Mathematical problem-solving ability of junior high school students on quadrilateral geometric shapes

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Abstract
This research is based on the results of previous research that showed that students' mathematical problem-solving skills have not been as expected. While problem solving skills are a way to build education so that students further develop problem solving skills. The writing of this article aims to review and analyze the problem-solving skills of junior high school students in working on mathematical problem solving. The research method used is a descriptive analysis method to analyze the available and processed data so that a clear picture of the facts is obtained. The samples in this study were grade VIII junior high school students. The study subject consisted of 3 grade VIII Mts students located in Sukarasa Village. The samples in this study were determined by stratified proportional random sampling. The results showed that 3 students who were subjected to the study had problem solving skills in low criteria.
Keywords: mathematical problem-solving ability; Side Space Quadrilateral; geometric

Abstrak
Penelitian ini dilatarbelakangi oleh hasil-hasil penelitian terdahulu yang menunjukkan bahwa kemampuan pemecahan masalah matematis siswa belum sesuai dengan yang diharapkan. Sedangkan kemampuan pemecahan masalah merupakan sebuah jalan untuk membangun pendidikan agar siswa lebih mengembangkan kemampuan pemecahan masalah. Penulisan artikel ini bertujuan untuk mengkaji dan menganalisis kemampuan pemecahan masalah siswa SMP dalam mengerjakan soal-soal pemecahan masalah matematis siswa. Metode penelitian yang digunakan adalah metode analisis deskriptif untuk menganalisis data-data yang tersedia dan diolah sehingga diperoleh gambaran yang jelas tentang fakta-fakta. Sampel dalam penelitian ini adalah siswa SMP kelas VIII. Subjek penelitian terdiri dari 3 siswa kelas VIII Mts yang berada di Desa Sukarasa. Sampel dalam penelitian ini ditentukan dengan *stratified proporsional random sampling*. Hasil penelitian menunjukkan bahwa 3 siswa yang dijadikan subjek penelitian memiliki kemampuan pemecahan masalah dalam kriteria rendah.
Kata Kunci: Kemampuan Pemecahan Masalah Matematis; Bangun Ruang Sisi Datar; geometri

Introduction

Mathematics plays an important role in all aspects of life, especially in improving human thinking power, so that mathematics is one of the subjects that are required at every level of school from elementary school to college (Akbar et al., 2017; Lusiana, Armiati, & Yerizon, 2022). Because mathematics is very necessary for use in everyday life (Istigosah & Noordyana, 2022).

The purpose of learning mathematics is to foster students' reasoning abilities. This is in line with what was stated by (Nugraha & Mahmudi, 2015), mathematics learning aims to foster students' reasoning abilities through knowledge, skills, and attitudes. This can be seen from the ability to think critically, logically, systematically, and be able to communicate and appreciate the usefulness of mathematics in solving problems in everyday life (Cahyani & Sritresna, 2023).

One of the mathematical abilities that must be achieved by students in the objectives of learning mathematics is problem-solving ability (Utami & Wutsqa, 2017; Rahmawati & Afriansyah, 2023). As stated by Panjaitan (2018), problem solving is the heart of mathematics, so it is important for students to develop the ability to solve mathematical problems and find solutions to everyday problems. Problem solving ability is a process by which students apply previously acquired knowledge to new, unfamiliar situations.

Problem solving is also a step that determines whether or not students can face their problems because problem solving has a very large effect on supporting students' abilities (Minggi, Arwadi, & Bakri, 2022). Therefore, solving mathematical problems is very important in learning mathematics because it can make it easier for students to face problems in students' lives today and in the future. On the one hand, solving mathematical problems is important, but on the other hand, students often have difficulty solving mathematical problems.

The low problem-solving ability of students is proven by the test results conducted by two international studies, the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS). The PISA report in 2012, Indonesian students' mathematics scores were in 64th position out of 65 countries with an average score of 375, while the average international score was 494. In the 2011 TIMSS report, Indonesian students were in 38th position out of 42 countries with an average score of 386.

The data above shows that mathematics learning, especially in problem solving in Indonesia, is included in the lowest ranks. Therefore, (Akbar et al., 2017) stated that the role of teachers is very important in creating students who have good problem-solving skills, so that they obtain satisfactory learning outcomes and the learning objectives set can be achieved. Because having the ability to solve problems or mathematical questions

is one of the goals of students' mathematics learning and helping students express how the process goes in their minds when solving problems is one of the roles of teachers in mathematics learning.

