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Analysis of Problem-Solving Abilities Based on Student Proficiency Levels in D Phase

Aisyah Nabilah Rusvi[1]

[1] Universitas Muhammadiyah Gresik; Indonesia

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ABSTRACT

This study investigates the problem-solving abilities of seventh-grade students at SMP Muhammadiyah 1 Gresik in the context of flat-sided spatial figures. Employing a qualitative descriptive approach, the study involved three subjects representing varying levels of problem-solving abilities: excellent, moderate, and low. Data collection was conducted through tests, observations, and in-depth interviews. The findings revealed a range of problem-solving abilities among the three subjects. The student with excellent problem-solving skills demonstrated the ability to comprehend the problem, employ clear and rational strategies, construct accurate mathematical models, and thoroughly check their answers. The subject with moderate problem-solving skills exhibited an understanding of the problem and utilized rational strategies; however, they faced challenges in creating accurate models and drawing conclusions. The subject with low problem-solving skills encountered difficulties in comprehending the problem, selecting appropriate strategies, and correctly solving the problem. The study's conclusions emphasize the need for specialized attention and guidance for students with low problem-solving abilities to foster their effective problem-solving skills. Conversely, students with high problem-solving abilities can be provided with more complex challenges to optimize their capabilities. This research provides a foundation for teachers to tailor their support to students' individual problem-solving abilities in mathematics.

Corresponding Author:
Aisyah Nabilah Rusvi
Universitas Muhammadiyah Gresik; ppg.aisyahrusvi01830@program.belajar.id

INTRODUCTION

Mathematics stands as a foundational discipline permeating every level of education, including junior high school (SMP). Its significance extends beyond the confines of mathematical study, as its applications transcend boundaries into diverse fields of knowledge. Mathematics education encompasses endeavors that empower students to construct mathematical concepts and principles independently through a process of internalization, enabling them to re-formulate these concepts and principles within their own understanding (Freudenthal, 2005).

As outlined in Indonesian Ministerial Regulation No. 22 of 2013, the primary goal of junior high school (SMP) mathematics education is to equip students with the ability to tackle mathematical problems effectively. This encompasses developing competencies in comprehending problems, constructing mathematical models, solving these models, and interpreting the solutions obtained (Khoerunnisa & Imami, 2020). Echoing this sentiment, the National Council of Teachers of Mathematics (NCTM) advocates for problem-solving as a central objective in mathematics education, emphasizing the importance of providing opportunities for all students to engage in problem-solving activities (National Council of Teachers of Mathematics, 1999).

Problem-solving skills are of paramount importance in mathematics, not only for those who will pursue advanced mathematics studies but also for those who will apply mathematical concepts in other disciplines and in their daily lives. Learning problem-solving is essentially learning to think or learning to reason, which involves applying previously acquired knowledge to address novel problems (Corte et al., 1996). Through the problem-solving process, students can cultivate their critical thinking abilities (Ennis, 1993).

Despite the recognized importance of problem-solving skills among students, Indonesia faces the challenge of low student proficiency in this area. This is evident in the results of the Programme for International Student Assessment (PISA), which evaluated problem-solving skills among students from 79 countries in 2018 (OECD, 2019). Indonesia scored an average of 371 (placing sixth from the bottom) in reading, 379 (seventh from the bottom) in mathematics, and 396 (ninth from the bottom) in science performance.

Flat-sided solids, also known as polyhedra, stand as a pivotal topic within the mathematics curriculum of junior high school. The study of flat-sided solids offers multifaceted benefits for students, not only in facilitating the comprehension of subsequent mathematical concepts but also in establishing connections to real-world applications (Sari et al., 2017). Mastering the understanding of flat-sided solids serves as a prerequisite for students to effectively grasp more advanced mathematical topics (Anggraeni & Kadarisma, 2020).

Problem-solving abilities exhibit significant variations among junior high school students, as evidenced by various research studies investigating this aspect of mathematical proficiency. Anggraeni and Kadarisma explored the problem-solving skills of first-grade of junior high school students in the context of set theory, employing Polya's heuristic procedure and identifying common errors made by students during problem-solving (Anggraeni & Kadarisma, 2020). Rio and Pujiastuti examined the problem-solving abilities of second-grade junior high school students in the domain of integers at SMP 1 Kadu Hejo (Rio & Pujiastuti, 2020). Rahmawati and Warmi analyzed students' problem-solving capabilities in applying the Pythagorean theorem in mathematics at SMPN 16 Bekasi (Rahmawati & Warmi, 2022).

Existing research has consistently demonstrated the wide range of problem-solving abilities exhibited by students. This diversity is also evident among the seventh-grade students at SMP Muhammadiyah 1 Gresik. Preliminary studies reveal that not all students are capable of successfully solving problems, a situation that necessitates the exploration of effective solutions to support these

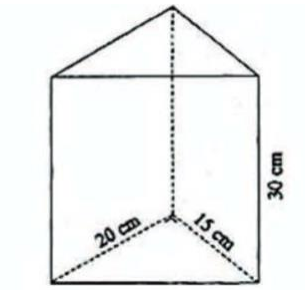
students. To provide targeted intervention, a thorough analysis of students' problem-solving abilities is essential. Consequently, this research aims to analyze the mathematical problem-solving abilities of seventh-grade students at SMP Muhammadiyah 1 Gresik, focusing on the topic of flat-sided solids. The study will delve into the characteristics of students' problem-solving skills at each stage of the problem-solving process. The findings of this research are expected to serve as a foundation for teachers to provide appropriate assistance to students facing challenges in mathematical problem-solving.

