M A T H L I N E
JURNAL MATEMATIKA DAN PENDIDIKAN MATEMATIKA

ISSN 2502-5872 (Print)
ISSN 2622-3627 (Elektronik)

Volume 8 Number 3, August 2023, 1133-1148

THE ANALYSIS OF THE PROBLEM-SOLVING ABILITY OF THE ETHNOMATEMATCS NUANCED PLANE FIGURE IN THE SIPIROK WOVEN FABRICS PATTERN TO MTs STUDENTS

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ABSTRACT

The ability to solve problems is one of the goals of mathematics education. The aim of this study was to describe the problem-solving skill of students in class VII-1 of MTsL 3 Tapanuli Selatan on the material of the Plane figure with ethnomathematical nuances of Sipirok woven fabrics patterns. This qualitative descriptive research involved 25 students of class VII-1 MTsN 3 Tapanuli Selatan as the subjects. Data collection techniques included problem-solving skills tests and interview papers. The results showed that the student's problem-solving skills based on the steps Polya, flat geometric material with ethnomathematical nuances for class VII-I, belonged to the low category with an average percentage of 55.4% and the step indicator more dominant of the polya was an indicator understanding the problem with 80% capture.
Keywords: Problem-Solving Ability, Flat Shape, Woven Fabric Motif

How to Cite: Harahap, A & Hasanah, R.U. (2023). The Analysis of The Problem-Solving Ability of The Ethnomatematcs Nuanced Plane Figure In The Sipirok Woven Fabrics Pattern To MTs Students. *Mathline: Jurnal Matematika dan Pendidikan Matematika, 8*(3), 1133-1148. http://doi.org/10.31943/mathline.v8i3.495

PRELIMINARY

Learning mathematics serves a variety of purposes, including encouraging the development of new information as well as the transfer of existing knowledge. One of the objectives of mathematics education, according to (Ramadanti Jaelani, Risma; Hidayanti, 2021), is to foster students' capacity for arranging, analyzing, and assessing problems. Because mathematics is directly tied to and heavily influenced by parts of history, geography, and the immediate environment, mathematics learning is very tightly related to the student's culture or everyday life (Hastuti et al., 2020). In order for students to better understand mathematical ideas, math lessons should incorporate aspects of their culture and daily lives. The Sipirok woven fabric pattern is one of the cultures that can be used to examine mathematical ideas because of the geometrical shapes seen in the patterns. It is possible to use the planar figure contained in the patterns to help pupils learn mathematics and problem-solve more effectively.

Problem-solving ability is the process of addressing problems using information, skills, and attitudes (Öztürk et al., 2020). (Aisyah et al., 2018) emphasized that the core of problem-solving skills is creativity in issue-solving by prioritizing good actions to identify the correct answer. It may be inferred from this that the capacity to solve difficulties is the capacity to locate a solution to a problem by using one's understanding in a methodical manner to identify the correct answer.

But there is a problem: Indonesian pupils still have poor problem-solving abilities, making it challenging for them to meet the objectives of mathematics instruction. This is obviously a roadblock to students' academic success. The Organization for Economic Co-operation and Development (OECD) conducted the PISA (Program for International Student Assessment) in 2018 to assess students' math problem-solving skills. According to data gathered by (Qadry et al., 2022), the results placed Indonesia in the second rank (-73 out of 79 countries) with an average of 379 of the OECD average score of 489.

The data above demonstrates that Indonesian students' arithmetic problem-solving abilities are still at a poor level, preventing them from being able to address a variety of issues that are related to learning mathematics and resulting in unsatisfactory marks. According to (Sunandar et al., 2018), problem solving and student learning assessment are closely related. Since the most crucial component in solving arithmetic problems is problem-solving ability, students' academic proficiency in mathematics declines as problem-solving ability increases.

