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Analysis students' error in problem solving of two-dimensional figure

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ABSTRACT: Mathematics problems solving, especially in plane material, is an important aspect for the development of logical thinking abilities. This article aims to analyze the errors that often occur to students when completing problem solving questions on flat shapes. This research uses descriptive qualitative methods to explain students' mistakes when answering questions. The subjects of this research consisted of 3 class VIII students at SMPN Langsa who were selected based on their mathematics semester scores, namely the highest, medium and low. The research results showed that the subjects made mistakes when answering questions in the sections understanding the problem, planning procedures and completing mathematical procedures. This shows the need for further research to overcome these errors. At the end of the writing, the researcher offers solutions that teachers can use to minimize the mistakes students make when working on problem solving questions.

Keywords: Flat shapes; math problem solving; student errors

Introduction

Mastering mathematics in this era is very helpful in supporting your career and making life more comfortable. Having high mathematical abilities can make great workers, get paid more and develop well in everything (Austin & Pisano, 2017; Caplan, 2018). To achieve this stability, of course, effort and preparation are needed from elementary school and continue to be developed until they are truly in society (Senk & Thompson, 2020). This development process requires hard work to understand and continue to master mathematics well, regardless of whatever job you dream of. Mathematics has a big role for survival (Altrock et al., 2015) and teaches students to think logically (Oljayevna & Shavkatovna, 2020; Rahman & Ahmar, 2016; Su et al., 2016). This requirement requires that mathematics be presented in a form that is easy for students to understand and accept. However, in reality, many students still experience difficulties even though they have tried to study mathematics at school (Jupri & Drijvers, 2016; Mazana et al., 2019).

Mastering mathematics will make it easier for students to solve problems systematically by recognizing the problems they face and choosing practical strategies to solve them (Laurens et al., 2017; Simamora et al., 2017; Yayuk & As'ari, 2020). However, students often experience obstacles when studying mathematics. The obstacles experienced by students can be seen in the answers that students write to the questions given (Cai et al., 2015; Hadi et al., 2018; Schoenfeld, 2016). Not being able to answer questions correctly indicates that students are weak in solving mathematical problems (Acharya, 2017; Grootenboer & Marshman, 2016). Problem solving solutions are designed as a high-level thinking process (Chinedu et al., 2015; Retnawati et al., 2018). Training students to work on contextual mathematics problems can help them solve problems when they enter society (Gravemeijer et al., 2017; Simamora & Saragih, 2019).

Students are accustomed to understanding and choosing appropriate and fast solution strategies which also have an impact on various activities carried out, even those that are not related to mathematics. This ability is certainly needed by anyone who wants work to be completed easily and it is appropriate for students to master mathematics and have good problem solving skills. Problem solving in mathematics refers to the systematic use of strategies, procedures and methods for solving problems that can be proven correct (English & Gainsburg, 2015; Greeno, 2017; Liljedahl et al., 2016). Problem solving is obtained through combining previously agreed mathematical concepts and rules (Ramirez et al., 2016; Surya & Putri, 2017). Problem solving begins with identifying and formulating what needs to be solved (Treffinger et al., 2023). The identification process will lead to the discovery and evaluation of needs so that knowledge can be developed (Van Aken & Berends, 2018). Students will carry out in-depth exploration to find solutions to the problems presented. Contextual problems become a wrong way for students to apply the problem solving process (Carpenter & Moser, 2020; Jonassen & Hung, 2015). Being able to solve real problems can help students to master the mathematics needed in everyday life (Sumirattana et al., 2017). So that by solving problems students can find the relationship between mathematics and content.

When solving problems, students involve the knowledge they already have to find solutions to problems that were not previously known (Rebello et al., 2017) thereby developing a new understanding of mathematics and this is how the problem solving process arises for every student (Pourhosein Gilakjani & Sabouri, 2016; Riccomini et al., 2015). To make new understanding solid, students need to complete various problem solving questions with tasks that allow them to think logically and systematically (Al-Mutawah et al., 2019; Pete & Fogarty, 2017). Mathematical competency is very dependent on the ability to connect concepts with the required procedures (Al-Mutawah et al., 2019). Even though problem solving is one of the mathematical processes and principles in school, it is placed at the core of the mathematics learning process.