METHODS

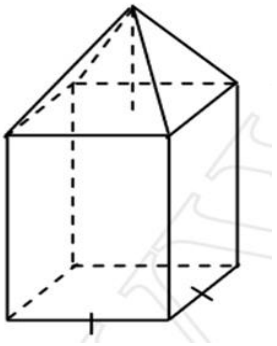
This study employs a qualitative descriptive research methodology, primarily aiming to portray students' mathematical problem-solving abilities in the context of flat-sided solids. The research subjects comprise three seventh-grade students from SMP Muhammadiyah 1 Gresik, Academic Year 2023/2024, each representing a different level of mathematical problem-solving proficiency: very good, average, and very low. The selection of research subjects involves administering a written mathematics ability test. The research was conducted in April 2024.

In addition to describing students' problem-solving abilities, the study also identifies the errors they make in solving mathematical problems, considering their levels of mathematical problem-solving proficiency based on Polya's theory. The indicators used to measure problem-solving abilities include analyzing and understanding the problem, designing and planning a solution, exploring solutions to difficult problems, and verifying the solution (Polya, 2004). The instruments employed in data collection include a general mathematics ability test for all seventh-grade (B) students, a flat-sided solids problem-solving ability test for the three selected students, and observation. Additionally, in-depth interviews are conducted. The validity and reliability of the tests are established before administering them to the students. The following is a test instrument to measure the ability to solve problems with flat-sided geometric figures :

1. Imagine you have a triangular prism-shaped aquarium like the one shown in the accompanying image. This aquarium is used to keep ornamental fish. Determine the volume of water that the aquarium can hold ....



2. You have a toy shaped like the one shown in the accompanying image. The toy consists of a block with dimensions of 6 cm (length), 6 cm (width), and 12 cm (height), topped by a square pyramid with a height of 4 cm. The toy is made of colorful plastic and is used as a decoration in your room. Calculate the total surface area of the toy !



FINDINGS AND DISCUSSION

This section presents and analyzes the research data obtained from the selected subjects. The data is presented in a sequential manner, following Polya's problem-solving steps, which include analyzing and understanding the problem, designing a solution, solving the problem, and verifying the solution. Problem-solving abilities are examined based on each step of the problem-solving process. Subsequently, the research data is analyzed based on the classification of subjects and their problem-solving abilities.

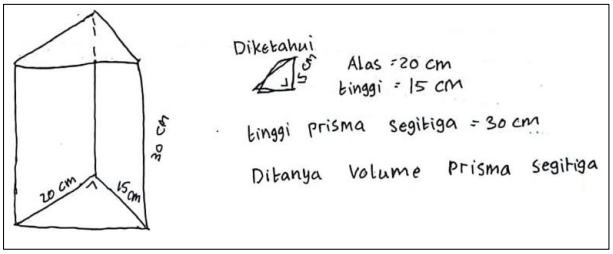
According to the results of the general mathematics ability test, the students of class VII B at SMP Muhammadiyah 1 Gresik exhibit heterogeneous abilities. Based on the results of this general mathematics ability test, three subjects were selected: one with very high ability, one with average ability, and one with very low ability.

1. Problem-Solving Abilities of High-Ability Students

   Analyze the answer to question number 1

   a. Stage 1 (*Understanding*)

      The first step in solving problems according to Polya is understanding the problem. In the first stage, students are required to make pictures or illustrations if possible, look for special cases, and try to understand the problem in simple terms. Results of student work:



Picture 1. KE's Understanding Stage (1st Question)

In the picture above, it can be seen that the KE subject was complete in writing down the information he knew and was asked about and during the interview he was able to express everything he knew about the questions very well. This can be seen from the interview quote which shows that the subject can express it in his own language.

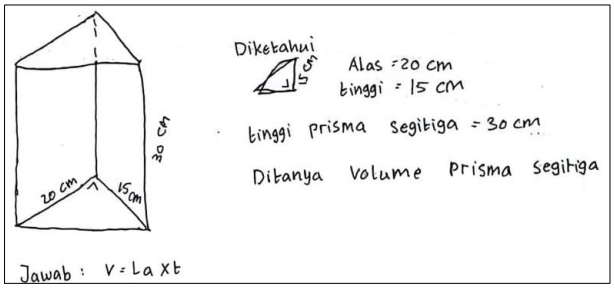
Researcher : *Berdasarkan soal ini, apa saja ya yang diketahui?*

KE subject : *Alasnya segitiga punya alas 20 cm dan tinggi 15 cm. Tinggi prisma 30 cm.*

Based on the subject test worksheet, as well as interviews and observations carried out by researchers, it can be concluded that KE subjects have the ability to understand problems. KE subjects are able to write down everything they know about the question and have the skills to express the information contained in the question.

   b. Stage 2 (*Planning*)

      The second step in solving problems according to Polya is planning a solution. The designing and planning solution stage includes planning the solution systematically and determining what will be done, how to do it and the expected results.