Sumarmo argues that problem solving is a process to overcome difficulties encountered to achieve a desired goal (Rahmawati, 2020; & Bernard et al., 2018). Solving is also a learning approach that optimally involves students actively which allows students to explore, observe, experiment, and investigate (Bernard et al., 2018). So, problem solving skills are learning that allows students to explore, observe, experiment and investigate as a process to overcome difficulties and student efforts when solving problems, especially in mathematics learning. This aims to facilitate students' understanding of the subject matter obtained as well as supporting media, methods or techniques to make students more active and independent in solving problems (Ulfa & Roza, 2022). Based on these definitions, it can be concluded that problem solving skills are the ability of individuals to apply their knowledge, skills and understanding to find solutions to unusual situations (Sriwahyuni & Maryati, 2022).

The indicators of students' mathematical problem-fcv solving abilities according to Sumarmo (Juanda et al., 2014) are: a. Identifying known elements, those asked, and the adequacy of the required elements; b. Formulating mathematical problems or constructing mathematical models; c. Applying strategies to solve various problems (similar and new problems) in or outside mathematics; and d. Explaining or interpreting results according to the original problem, and checking the correctness of the results or answers.

Based on this, the researcher wants to know the extent of the level of mathematical problem-solving ability of junior high school students on the material of flat-sided spatial figures.

Method

The method in this study uses a descriptive qualitative method. According to Arikunto (2019) Descriptive research is research that aims to determine the conditions and circumstances of which the results are explained in the form of a research report. Qualitative research is research on research that is descriptive in nature and tends to use analysis. The process and meaning (subject perspective) are more emphasized in qualitative research. The selection of research subjects based on purposive sampling, namely 5 MTs Class VIII students in one of the villages in Sukarasa Village. The object of this study is students' problem-solving abilities in learning flat-sided spatial figures. This research was conducted on January.

The data collection techniques used in this study are measurement techniques and direct communication techniques. The instruments used in this study are tests, interviews

and field notes. The written test given is in the form of a description containing questions related to the material of flat-sided geometric shapes.

Result

In this section, the researcher will present the results of the research that has been conducted by the researcher on the research subjects. This research was conducted on students who had studied the material of Flat-sided Space Building in grade VII, even semester.

In this study, there is data that has been collected by the researcher in the form of data from the results of students' problem-solving written tests, the results of researcher interviews and observations of the subjects. The students selected by the researcher to be the subjects were 5 students consisting of 4 female students and 1 male student.

Table 1. This is an example 1 of table. Table should be placed in the main text near to the first time they are cited.

No.	Frequency of students answering correctly	Percentage
1	3	60%
2	0	0%
3	2	40%
4	3	60%
5	5	100%

As seen in Table 1, in general, from all the questions, the proportion of students who answered correctly to two questions is still relatively low. It is more clearly seen in questions 2 and 3 which were answered by several students and only a few students experienced obstacles. In question number 2, there were 0 students who could answer the question correctly, students who could answer correctly or all students experienced obstacles in answering the question.

The results of qualitative research in this study were obtained through the results of the subject's problem-solving ability test and the results of interviews conducted by researchers with the subjects. Analysis of the test results and interviews was carried out to determine the students' problem-solving abilities. The research subjects worked on 5 problem-solving ability test items and the researchers used all the questions for analysis. The subjects selected were S1, S2, and S3. In the presentation of the test results and students' answers.