In the process of solving problems, learning mathematics must train students to solve problems in sequence. Systematic problem-solving steps will provide maximum results (Rachmady et al., 2019). (Latifah & Khabibah, 2017) explained that the steps of the questions according to Polya could lead students to be able to solve the questions well. There are four stages of problem solving according to Polya, namely: identifying the problem, developing a solution plan, implementing the solution plan and reviewing the answers.

One of the mathematics materials at the junior high school level which contains the stages of solving problems is plane figures material. Plane figures can be used to evaluate mathematical problem-solving abilities because the questions on plane figure can reveal how well students can apply mathematics to real-world problems (Sari & Aripin, 2018). A plane figure is a two-dimensional building that only has length and width and is bounded by straight lines or curved lines (Wahyudi & Anugraheni, 2017). In fact, most students find it difficult in the material of Plane Figures, especially in finding solutions to questions related to the perimeter and area of Plane Figures because students do not understand the concept of area and perimeter so they often reverse the application of formulas (Rosdiana et al., 2022). This is in line with the opinion of (Ratnawati, 2022) asserting that the challenges students experience when studying geometry in the plane figure shape sub-material are visualizing Plane Figures which most students consider abstract and difficult to distinguish between one shape and another. So that the plane figure material is considered difficult and challenging by students because it requires a lot of contextual and illustrative examples to fully understand the material properly.

From the difficulties and challenges faced by these students, teachers should develop innovative learning methods that provide the students with various contextual examples to make the students get a better understanding of the materials. Teaching and learning mathematics will be more meaningful by correlating the students' situation or culture that grows in their daily life. It will be effective and meaningful for students' understanding when learning activity is related to their daily life, they will understand the material better. In addition, students become accustomed to connecting every mathematical concept with the culture they encounter in the real world. Learning mathematics with cultural nuances is called Ethnomathematics.

According to (Sarwoedi et al., 2018), one method of studying mathematics is through the alignment of the cultural activities of the society, which makes the subject matter simpler to comprehend. In this instance, Indonesia establishes ethnomathematics as an alternate strategy for fostering contextual mathematics learning. It must be able to motivate students to engage actively in learning, especially problem-solving, and provide them the opportunity to create their own understanding of the mathematical ideas they have acquired. Therefore, ethnomathematics nuanced learning is one of the teaching strategies that can encourage students to actively solve context-related challenges.

Woven fabric as a local Sipirok culture has ethnomathematics content. The typical Sipirok woven fabric is part of the people culture of South Tapanuli Regency, North Sumatra Province. Each Sipirok woven fabric pattern has a meaning that reflects the philosophy of the surrounding community life. The patterns on the Sipirok woven fabric have two-dimensional geometric shapes, namely distance pattern, hiok-hiok pattern, singap pattern, lus-lus pattern, and letter pattern (Habibah & Efi, 2019). The design forms of these patterns contain two-dimensional geometric parts such as rectangles, circles, triangles, rhombuses, and various lines. So that the typical Sipirok woven fabric pattern is expected to make it easy for students to understand the concept of plane figures in mathematics because it correlates with student culture which is an activity in real life.

Based on research conducted by (Nursyahidah et al., 2018), ethnomathematics-based mathematical problem-solving skills, students with high mathematical-solving abilities show satisfactory results. Students are able to elaborate on their complete understanding of the problem, plan appropriate stages and carry out good processes so as to get the right solution. In line with the results of the study, (Selviani & Rasiman, 2021) explain that the ability to solve problems with ethnomathematics nuanced geometry material, students with high-level problem-solving abilities can make the most of Polya's problem-solving instructions, students can optimize solution ideas to solve nuanced problems ethnomathematics.

Therefore, the researchers are interested in conducting research on the analysis of problem-solving abilities in ethnomathematics nuances of Sipirok's typical woven fabric. The purpose of this study was to determine the problem-solving ability of plane figures with ethnomathematics nuances of Sipirok's typical woven fabric patterns for students in learning mathematics.