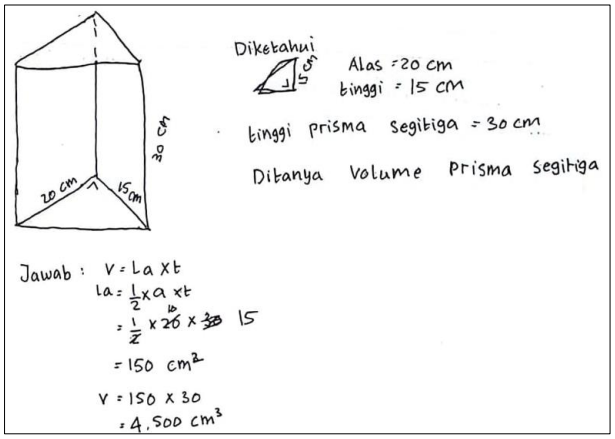


Picture 2. KE's Planning Stage (1st Question)

At this stage, students write a solution plan on the answer sheet. Apart from that, based on the interview results, KE subjects revealed that to find the volume of a geometric figure, multiply the area of the base by the height of the spatial figure. So, it can be concluded that KE subjects are able to plan the solution to this problem and use a clear strategy.

c. Stage 3 (*Solving*)

The third stage is finding a solution to the problem. In the problem solving stage, it really depends on students' experience to be more creative in preparing solutions to a problem. At this stage, based on the subject KE completes using the correct procedures and obtains the correct results, as seen in the following picture:



Picture 3. KE's Solving Stage (1st Question)

Subject KE implemented his plans very well. Based on the researcher's observations, the subject calculated the base area first, then calculated the volume of the triangular prism using the base area previously obtained. In accordance with the results of the following interview:

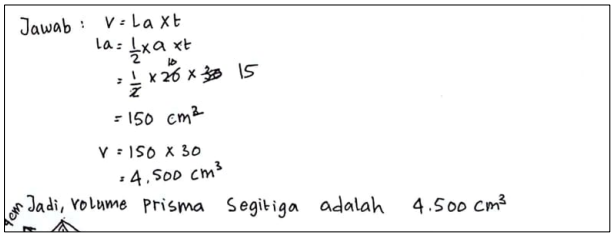
Researcher : *Luas alas disini tertulis setengah alas dikali tinggi. Alas yang mana dan tinggi mana yang dimaksud?*

KE Subject : *Alas dan tinggi segitiga siku-sikunya bu.*

Based on the subject test worksheet, as well as interviews and observations carried out by the researcher, it can be concluded that the KE subject is able to complete the completion plan properly and correctliy and the calculation results are correct.

d. Stage 4 (*Checking*)

The final stage is to examine the solution which consists of using specific checks on each information and resolution steps and using general checks to determine the problem in general and its development.



Picture 4. KE's Checking Stage (1st Question)

On the test worksheet, the subject writes a conclusion regarding the final answer given. Based on the observations of researchers, the subject of KE checking can be seen from the conclusions of the answers written. The results of checking the subject KE are supported by the results of the researcher's interview with the subject.

Researcher: *Apakah sudah dicek jawabannya?*

KE Subject *: Sudah.*

Researcher : *Ada perubahan gak, setelah kamu cek ulang?*

KE Subject : *Tadi saya keliru nulis satuan luas alas. Aslinya saya nulis* cm^3 *saya betulkan menjadi* cm^2.

Researcher : *Apakah ada kesulitan saat mengerjakannya?*

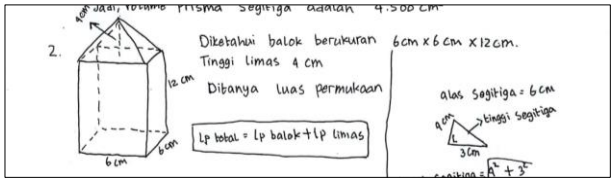
KE Subject : *Tidak ada.*

Based on the subject's test worksheets, as well as interviews, and observations that have been made by the researcher, it can be concluded that the subject of KE has done Stage *checking* and obtained the right answer.

Analyze the answer to question number 2

a. Stage 1 (*Understanding*)

The first step to problem solving according to Polya is to understand the problem. In the first stage students are required to make pictures or illustrations if possible, look for special cases, and try to understand the problem simply. Student work results:



Picture 5. KE's Understanding Stage (2nd Question)

In the picture above, it can be seen that the subject KE is complete in writing down the information known and asked and at the time of the interview is able to know everything in the question very well. This can be seen from the interview excerpts which show that the subject can tell the problem in his own language.

Researcher : *Soal ini terdapat bangun ruang apa ya?*

KE Subject : *Yang bawah bangun ruang balok dan di atasnya ada limas.*

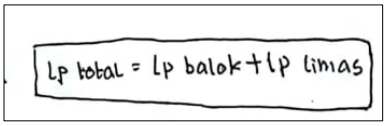
Researcher : *Apa saja yang diketahui dalam soal?*

KE Subject : *Balok berukuran panjang 6 cm, lebar 6 cm, tinggi 12 cm dan tinggi limas 4 cm.*

Based on the subject test worksheets, as well as interviews, and observations that have been made by the researcher, it can be concluded that the subject of KE has the ability to understand the problem. The subject of KE has been able to write down what is known what the problem is and has skills in expressing the information contained in the problem.

b. Stage 2 (*Planning*)

The second step of problem solving according to Polya is to plan a resolution. The stage of designing and planning solutions includes planning solutions systematically and determining what will be done, how to do it and expected results. At this stage, the subject of the KE writes a completion plan on the answer sheet, that to find the surface area as a whole means having to add the surface area of the beam and pyramid.



