10	64
Average Score	2.78		

Source: data processing results

Students gave the statement "I feel the questions given are very difficult" with a good reaction, with an average score of 2.78 as seen in Table 7. Most students said that they rarely thought the set analysis task was very difficult.

Table 9. Student responses to question no. 5

Student response	F	Score Weight	$n_i * F_i$
Very Often (SS)	3	1	3
Often (S)	6	2	12
Rare (J)	8	3	24
Never (TP)	6	4	24
Amount	23	10	63
Average Score	2.74		

Source: data processing results

Table 9 shows the statement "I am less able to understand a mathematical problem on the set in real " received a positive response from students with an average score of 2.74. The majority of students stated Rarely and Almost Never that the student was less able to understand the problems in the analysis of sets in real .

Table 10. Average scores of student responses

No	Statement	Average score
1	I am unable to recognize every problem in the math problems on sets.	2.48
2	I am able to work together to solve a mathematical problem on a set.	3.04
3	I am able to work using logic in solving a mathematical problem on a set.	2.83
4	I feel the problems given are very difficult	2.78
5	I am less able to understand a mathematical problem on sets.	2.74
Total Score		13.87
Average		2.77

Based on the decided statement, a student response is considered successful if the proportion of student answers on each component stated positively is ≥90%. Because all statements on the mathematical problem solving ability test received a positive response from students of at least 90%, it can be concluded that the responses given by students were successful.

One of the respondents gave a very satisfactory assessment in each of the math question options, one of which was "are you able to understand the problems on the worksheet?" the respondent answered that he was able to understand the available problems but for the steps of mathematical solution the respondent still did not

understand the problems related to solving problems in Pythagoras, the respondent also said that the respondent did not know many symbols in mathematics. According to the results obtained, out of 23 respondents, good results were obtained considering the number of respondents who gave good responses to the questions.

Conclusions and Suggestions

The ability of grade XI students of YPI Delitua Private High School in analyzing sets on Real numbers can be classified based on the problem solving indicators achieved. The highest percentage score is 86.96% for the indicator of planning problems and calculating, while the lowest percentage is 11.59% for the indicator of understanding problems. Overall, the average percentage score is 41.30%, which is classified as standard with the average ability of students. This means that the ability of grade XI students of YPI Delitua Private High School in analyzing sets on Real is quite low. Students are less able to draw mathematical conclusions on the available problems. And the reason for the test in the mathematical problem solving test is very effective, because all statements are answered positively by ≥90% of students. Students are expected to deepen their understanding related to analyzing sets on Real, understanding the mathematical symbols contained in the problem.

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