

Students' Mathematical Problem-Solving Ability Based on The Level of Learning Outcomes on Sequence and Series

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Abstrak

Pembelajaran difungsikan sebagai wadah siswa dalam mengembangkan diri sebelum terjun ke masyarakat. Kemampuan pemecahan masalah matematis menjadi salah satu kemampuan yang penting bagi siswa dalam menyelesaikan tantangan di abad 21. Penelitian ini bertujuan untuk menganalisis kemampuan pemecahan masalah siswa ditinjau dari tingkat hasil belajar siswa. Jenis penelitian ini adalah penelitian kualitatif dengan pendekatan deskriptif. Subjek penelitian sebanyak 6 siswa berasal dari kelas XI SMA. Data diambil pada semester ganjil Tahun ajaran 2022/2023. Teknik pengumpulan data adalah tes dan wawancara. Hasil penelitian menunjukkan bahwa (1) siswa tingkatan rendah hanya dapat melakukan tahapan memahami informasi, (2) siswa tingkatan sedang dapat melakukan tahapan memahami informasi, merencanakan dan melaksanakan penyelesaian walaupun masih terdapat kesalahan operasi hitung (3) siswa dengan tingkatan tinggi juga sama siswa tingkatan sedang, yang mana siswa sudah sampai ke pada tahap menyelesaikan masalah dengan benar tetapi tidak melakukan pengecekan ulang terhadap solusi yang ditemukan.

Kata Kunci: Kemampuan pemecahan masalah matematis; Tingkat hasil belajar; Barisan dan deret.

Abstract

Learning serves as a forum for students' self-development before becoming part of society. Mathematical problem-solving ability is one of the important skills for students in solving challenges in the 21st century. This study aims to analyze students' problem-solving abilities based on the level of student learning outcomes. This type of research is qualitative with a descriptive approach. The research participant was 6 senior high school students from grade 11. Data were obtained in the odd semester of the 2022/2023 academic year. Data collection techniques were tests and interviews. The result showed that: First, low-level students are only able to pass understanding the information stage. Second, medium-level students can understand information, plan, and carry out solutions even though there are arithmetical errors. High-level students are also the same as medium-level students, where students have reached the stage of solving the problem correctly but did not re-check the final solutions

Keywords: Mathematical problem solving; Learning outcome level; Sequence and series.

I. INTRODUCTION

Mathematics serves as a training ground for the brain to think. A skilled mind can help solve many issues. Daily issues continue to develop along with the uncertain world situation and conditions from an economic and political perspective (Taufiq & Basuki, 2022). Students who study mathematics in good order can solve problem systematically and correctly. Learning mathematics can help students think critically and creatively and develop other mathematical abilities (NCTM, 2000; Sumarmo et al., 2012; Utami & Puspitasari, 2022).

There are various students' mathematical abilities according to their cognitive level (Kusnadi & Mardiani, 2022). One of them is problem-solving ability. Problem-solving ability is one of the objectives of learning mathematics (Syahrudin et al., 2021; Ratna & Yahya, 2022). This ability is also a measure of student success in learning mathematics. Therefore, student need to develop problem-solving skills. Problem-solving ability should always be integrated into learning mathematics through solving non-routine math problems (Harahap, 2022). Thus, when students face real life problem, they will get used to applying the problem-solving procedures they learn when solving math problems (Aeni & Afriansyah, 2022).

The results of interviews with one of high school mathematics teacher show that student's problem-solving skills are still relatively low. The results of the initial study show: (1) Students have a passive role in the learning process, so students mostly memorize formulas and imitate the completion steps of the questions given to

students, (2) When they are asked to solve non-routine questions, they find it difficult to solve them, (3) Students still feel confused in choosing and determining the correct formula to solve the problem. This indicates the students' difficulties in solving mathematical problems.

According to Utami and Wutsqa (2017), and also Disparilla and Afriansyah (2022), students lacked problem-solving skills. This is shown by (1) students did not understand the problem, (2) students could not make mathematical models, and (3) students were not careful in performing calculations. Another research finding also confirmed that students' mathematical problem-solving abilities are still relatively low, which is below 50% (Agustami et al., 2021; Pirmanto et al., 2020)

The inability of students to solve this problem is a concern for research. Sequence and series material is high school material with various non-routine questions (Damayanti & Kartini, 2022). There are still many students who have not been able to solve questions if the questions given by the teacher vary from the examples given previously (Andayani & Lathifah, 2019; Minggu, I., Arwadi, F., & Bakri, 2022). Therefore, this study aims to analyze the mathematical problem-solving ability of high school students who have level of learning outcomes on a specific topic, sequence and series. This research examines it from a different perspective. Previous research tried to analyze problem-solving skills by obtaining presentations from each indicator. Meanwhile, this study looks at the extent to which students' problem-solving stages are based on high, medium, or low learning outcomes. This

research is expected to be a reference in designing a learning, especially as an effort to improve students' mathematical problem-solving abilities.