Picture 6. KE's Planning Stage (2nd Question)

To reconfirm the understanding of what has been written by KE subjects, here are interviews conducted by researchers:

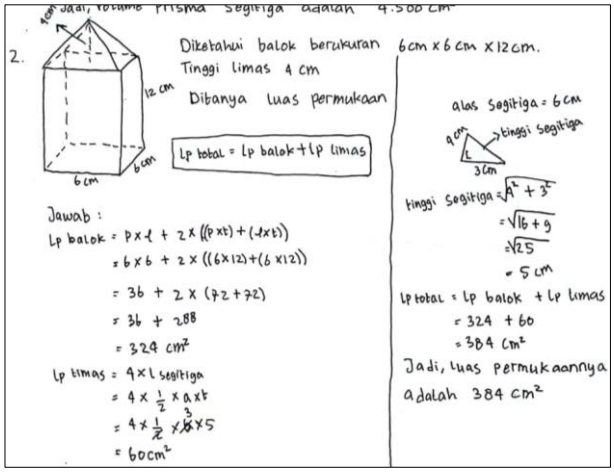
Researcher : *Disini kamu menuliskan luas permukaan total sama dengan luas permukaan balok dan luas permukaan limas. Apakah bisa dijelaskan lebih detail?*

KE Subject : *Jadi untuk mencari luas permukaan total, hanya sisi luar yang dihitung. Dan disini ada pengecualiannya juga. Kayak yang sisi bawah limas sama sisi atas balok ini gapakai dihitung.*

Therefore, based on the subject test worksheets, as well as interviews, and observations that have been made by researchers, it can be concluded that KE subjects have the ability to understand and plan problems coherently and correctly.

c. Stage 3 (*Solving*)

The third stage is to find solutions to problems, in the problem solving stage depends heavily on student experience to be more creative in compiling solutions to a problem. At this stage, subject-based KE completes using the correct procedure, with the following work:



Picture 7. KE's Planning Stage (2nd Question)

The subject of KE is correct in implementing the concept of phytagoras when finding the area of a triangle in the calculation of the surface area of the pyramid. The subject also obtained the exact answer for the combined surface area of the beam and pyramid space construct is 384 cm^2. Therefore, it can be concluded that, subject KE can solve the problem on this problem and use the appropriate steps.

d. Stage 4 (*Checking*)

The final stage is to examine the solution which consists of using specific checks on each information and resolution steps and using general checks to determine the problem in

general and its development. At this stage based on the researcher's observation, the subject of KE has double-checked the results of his work, so as to get the right answer.

Researcher : *Sudah dicek kembali jawabannya?*

KE Subject : *Sudah bu.*

Researcher : *Sudah yakin jawabannya 384 cm^2?*

KE Subject : *Yakin bu.*

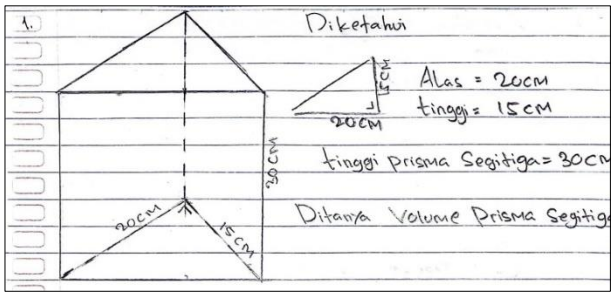
Therefore, it can be concluded that subject KE has checked the answer carefully and obtained the final correct answer.

2. Results of Problem Solving Ability in Sufficient Level Students

Analyze the answer to question number 1

a. Stage 1 (*Understanding*)

The first step to problem solving according to Polya is to understand the problem. In the first stage students are required to make pictures or illustrations if possible, look for special cases, and try to understand the problem simply. Student work results:



Picture 8. AL's Understanding Stage (1st Question)

In the picture above, it can be seen that the AL subject is complete in writing down the known information and at the interview is able to convey what is known on the question very well. This can be seen from the interview excerpts which show that the subject can tell the problem in his own language.

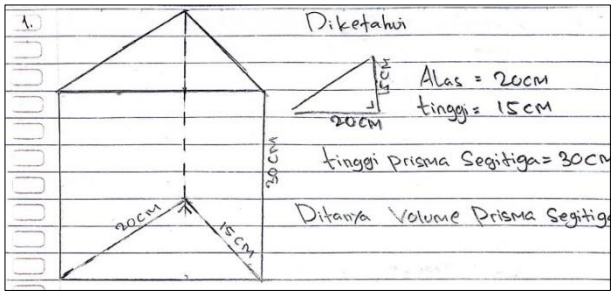
Researcher : *Berdasarkan soal ini, apa saja ya yang diketahui?*

AL Subject : *Ini Picturenya berupa prisma segitiga. Tingginya 30 cm. Segitiganya di sini, saya coba Picturekan, alasnya sepanjang 20 cm dan tingginya 15 cm.*

Based on the subject test worksheets, as well as interviews, and observations that have been made by the researcher, it can be concluded that the AL subject has the ability to understand the problem. The subject has been able to write down what is known what the problem is and has skills in expressing the information contained in the problem.

b. Stage 2 (*Planning*)

The second step of problem solving according to Polya is to plan a resolution. The stage of designing and planning solutions includes planning solutions systematically and determining what will be done, how to do it and expected results. At this stage, students do not write a completion plan on the answer sheet. However, when researchers observe subjects when solving problems. The subject of AL murmured "*Volume itu luas alas dikali tinggi ini. Ini segitiga siku-siku. Tak cari luasnya sek.*" In addition, the subject of AL wrote down what was asked on the question.