The problem solving procedure consists of, first: understanding the problem by identifying things that are known and asked from the question (Afifah & Faiziyah, 2024; Widodo et al., 2020). This stage requires students to be careful in selecting and sorting the information presented in the questions. Second: develop a plan by determining the relationship between the knowledge you already have and the questions given (Sesanti & Triwahyuningtyas, 2021; Yayuk & Husamah, 2020). At this stage, students organize the strategies that will be used by combining appropriate concepts. This includes explaining formulas, algorithms, equations, tables, graphs and illustrations. Third: carry out calculations according to mathematical procedures by referring to previously prepared plans (Darma et al., 2019; Rini & Purwanti, 2021). This stage students combine the knowledge they have mastered with the information available in the question. Fourth: checking again through recalculation or reverse (Firmansyah & Syarifah, 2023; Hidayati & Wagiran, 2020). Students with good problem solving abilities can be seen from the stages of answering questions based on this procedure. To find out this level of course requires a description and analysis of the answers.

Common errors that can be identified are conceptual errors, calculation errors and question interpretation errors. Conceptual errors occur if students misinterpret terms, facts and principles in mathematics due to not mastering certain concepts (Berner et al., 2020; Tran et al., 2017). Calculation errors occur when students carry out operating procedures that do not comply with the rules in mathematics (Gustafson, 2017; Hadi et al., 2018). Meanwhile, errors in problem interpretation occur because students are unable to interpret mathematical problems so they have difficulty converting them into other forms such as tables, symbols, pictures and diagrams (Freiman et al., 2019; Moon, 2020).

This error is very common when students work on math problems. A study of the errors that often occur when students work on contextual problem solving questions is needed to identify students' mathematical abilities in more detail. By knowing the obstacles that students experience, teachers can take action according to their needs. This research aims to find out the mistakes students make when solving contextual problems in plane material by reviewing the stages of the problem solving procedure. The results of this research can be used as a guide for teachers to improve students' problem-solving abilities and for the government to create new policies to support the abilities students need. Apart from that, this research can also be used as consideration for other researchers to continue their studies regarding solving students' mathematical problems in various regions in Indonesia.

Research methods

This research was written using a qualitative descriptive method in order to analyze students' conditions when solving problem solving questions. The researcher described the students' answers one by one to see the obstacles they experienced when solving the questions. The subjects in this research were class VIII junior high school students, selected with the help of teachers based on the level of semester mathematics learning outcomes. Researchers chose subjects with the highest, medium and low scores to be representatives. The instrument used for this research was in the form of a test with 2 contextual problem solving questions.

Research findings

Students who do not have problem solving skills can be caused by not being careful when reading the questions. Many students apply speed reading to questions, thereby opening up greater opportunities for missing information. The presence of missing information can confuse students even at the stage of understanding the problem by determining what is known and being asked from the question. Mistakes at the beginning will have an impact on the completion stage until the final conclusion. To overcome this problem, teachers can remind students to read the questions carefully and understand what is known and asked by the questions. Putting emphasis on the part of the question given can also help students determine the part they know and ask correctly.

The next obstacle also often occurs when students use mathematical calculation operations such as addition, subtraction, division and multiplication. Even though they are able to understand the problem and choose the strategy to use, students still cannot find the correct answer to the question if they make a mistake when doing the calculations. From here it is useful to check again when the question has been answered in its entirety.

Figure 1 shows that subject 1 already understands the problem presented in the question, he is able to state what he knows and what is asked from reading the question, then he is able to make a plan by selecting the concept that will be used to answer the question. After that, subject 1 was also able to carry out calculations based on appropriate mathematical procedures. However, at the end of the subject's answer, he missed π, the answer that should have been obtained was 45πm^2. This started because the subject calculated the area of the garden without changing the value of π to 3.14 or 22/7. The presence of symbols that are not replaced with numbers is more vulnerable to the operation being carried out ending with an incorrect answer. Apart from that, the subject also did not take advantage of the final problem solving stage, namely checking the answers that had been obtained.