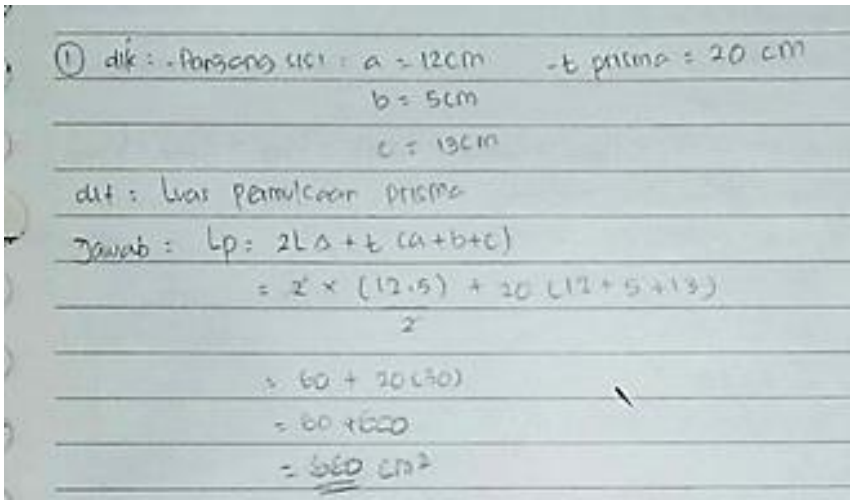

Figure 1. Question number 1 S-1

As seen in Figure 1, the results of the work show that subject S-1 is able to write down all the information known completely and correctly, and is also able to formulate the questions asked correctly. The picture also shows that subject S-1 determines what is known and asked using his own sentences. This can be seen from the sentences used, although not much different from the question sentences, subject S-1 writes what is known and asked using his own language, not by rewriting the question. This means that subject S-1 is able to explain the problem using his own language and sentences. Then it shows that subject S-1 is able to apply each step that has been planned to solve the problem in sequence and correctly, and is also able to apply each formula that has been determined to solve the problem. First, students are able to derive the surface area formula and then solve it correctly. Here are the interview results for question number 1 (see Figure 1).

Q: Do you understand question number 1?
S-1 : : Yes, understand.
Q: What do you know about this?
S-1: The length of the side of the triangle. and prism height.
Q: Then what is asked in the question?
S-1: surface area of the prism.
P: OK, do you think the information given in the question is enough to find what you are asking?
S-1: Enough.
P: That's enough, right? Are you sure that's enough?
S-1: Sure ma'am, that's enough.

Based on the test and interview results above, S-1 was able to work on the questions correctly and apply indicators 1, 2 and 3, but S-1 was not yet able to apply indicator 4.

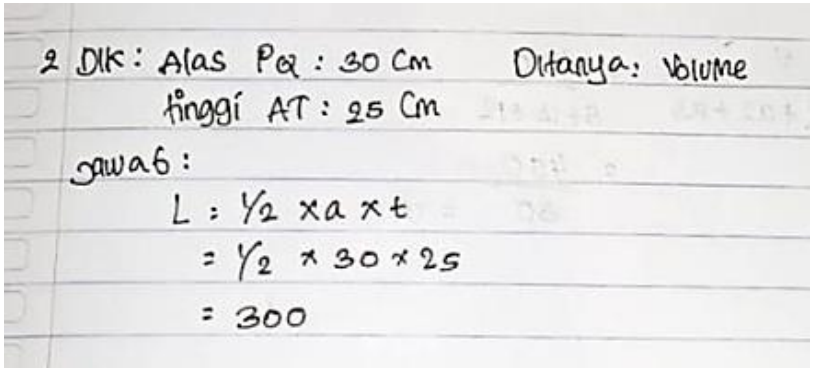

Figure 2. Answer to question number 2 S-2

As seen in Figure 2, the results of the work are almost the same as the previous one, namely showing that subject S-2 is able to write down all the information known completely and correctly, and is also able to formulate the questions asked correctly. The picture also shows that subject S-2 determines what is known and asked using his own sentences. This can be seen from the sentences used, although not much different from the question sentences, subject S-2 writes what is known and asked using his own language, not by rewriting the question. This means that subject S-2 is able to explain the problem using his own language and sentences. However, the picture shows that S-2 does not understand the problem. S-2 only knows that in the problem asked, namely finding the volume of the pyramid. but the formula that S-2 applies is not quite right, the formula for the volume of the pyramid should be 1/3 not ½, therefore because the direction of the next answer is wrong, the answer is also wrong (see Figure 2).

The interview results for answer number 2 S-2 are:

P: Do you understand question number 2?
S-2: hehe, Yes, I understand.
P: Do you think this question is easy, medium, or difficult?
S-2: quite a bit.
P: Then what is asked in the question, dear?
S-2: find the volume of the pyramid.
P: Okay, what concept do you use to solve the problem?
S-2: ½ times the area of the base times the height
P: are you sure about the formula?
S-2: hehe no
P: why?
S-2: 1/3 I think so ma'am.
P: so are you sure the answer is the same?
S-2: I think I'm wrong ma'am.
P: okay then. What should I do?
S-2: the height has to be found first ma'am.