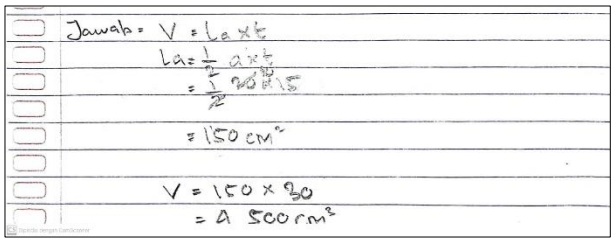


Picture 9. KE's Planning Stage (1st Question)

Based on this, it can be concluded that the subject of the AL is able to plan the solution of this problem and use a clear strategy.

c. Stage 3 (*Solving*)

The third stage is to find solutions to problems, in the problem solving stage depends heavily on student experience to be more creative in compiling solutions to a problem. At this stage, based on the subject AL resolves using the correct procedure and obtaining the correct results, as seen in the following picture:



Picture 10. AL's Solving Stage (1st Question)

The subject of the AL implemented his plan very well. Based on the researcher's observations, the subject calculated the area of the base first, then calculated the volume of the triangular prism using the area of the base that had been obtained previously. In accordance with the results of the following interview:

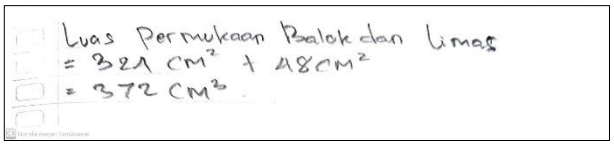
Researcher : *Berapa hasil akhirnya?*

AL Subject : *4500cm^3 bu.*

Based on the subject test worksheets, as well as interviews, and observations that have been made by researchers, it can be concluded that the AL subject is able to complete his completion plan properly and correctly and the results of precise calculations.

d. Stage 4 (*Checking*)

The final stage is to examine the solution which consists of using specific checks on each information and resolution steps and using general checks to determine the problem in general and its development.



Picture 11. AL's Solving Stage (1st Question)

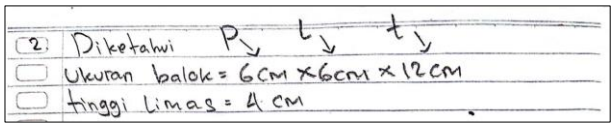
Based on the observations of researchers, the AL subject checked as seen from the conclusions of the answers written. The results of checking AL subjects are supported by the results of the researchers' interviews with subjects.

Researcher : *Apakah sudah dicek jawabannya? Ada kesulitan?*
AL Subject : *Sudah bu, sejauh ini tidak ada kesulitan.*
Therefore, it can be concluded that the subject of AL has done Stage checking and obtained the right answer.

Analyze the answer to question number 1

a. Stage 1 (*Understanding*)

The first step to problem solving according to Polya is to understand the problem. In the first stage students are required to make pictures or illustrations if possible, look for special cases, and try to understand the problem simply. Student work results:



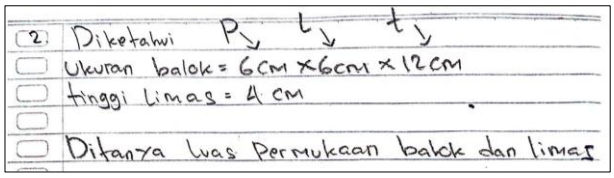
Picture 12. AL's Understanding Stage (2nd Question)

Researcher : *Soal ini terdapat bangun ruang apa ya?*
AL Subject : *Ada balok dan limas.*
Researcher : *Apa saja yang diketahui dalam soal?*
AL Subject : *Balok punya panjang 6 cm, lebar 6 cm, tinggi 12 cm. Lalu, limas diketahui tingginya 4 cm.*

Based on the subject test worksheets, as well as interviews, and observations that have been made by the researcher, it can be concluded that the AL subject has the ability to understand the problem. AL subjects have been able to write down what is known about the problem and have skills in expressing the information contained in the problem.

b. Stage 2 (*Planning*)

The second step of problem solving according to Polya is to plan a resolution. The stage of designing and planning solutions includes planning solutions systematically and determining what will be done, how to do it and expected results. At this stage, the AL subject writes a completion plan on the answer sheet, that to find the overall surface area means having to add the surface area of the beam and pyramid.



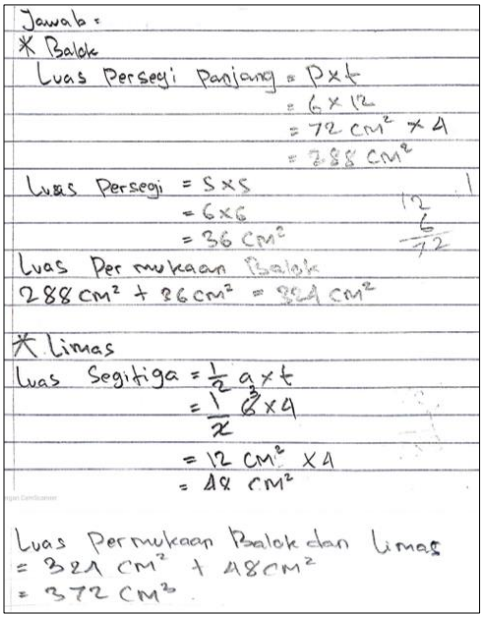
Picture 13. AL's Planning Stage (2nd Question)

To reconfirm the understanding of what has been written by the subject of AL, the following interview conducted by the researcher:
Researcher : *Bagaimana sih cara mencari luas permukaan? Bagaimana Picturean sederhananya?*
AL Subject : *Jadi semua sisi luar yang ada di bangun ruang, luasnya ditambahkan.*
Researcher : *Kalau berdasarkan kasus yang ada di soal ini, berarti sisi mana aja yang dihitung luasnya?*
AL Subject *: Berarti sisi luar bangun ruang yang sudah tergabung yang hanya ditambahkan. Sisi atas kubus atau sisi bawah limas gapakai karena mereka bukan sisi luar lagi.*

Therefore, based on subject test worksheets, as well as interviews, and observations that have been made by researchers, it can be concluded that AL subjects have the ability to understand and plan problems coherently and correctly.

c. Stage 3 (*Solving*)

The third stage is to find solutions to problems, in the problem solving stage depends heavily on student experience to be more creative in compiling solutions to a problem.