II. METHOD

This study aims to describe the problem-solving ability of high school students' sequence and series topic. Thus, the researcher chose the qualitative descriptive research because it was considered appropriate to answer the research question. Data was obtained in the odd semester of the 2022/2023 academic year. The participants of this study were selected from grade 11 Senior High School, total 26 people. Then these students are being classified based on their learning outcomes, namely high, medium and low. Furthermore, 2 students were chosen to represent each level of learning outcomes. So total participant in this study is to 6 students.

Data collection techniques are tests and interviews. The mathematical problem-solving ability test consists of 2 questions, as shown in Table 1. The interview was conducted in a semi-structured style after the test was given to the students.

Table 1.
Test Item of Mathematical Problem-Solving Ability

No.	Question Items
1.	Mr. Tono managed to pick 12,300 mangoes in 30 days. If the number of mangoes he can pick each day form an arithmetic sequence, and on the first day he only picks 20 mangoes, how many mangoes did Pak Tono pick on the last day?
2.	Andin's, Bimo's, and Citra's ages form a geometric sequence, respectively. The sum of their ages is 14 years. The

comparison between Bimo and Citra's age is 2:1. How old will Bimo be 5 years from now?

The data were analyzed descriptively according to the four stages of problem-solving. There are four stages, namely (1) understanding the problem, (2) planning the solution, (3) implementing the solution, and (4) reviewing the solution. The description of each stage based on (Polya, 1973) can be seen in Table 2. Students are said to have good solving abilities when students can go through the four stages of problem-solving.

Table 2.
Stages of Problem Solving

No	Stages	Learning Outcome rate
1	Understanding the problem	Acknowledge what is known and asked in the problem; explain the problem in their own words.
2	Planning the solution	Simplify the problem; able to make experiments and simulations; able to search for sub-goals; and sort information.
3	Implementing the solution	Interpreting the provided problem in the form of a mathematical sentence; implement the strategy during the process and calculation takes place
4	Reviewing the solution	Check all the information and calculations involved; consider whether the solution is logical; look at other alternative solutions; read the question back, and ask yourself if the question has been answered.

The procedures in this study are: (1) preparing instrument that is an essay problem-solving abilities and interview guideline (2) testing test questions so that a valid and reliable instrument is obtained (3) giving test questions to 26 students in class XI (4) summarizing and analyzing data. The data in this study are qualitative, so to make an analysis, it takes 3 stages, namely (1) data reduction; in this stage, the researcher checked the answers that the students had written, compose the transcripts of student interviews, and selected the main parts to be displayed and analyzed, (2) data display; in this stage, the researcher provides an overview of the answers that have been written by students, especially the six students who have been selected to represent each level of learning outcomes, and (3) conclusions; in this stage, the researcher provides an interpretation of the student's mathematical problem-solving abilities based on the level of learning outcomes.

III. RESULT AND DISCUSSION

The subjects were coded as in Table 3. Students with low levels of learning outcomes were coded as S1 and S2, then students with medium learning outcomes were coded as S3 and S4, and students with high learning outcomes were coded as S5 and S6.

Table 3.
Coding of Research Subjects

No	Subject Code	Learning Outcome Level
1	S1	Low
2	S2	Low
3	S3	Medium
4	S4	Medium
5	S5	High

6	S6	High
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The first group is, students with low learning outcomes, consisted of S1 and S2. The answers of S1 for question 1 is presented in Figure 1.

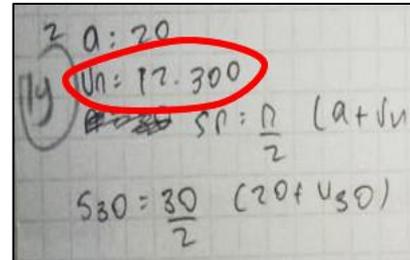


Figure 1. S1 Answers For Item 1

From Figure 1, it is noticeable that S1 gave wrong answer in formulating what is known from the question's narrative even though the final answer is correct. Here it appears that students do not understand the information provided. What should be known from the problem is the number of series (Sn), not the nth term (Un). From interview result, obtained information that S1 only guessing how to solve the problem by substituting the known numbers from the problem into the formula.

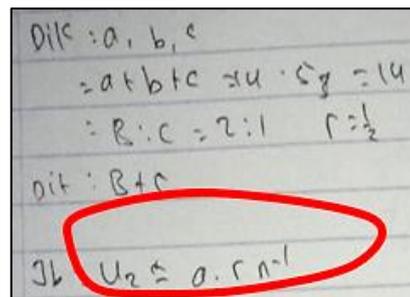


Figure 2. S2 Answers For Item 2

From Figure 2, it can be observed that S2 understand the information provided, Students can identify the information in the problem and turn into a correct mathematical model. Students S2 also understand the question by writing "B+5" based on the verbal. The student can