P: yes
S-2: oh yes ma'am now I understand.

The interview results above show that S-2 had a little difficulty in working on written test question number 2, because he did not understand the concepts of spatial shapes. Based on the results of the answer sheet and interview, it is known that S-2 has not been able to work on the question properly and correctly and in accordance with what was asked in the test, so it can be concluded that S-2 in this test question has not been able to solve problems in understanding between mathematical topics (see Figure 2).

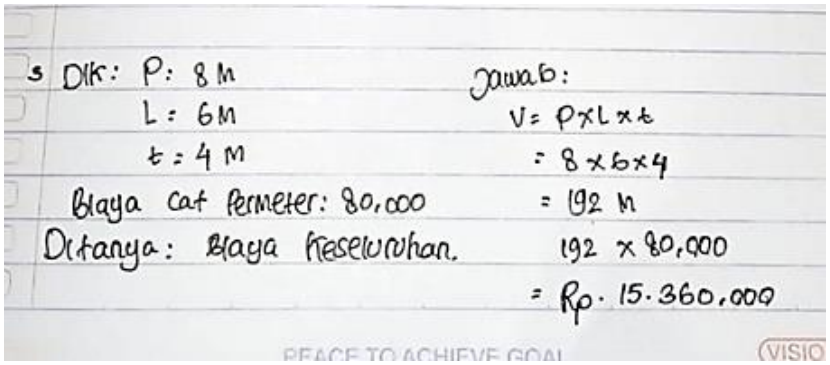

Figure 3. Question number 3 S-2

Based on Figure 3, the results of the work show that subject S-2 is able to write down all the information known completely and correctly, and is also able to formulate the questions asked correctly. The figure also shows that subject S-2 determines what is known and asked using his own sentences. This can be seen from the sentences used, although not much different from the question sentences, subject S-2 writes what is known and asked using his own language, not by rewriting the questions. This means that subject S2 shows that S2 can understand the test questions given but has not been able to derive the concept or formula in question so that the next step in solving them is less precise. The interview results for S2's answers are:

P: Do you understand question number 3?
S-2: Hehe, yes, I understand.
P: Do you think this question is easy, medium, or difficult?
S-2: Not bad.
P: Then what is asked in the question, dear?
S-2: Total paint cost.
P: Okay, what concept do you use to solve the problem?
S-2: (smiles) first find the volume.
P: If you only chat the surface/wall, why are you looking for the volume? Are you going to spill the chat to the building?
S-2: Oh, yes, ma'am, I forgot
P: So what should it be?

S-2: What should you look for is the surface area, ma'am, then the result is multiplied by the price of the paint. Is that right, ma'am?
P: Now do you understand?
S-2: Hehe, I understand, ma'am.

Based on the test results and interviews above, students have not been able to work on the test questions correctly because they do not understand the questions or have not been able to apply indicator 2, so the next step is also less appropriate. It can be concluded that S-2 in this test question has not been able to solve problems in understanding between mathematical topics.

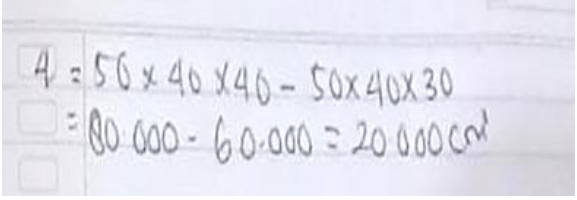

Figure 4. Question number 4 S-3

Based on Figure 4, the results of the work show that subject S-3 has not been able to write down all the information known completely and correctly. The picture also shows that subject S-3 did not determine what was known and asked using his own sentences. This can be seen from the sentences used, although not much different from the question sentence, the direction of the answer is also wrong because S-3 wrote down what was asked. The students were fooled by this question because it was wrong at first, so the next one was wrong. What should be sought is the volume of water in the aquarium, but S-3 answered the volume of the aquarium that was not filled with water. As for the results of the interview for question number 4.