Picture 14. AL's Solving Stage (2nd Question)

At this stage, the subject of AL is not correct, the subject should implement the concept of phytagoras when calculating the surface area of the pyramid. The correct answer to the combined surface area of the beam and pyramid space is 384 cm^2. Therefore, it can be concluded that, the subject of the AL has not been able to solve the problem on this issue. However, the measures used are appropriate.

d. Stage 4 (*Checking*)

The final stage is to examine the solution which consists of using specific checks on each information and resolution steps and using general checks to determine the problem in general and its development. At this stage, based on the observations of researchers, the AL subject has re-checked the results of his work, but there are still wrong answers because they are not careful.

Researcher : *Sudah dicek kembali jawabannya?*
AL Subject : *Sudah bu.*
Researcher : *Sudah yakin jawabannya 372* cm^3 *?*
AL Subject : *Salah di satuannya gak sih bu? Saya kurang teliti ini seharusnya* cm^2.
Researcher : *Ok, betul. Selain itu, disini jawaban akhirnya juga kurang tepat. Coba cek lagi, kira-kira salahnya dimana ya?*
AL Subject : *Bingung bu, menurut saya ini sudah benar.*
Researcher : *Bangun ruang yang bagian atas itu bangun ruang apa?*
AL Subject : *Limas.*
Researcher : *Buat menghitung luas permukaan bangun ruang limas, kamu menghitung luas bangun datar apa disitu?*
AL Subject : *Segitiga bu.*
Researcher : *Rumus luas segitiga apa?*

AL Subject : *a dikali t dibagi 2.*
Researcher : *Alasnya berapa?*
AL Subject : *6 cm*
Researcher : *Tinggi nya segitiga berapa?*
AL Subject : *4 cm bu. EH, salah bu. Ini 4 cm tingginya punyanya limas bukan segitiga.*

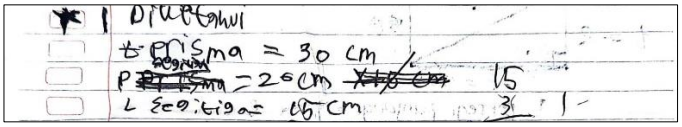
Based on the interview above, subject AL had double-checked but was still not careful during the checking process with the final answer that was not right and did not write down the conclusion of the answer obtained.

3. Results of Problem Solving Ability in Less Level Students

Analyze the answer to question number 1

a. Stage 1 (*Understanding*)

The first step to problem solving according to Polya is to understand the problem. In the first stage students are required to make pictures or illustrations if possible, look for special cases, and try to understand the problem simply. Student work results:



Picture 15. FA's Understanding Stage (1st Question)

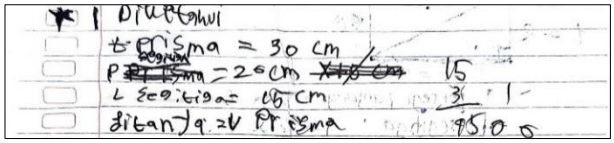
In the picture above, it can be seen that the subject of FA is incomplete in writing down known information. This is also supported by interview excerpts that show that the subject can tell the problem in his own language.

Researcher : *Berdasarkan soal ini, apa saja ya yang diketahui?*
FA Subject *: Tinggi prismanya 30 cm. Ini bawahnya ada segitiga, panjangnya 26 cm sama lebarnya 15 cm.*

Here there is a misunderstanding when giving the elements of a triangle. The triangular element should use the base and height instead of length and width. Based on the test worksheets of the subjects, as well as interviews, and observations that have been made by the researcher, it can be concluded that the subject of FA cannot understand the problem.

b. Stage 2 (*Planning*)

The second step of problem solving according to Polya is to plan a resolution. The stage of designing and planning solutions includes planning solutions systematically and determining what will be done, how to do it and expected results.



Picture 16. FA's Planning Stage (1st Question)

At this stage, the subject of the FA does not write the completion plan on the answer sheet. In addition, the subject did not understand what plan or strategy was used to solve this problem, based on the following interview excerpts:

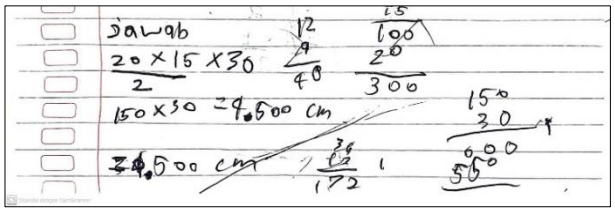
Researcher : *Disini kamu menuliskan yang ditanyakan adalah volume prisma. Gimana sih cara menentukan volume prisma?*
FA Subject : *Volume itu kayaknya luas alas dikali tinggi bu.*

Researcher : *Oke, luas alas dikali tinggi. Tinggi apa ya yang dimaksud?*
FA Subject : *Tinggi prisma bu, yang ini (menunjuk bangun prisma).*
Researcher : *Kalau luas alasnya bagaimana? Alasnya yang mana sih? Bagaimana cara mencari luas alas?*
FA Subject :: *Alasnya segitiga bu. Saya lupa rumus luas segitiga bu, pokoknya ini dikali ini, nanti dibagi 2.*

Based on this, it can be concluded that the subject of the FA did not use a clear strategy and hesitated when explaining his plans.

c. Stage 3 (*Solving*)

The third stage is to find solutions to problems, in the problem solving stage depends heavily on student experience to be more creative in compiling solutions to a problem. At this stage, based on the subject the FA obtained the right results, although hesitant in devising a plan or strategy for its completion.