Diket: $a + b + c = 14$ $S_2 = 14$
 $r = \frac{1}{2}$
 Dit: $B + S$ / usia bimo
 Jawab: $U_2 = a + r^{n-1}$
 $S_n = \frac{a(1-r^n)}{1-r}$
 $S_2 = \frac{a(1-\frac{1}{2}^2)}{1-\frac{1}{2}} = 14$
 $\frac{a(1-\frac{1}{4})}{\frac{1}{2}} = 14$
 $a \cdot \frac{\frac{3}{4}}{\frac{1}{2}} = 14$
 $a \cdot \frac{3}{2} = 14$
 $a = \frac{14 \cdot 2}{3} = \frac{28}{3}$
 $a = 8$
 usia bimo 5 tahun kedepan adalah 9 tahun

Figure 4. S4 Answers For Item 2

The answer of S4 for item 2 is presented in Figure 4. S4 has understood the information of the problem, planned how to solve the problem, and solved it. It is found that the student made an arithmetical error. and find answers to the questions. The researcher saw that these students were imitating the results of their friends' work as if forcing answers so that the results obtained were correct.

Based on the description about S3 and S4, it is inferred that these students can perform three stages of problem-solving, namely understanding the problem, planning, and carrying out the solution. Students with medium-learning outcomes are not accustomed to re-checking the final answers, so the final answers might not be proven true. Research from Hidayat & Sariningsih (2018) indicates that students with adversity quotient campers also experience the same thing as students with the intermediate learning level. For medium-group students can also be used with a generative learning model because students can be more active in learning and the subject matter is easier to remember, so problem-solving abilities can be fully mastered Mawaddah & Anisah (2015).

The last group is students with high learning outcomes, S5 and S6. For item 1,

the researcher displays the answers of S5 students (see Figure 5).

Diket: $A = 20$ buah
 $S_{30} = 12.300$ buah
 ditanya: $U_{30} = ?$
 Jawab: $S_n = \frac{n}{2}(a + U_n)$
 $S_{30} = \frac{30}{2}(20 + U_{30})$
 $12.300 = 15(20 + U_{30})$
 $(20 + U_{30}) = \frac{12.300}{15}$
 $U_{30} = 820 - 20$
 $U_{30} = 800$
 Jadi pada hari ke Terakhir pakitno memetik sebanyak 800 buah mangga.

Figure 5. S5 Answers For Item 1

It is shown in Figure 5 that, S5 can understand the problem of this test well. The problem can be expressed in the form of mathematical symbols well, such as the first term of the arithmetic sequence and the 30th arithmetic series of picking mangoes. S5 can devise a plan to solve it and carrying it out appropriately. However, the S5 still did not check the final result.

Item 2 was chosen from the answers of S6 students and can be seen in Figure 6.

$S_n = \frac{a(1-r^n)}{1-r} = 14$
 $S_2 = \frac{a(1-\frac{1}{2}^2)}{1-\frac{1}{2}} = 14$
 $= \frac{a(1-\frac{1}{4})}{\frac{1}{2}} = 14$
 $= \frac{a(1-\frac{1}{4})}{\frac{1}{2}} = 14$
 $= \frac{a \cdot \frac{3}{4}}{\frac{1}{2}} = 14$
 $= \frac{a \cdot \frac{3}{4} \cdot 2}{1} = 14$
 $a \cdot \frac{3}{2} = 14$
 $a = \frac{14 \cdot 2}{3} = \frac{28}{3}$
 $a = 8$
 Umur bimo 5 tahun kedepan adalah 9 tahun

Figure 6. S6 Answers For Item 2

From Figure 6, S6 answered like students with medium abilities. It means that students can correctly state what is known, mention what is asked, and can solve the problem correctly, but did not re-

check the answers that have been obtained. S6 only concludes the final solution from the results of calculation. Research from Purnamasari & Setiawan (2019) has also shown similar results that students with high initial abilities can already master the three stages of problem-solving and did not get to the fourth stage, re-checking answers.

In addition, the researcher also interpreted that the students did not know the importance of re-checking the answers. Based on the results of interviews with S5 and S6, they are not accustomed to double-checking solutions because there is no such requirement during learning. The results of research by Jayanti et al., (2018) and Rambe & Afri (2020) showed that only a small proportion of students re-checked their answers. Whereas re-checking is an important step that must be passed by students so that the answers that have been obtained can be valid and can be justified.

Providing non-routine questions is one way to make students better find alternative answers so that students can complete mathematics tests convincingly (Amam, 2017). Hadi & Radiyatul (2014) added that students who have not mastered all stages of problem-solving skills are trained to work on tests with various alternative solutions so that students can understand the problem even though the variables are modified.

IV. CONCLUSION

Low-level students can only understand information. While, middle-level students can carry out the steps of understanding

information, planning, and carrying out solutions even though there are still arithmetical errors. High-level students are also the same as medium-level students, where students have reached the stage of solving the problem correctly but did not re-check the solutions discovered.

From the results of this study, researchers provide suggestions (1) in designing mathematics learning, teachers should always provide problem-solving questions to students (2) teachers must also emphasize to their students the importance of answering questions using Polya stages.

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