Answer of subject 1 from figure 2 is not much different from figure 1. In this case the subject was also able to understand the problem, choose the concept and solution procedure but did not check again. Besides that, the subject also left π in the final answer which should have obtained 500πm. Double checking has a big impact on mistakes like this. By re-checking the subject can find out that something was not operated or there was a wrong procedure.

The second subject was able to solve problems that fulfilled the 3 stages of problem solving. The subject stated that he knew and was asked based on the information obtained from the question. So it can be categorized as having understood the problem presented, then choosing the appropriate formula and then combining it with several concepts at once. Finally, carry out mathematical operating procedures to obtain the right answer. Even though you have found the correct answer, checking again is still needed to ensure there are errors.

Tabel 1. The questions for test

No	Questions
1.	The grass is planted by the gardener in a square garden with sides 7m long. There is a fish pond with a diameter of 7m in the middle of the park. How much area can the gardener plant with grass?
2.	A circular field with a diameter of 100m is used by runners for training. If the runner circles the field 5 complete laps. How far did the runner travel?

Subject 1

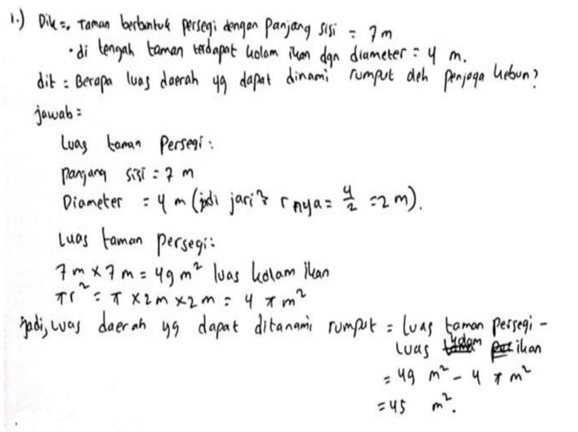

Figure 1. Answer of Subject 1

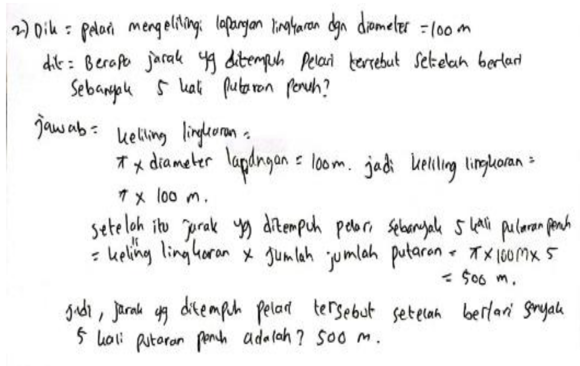

Figure 2. Answer of Subject 1

Subject 2

Figure3. Answer of Subject 2

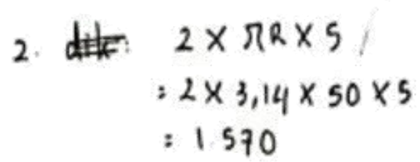

Figure 4. Answer of Subject 2

Subject 3

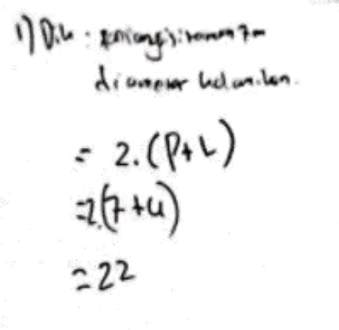

Figure. 5 Answer of Subject 3

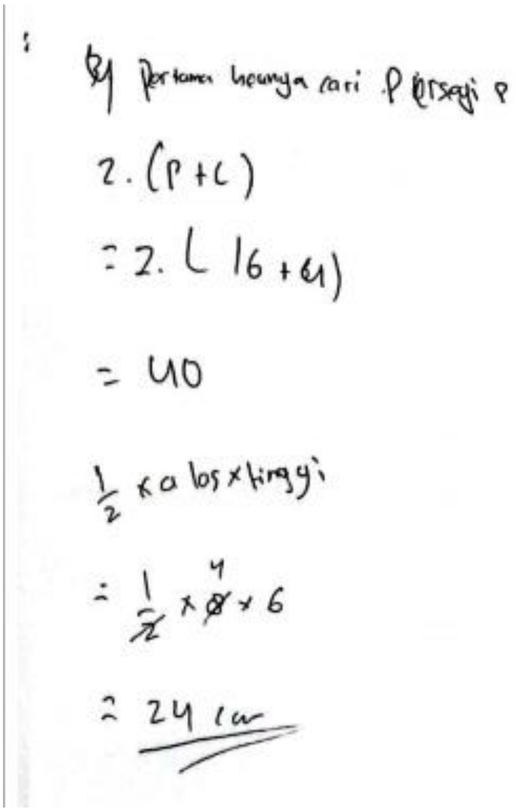

Figure. 6 Answer of Subject 3

In the answer to question number 2, subject 2 got the correct answer but missed the procedure for solving the problem. The subject does not include the stages of understanding the problem and goes straight to the resolution plan. Even though the calculation figures obtained are correct, they do not explain the units that should be used in the answer. The answers obtained have not yet reached a final conclusion. So that the conclusion that shows the answer to the question is in the form of reality is not produced.

The third subject's answer to question number 2 also shows conditions that are not much different from the first question answered by the third subject. This subject did not write down what he knew and asked completely and clearly. Followed by selecting concepts that do not match the requirements of the question. Then operate on numbers that are not even in the problem. These conditions have an impact on the results of the answers that the subject gets.

Discussion

Not understanding the problem is indicated by not explaining what is known and being asked about the question. This can be seen in subject 3 who even operates with numbers that are not related to the question information. However, there are also students who do not write down what they know and ask because they think the information presented has been understood so it does not need to be expressed again. Students who are able to carry out mathematical procedures but do not write down the information about the questions can be seen in subject 2 when working on question number 2. However, without writing it down, it is known and asked, making students vulnerable to carrying out incorrect operating procedures.