Picture 17. FA's Solving Stage (1st Question)

Based on the researcher's observations, the subject calculated the area of the base and directly multiplied it against the height of the prism to obtain the volume of the prism. In accordance with the results of the following interview:
Researcher : *Untuk kedepannya, sebelum menulis angkanya lebih baik ditulis rumusnya dulu ya. Supaya ibu tahu, 20 ini asalnya dari mana, 15 ini dari mana, 2 dari mana, dan seterusnya.*
FA Subject : *20 sama 15 ini punyanya segitiga bu. 30 ini tinggi prisma. Terus ini dibagi 2 karena rumus luas segitiga kayaknya dibagi 2.*
Based on the subject test worksheets, as well as interviews, and observations that have been made by the researcher, it can be concluded that the subject of FA is able to complete his completion plan precisely even though the plan made is not yet clear.

d. Stage 4 (*Checking*)

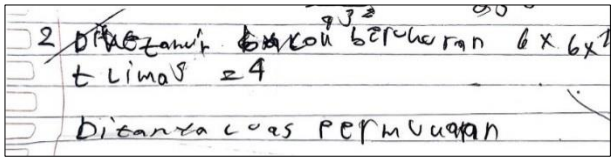
The final stage is to examine the solution which consists of using specific checks on each information and resolution steps and using general checks to determine the problem in general and its development. At this stage based on the researcher's observations, the subject of FA did not double-check the results of his work, but the final answer was correct.
Researcher : *Apakah sudah dicek jawabannya?*
FA Subject : *Tidak perlu bu, kesuwen (terlalu lama).*

Therefore, it can be concluded that the subject of FA did not perform stage checking but obtained the right answer and did not conclude in writing what was the answer.

Analisis Jawaban Soal Nomor 2

a. Stage 1 (*Understanding*)

The first step to problem solving according to Polya is to understand the problem. In the first stage students are required to make pictures or illustrations if possible, look for special cases, and try to understand the problem simply. Student work results:



Picture 18. FA's Understanding Stage (2nd Question)

In the picture above, it can be seen that the subject of FA is incomplete in writing down known information and at the time of the interview is unable to explain what has been written. This can be seen from the following interview excerpts:

Researcher : *Soal ini terdapat bangun ruang apa ya?*
FA Subject : *Bawahnya balok dan di atasnya ada limas.*
Researcher : *Apa saja yang diketahui dalam soal?*
FA Subject : *Ukurannya balok 6 x 6 x 12. Limas tingginya 4 cm.*
Researcher : *6 6 12 ini apa ya?*
FA Subject : *Saya tidak tahu bu, lupa.*

Based on the subject test worksheets, as well as interviews, and observations that have been made by researchers, it can be concluded that FA subjects do not perform stage understanding and are less able to explain what has been written.

b. Stage 2 (*Planning*)

The second step of problem solving according to Polya is to plan a resolution. The stage of designing and planning solutions includes planning solutions systematically and determining what will be done, how to do it and expected results. At this stage, the subject of the FA does not write the completion plan on the answer sheet.

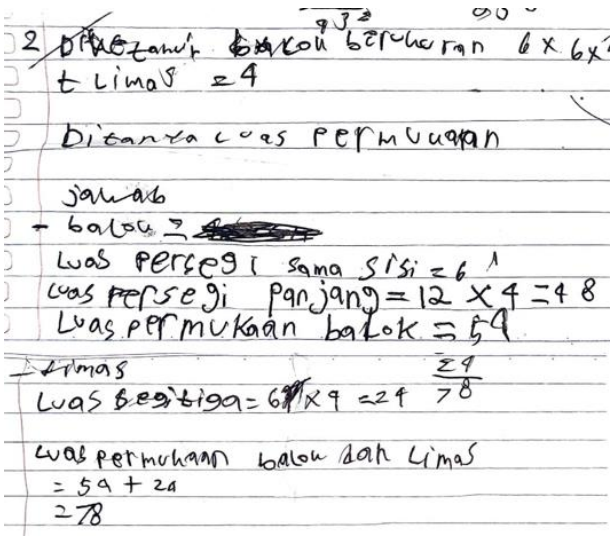
To reconfirm, researchers conducted interviews with FA subjects as follows:

Researcher : *Apa sih itu luas permukaan?*
FA Subject : *Sisi sisi yang ini (menunjuk bagian sisi terluar), luasnya ditambah semua.*
Researcher : *Ini luas permukaan mana yang ditanyakan?*
FA Subject : *Ya, bangun ruang ini bu (menunjuk bangun ruang yang terdapat pada soal).*
Researcher : *Nah tadi kan kamu bilang luasnya ditambah semua. Itu gimana yaa caranya? Langkah-langkahnya bagaimana?*
FA Subject : *Gatau bu, saya ngawur ini nulisnya.*

Therefore, based on the subject test worksheets, as well as interviews, and observations that have been made by researchers, it can be concluded that FA subjects do not have the ability to plan problem solving coherently and correctly.

c. Stage 3 (*Solving*)

The third stage is to find solutions to problems, in the problem solving stage depends heavily on student experience to be more creative in compiling solutions to a problem. At this stage, the subject of FA obtained incorrect results and did not use a clear strategy.