P: Do you understand question number 4?
S-3: Yes, I understand.
P: Do you think the answer is correct or not?
S-3: That's right ma'am. Hehe
P: Try reading again what is asked in the question?
S-3: The volume of water in the aquarium ma'am.
P: Why are the answers not the same?
S-3: (smiles) eh yes ma'am, sorry I wasn't careful.
P: When you finish working, do you like to be checked again?
S-3: I like ma'am but sometimes.
P: The answer is almost correct though. But you have the wrong concept.
S-3: Yes ma'am, you shouldn't have to find the volume of the aquarium, ma'am
P: Okay yes, now do you understand?
S-3: Hehe understand ma'am.

Based on the interview results above, it can be concluded that S-3 is actually able to solve the problem but he is not careful in understanding the problem and applying the solution strategy. S-3 cannot apply indicators 1, 2, 3 and 4, therefore S-3 cannot solve the problem correctly.

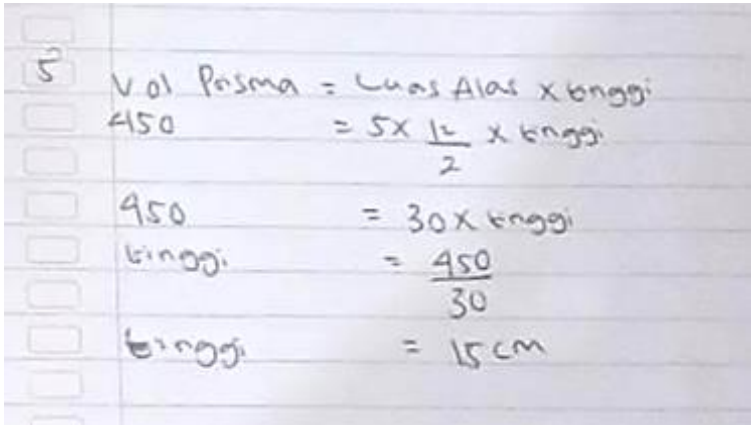

Figure 5. Question number 5 S-3

Based on Figure 5, the results of the work above show that subject S-3 has not been able to write down all the information known completely and correctly. The figure also shows that subject S-3 does not determine what is known and asked using his own sentences. but subject S-3 shows that subject S-3 is able to apply each step that has been planned to solve the problem in order and correctly, and is also able to apply each formula that has been determined to solve the problem, namely by re-deriving the prism volume formula to find the height asked and then solving it correctly. The following are the results of the interview for question number 5.

P: Do you think this question is easy, medium, or difficult?
S-3: easy ma'am.
P: What is known in the question?
S-3: volume and side length.
P: Then what is asked in the question?
S-3: the height of the prism.
P: Okay, what concept do you use to solve the problem?
S-3: re-enter the volume formula to find the height.
P: are you sure about your answer
S-3: God willing, I'm sure ma'am.

The results of the interview above can be seen that S-3 has understood the problem but it seems that he is not used to writing what is known and asked in the problem, but the work is correct. And it can be concluded that S-3 is able to solve problems in understanding and being able to use mathematics in everyday life.

Discussion

Authors should discuss the results and how they can be interpreted from previous studies and the working hypotheses, not repeating the explanation in the research results section. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted. The discussion must also refer to the theory or results of previous research so that it can be seen whether the research results contradict or support each other with the theory or results of previous research. In addition, in this discussion, the novelty of the research results should be seen compared to previous research.

Based on the results of the analysis above, it was found that problem-solving ability is classified as low only in the indicator of making a mathematical model of a situation or everyday problem. Students find it difficult in this indicator because they are not used to the problem. In addition, many students are not careful in their calculations. This is in line with the research of Khasanah, U (2015) which states that in solving problems, students' problem-solving ability still has difficulty in transforming sentences into mathematical models. As researchers can from previous studies, the exercises given are classified as routine questions that focus on the formulas given, not providing where students have to make their own mathematical models. However, in addition to the indicator of interpreting the results according to the initial problem, it is still classified as moderate and for the other three indicators it is classified as moderate.

Conclusion

Based on the results of the analysis above, it was found that problem-solving ability is classified as low only in the indicator of making a mathematical model of a situation or everyday problem. Students find it difficult in this indicator because they are not used to the problem. In addition, many students are not careful in their calculations. This is in line with the research of Khasanah, U (2015) which states that in solving problems, students' problem-solving ability still has difficulty in transforming sentences into mathematical models.

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Conflict of Interest

The authors declare that no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely by the authors.

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