Errors in concepts and procedural plans are shown by students not writing formulas according to the requirements of the questions. This condition was seen in subject 3 who started working on the problem by stating the area of the square. Then a calculation error also occurred in subject 3 which was caused by choosing an incorrect concept. Finally, do not double-check the answers you have obtained. This can be seen in subject 1 who has included information from the questions again, planned the work on the questions by writing the correct formula, carried out procedures in accordance with mathematical concepts and combined several concepts but did not double check. Not checking again resulted in subject 1 not getting the correct final answer.

These four errors that students experience can be minimized by getting students used to working on contextual problem solving questions (Simonsohn et al., 2015). Doing the questions repeatedly will make students understand the things that need to be done when solving the questions. Emphasizing certain concepts to strengthen students' memories (Laurens et al., 2017; Riccomini et al., 2015). Then the teacher can remind students when working on questions, such as being reminded to rewrite the information in the problem (Schoenfeld, 2016; Sprenger, 2018) and then provide an explanation of why this rewriting needs to be done every time they write a problem solving question in the form of a story. Teachers can also remind students to double-check the answers to each question (Anthony et al., 2015; Brahier, 2020). Double checking is also useful to ensure whether there is any information left out or procedures missed or incorrect mathematical operations. Teachers can give this understanding to students so that they continue to remember it every time they do a problem.

This research is limited to analyzing the mistakes students make when working on problem solving questions in the form of stories. Future research is expected to focus on corrective practices that teachers may carry out to minimize the mistakes students make when answering mathematics questions. Apart from that, further research can also be developed to detect errors by referring to abilities other than problem solving.

Conclusion

problem solving problems can occur because students do not understand the problem by not writing back the information stated in the problem. It can also occur in conceptual or planning errors where they have not been able to find a connection between the information they have obtained and the information presented in the question. Furthermore, procedural errors can occur because students have not mastered the prerequisite material. To overcome these obstacles, teachers must familiarize students with working on problem-solving questions in the form of stories, finding out the prerequisite material that must be mastered and reminding them to write down known questions and check again when working on questions.

Disclosure statement

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