Picture 19. FA's Solving Stage (2nd Question)

There is an error in the calculation of the surface area of the beam. The exact answer to the combined surface area of the beam and pyramid space is 384 cm^2. Therefore, it can be concluded that, the subject of FA has not been able to solve the problem in this matter.

d. Stage 4 (*Checking*)

The final stage is to examine the solution which consists of using specific checks on each information and resolution steps and using general checks to determine the problem in general and its development. At this stage, based on the observations of researchers, FA subjects also do not check the results of their work.

Researcher : *Sudah dicek kembali jawabannya?*

FA Subject : *Bu, saya gabisa ngerjainnya. Pasti salah ini bu. Saya nyerah.*

Based on the description above, broadly speaking the following is the suitability of student work results against four criteria for the level of problem-solving ability:

1) The subject of KE as a student with an excellent level of ability has criteria :
   - Understand the problem (write down what is known and what is asked)
   - Choose and use a clear and rational strategy
   - Create mathematical models and their calculations precisely
   - Double-check the answer exactly
2) The subject AL, as a student with an adequate level of ability, meets the following criteria:
   - Understands the problem (articulates known information and what is being asked)
   - Chooses and employs a clear and rational strategy
   - Creates models and calculations with some inaccuracies
   - Draws conclusions with some inaccuracies
3) The subject FA, as a student with a very low level of ability, meets the following criteria:
   - Fails to understand the problem (does not articulate known information and what is being asked)
   - Fails to choose and employ a clear and rational strategy
   - Does not create mathematical models and calculations
   - Does not complete the problem-solving task

The results of this study contradict the results of research conducted by (Imroatun, 2014) with the title "Strategi Pemecahan Masalah Matematika Siswa Kelas VII SMP Kristen Salatiga Ditinjau dari Langkah Polya" that "*... subjek dalam kelompok nilai tinggi maupun subjek dalam kelompok nilai rendah*

keduanya melakukan tiga langkah pemecahan masalah menurut Polya yaitu memahami masalah, membuat rencana pemecahan masalah dan melaksanakan pemecahan masalah sesuai rencana yang telah dipikirkan sebelumnya. Strategi yang digunakan siswa dalam kelompok tinggi adalah dengan mengidentifikasi informasi yang diinginkan, diberikan, dan diperlukan." .

However, in this study it was found that subjects with high abilities (KE subject) were not only able to understand problems and use clear and rational strategies, but also able to make mathematical models and perform calculations precisely, as well as re-examine the answers. Meanwhile, subjects with moderate ability (AL subject) despite understanding the problem and using clear strategies, had difficulty in modeling and performing calculations correctly on the second problem. On the other hand, subjects with low ability (FA subject) showed difficulties in all steps of problem solving according to Polya, namely in understanding the problem, choosing the right strategy, making mathematical models, and performing calculations and problem solving. Problem solving activities can increase student activity (Adhimah, etc, 2023) .

The results of this study showed a significant difference in mathematical problem-solving ability among students with different levels of ability. This emphasizes the importance of giving special attention and more intensive guidance to students with low abilities so that they can develop skills in understanding problems, choosing appropriate problem-solving strategies, and creating and implementing mathematical models effectively. On the other hand, for high-ability students, challenges are more complex and guidance in refining problem-solving strategies can help them optimize their abilities.

There are several external factors that affect the level of problem-solving ability in each student such as the quality of teaching, the availability of learning resources, and support from the school environment and family also play an important role. In addition, students' intrinsic and extrinsic motivation also determine the extent to which they try to understand the problem and find appropriate solutions. Differences in learning styles and previous experience with maths also affect how students approach and solve problems. Therefore, a learning approach tailored to individual needs and holistic support can help improve the mathematical problem-solving skills of each student.

Thus, this study is not entirely in line with the findings (Imroatun, 2014) as it indicates that not all students with different ability levels follow Polya's steps consistently. This suggests that the implementation of Polya's problem-solving strategies may require additional adaptation and support according to the student's ability level.

CONCLUSION

The results of this study indicate a significant difference in mathematical problem-solving abilities among students with varying levels of capability. This underscores the importance of providing special attention and more intensive guidance to students with lower abilities to help them develop skills in understanding problems, selecting appropriate problem-solving strategies, and creating and implementing mathematical models effectively. Conversely, for students with high abilities, presenting more complex challenges and providing guidance in refining problem-solving strategies can help them optimize their skills.

Several external factors influence the level of problem-solving ability in each student. These include the quality of teaching, availability of learning resources, and support from both the school environment and family. Additionally, both intrinsic and extrinsic motivation of students determine the extent to which they strive to understand problems and seek appropriate solutions. Differences in learning styles and prior experiences with mathematics also affect how students approach and solve

problems. Therefore, a tailored learning approach that meets individual needs and provides holistic support can enhance mathematical problem-solving abilities in all students.

Consequently, this study does not fully align with the findings of Imroatun (2014), as it suggests that not all students with different ability levels consistently follow Polya's problem-solving steps. This indicates that the application of Polya's problem-solving strategy may require adaptation and additional support according to the students' ability levels.

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CONFLICTS OF INTEREST

The author declares that there are no conflicts of interest influencing the results of this study. The research was entirely self-funded by the author.

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