METHODS

This descriptive qualitative research describes the students' ability to solve problems with ethnomathematics nuances of Sipirok's typical woven fabric. This research was conducted on class VII–1 students of MTsN 3 South Tapanuli for the 2022/2023 Academic Year, a total of 25 students. Data collection techniques were carried out by administering tests and interviews. The instrument used by the researchers was a test of 5 geometric essay questions with ethnomathematics nuances of Sipirok's typical woven fabric pattern which had been validated by 2 lecturers of mathematics education at UIN North Sumatra, as well as interview questions with steps to solve the problem according to Polya, they are understanding the problem, developing a completion plan, carrying out a completion plan, and reviewing answers to identify students' mathematical problem-solving abilities.

This research used qualitative data analysis techniques: data reduction and draw conclusions as described by Miles & Huberman. Data reduction is by associating data in the category of levels of mathematical problem solving from the test results given by students. Then the problem-solving test analysis uses a problem-solving assessment rubric based on problem-solving indicators according to Polya. Then the presentation of the data in this study is to analyze and process interview data to see the problem-solving categories of students who have been determined based on the 4 stages of problem-solving according to Polya. The following are categories of students' mathematical problem-solving abilities, namely:

Table 1. The category of Mathematical Problem-solving Ability.

Achievement Percentage	Category
$75 < P \leq 100$	High
$60 < P \leq 75$	Moderate
$0 < P \leq 60$	Low

Source: (Christina & Adirakasiwi, 2021)

The final score of the student's math test is then adjusted to the category. It matches the achievement percentage to the categories. The ranges of the percentage are categorized into three: high, moderate, and low. When the student's math final score percentage ranges from 0 to less than equal to 60 then their math problem-solving ability is low, when the student's math final score percentage ranges from 60 to less than equal to 75 so their math problem-solving ability is moderate. When the student's math final score ranges from 75 to less than equal to 100 so their math problem-solving abilities are high.

RESULT AND DISCUSSION

Based on the problem-solving test result with the Polya stages, it is found that the data of students from class VII-1 MTsN 3 Tapanuli academic year 2022/2023 are as follows:

Table 2. The result of Students' Problem-solving Ability

Mathematical Problem-Solving Category	Frequency	Percentage
High	6	24%
Moderate	7	28%
Low	12	48%
Total	25	100%

From table 2, It is shown that the total of the students with high problem-solving is 6 students, 7 students with medium problem-solving ability categories, and 12 students categorized as low in mathematical problem-solving. After calculating the test results of students' problem-solving abilities, then the results are analyzed by indicators which include four steps. The results of the problem-solving abilities of each indicator are shown in the following figure:

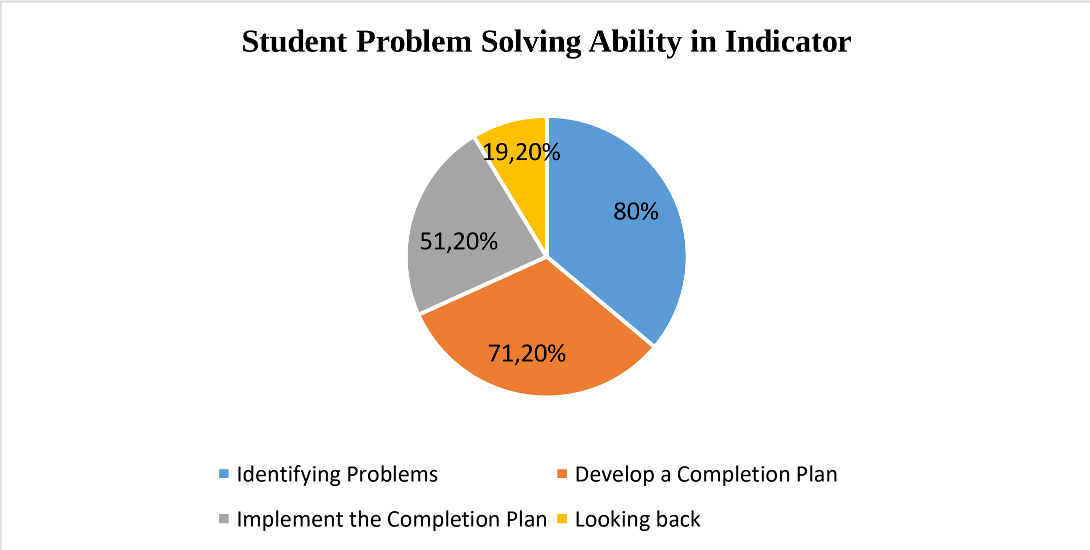


Figure 1. The Result of Students' Problem-Solving Ability for Each Indicator

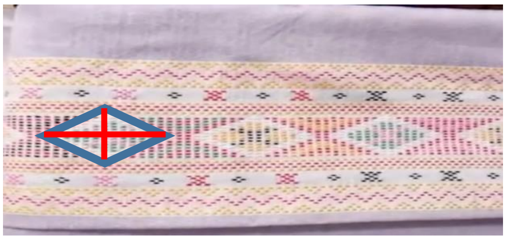
Figure 1 shows the results of students' problem-solving abilities on ethnomathematics based on ethnomathematics of Sipirok woven fabric pattern with the Polya stage indicator, where 80% of students are able to identify problems that are categorized as high, 71.2% of students are able to compile a plan for solving the problem categorized as moderate, 51.2% of students were able to carry out problem solving which was categorized as low and 19.2% of students were able to re-examine those which were categorized as low. The average result of the ability to solve students' mathematical problems shown in Table 2 is 55.4% in the low category.

Problem solving test results are classified into 3 categories, namely high, medium and low problem solving abilities. Reviews of the analysis will be described below:

Analysis of Students' Problem Solving Ability with High Category

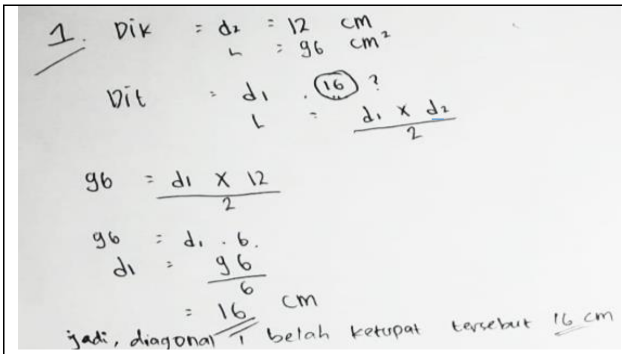
The researcher analyzed the students' problem solving ability using Polya's indocators problem-solving to plane enthnomathematics nuanced of plane figure questions in the Sipirok woven fabric. Here are the ability description for question number 1. The question 1 of S1 is as follow:

1. Take a look at the following picture!



The picture above is one of the Sipirok woven fabric patterns. It is space pattern with rhombus shape. If the rhombus above has 96 cm2 as the area and diagonal length 2 is 12 cm, then determine the diagonal length 1 of the rhombus!

S1 answer from question number 1

<table>
<tr>
<td>


</td>
<td>
1. Is known : d_2=12cm
L=96cm^2
Asked : d_1?
$L = \frac{d_1 \times d_2}{2}$
$96 = \frac{d_1 \times 12}{2}$
$96 = d_1 \times 6$
$d_1 = \frac{96}{6}$
= 16cm
So, the diagonal of 1 rhombus is 16cm
</td>
</tr>
</table>

Figure 2. The result of S1 from the question number 1

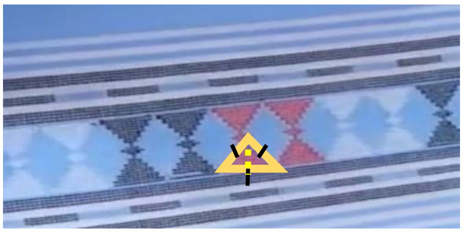
Figure 2 shows that S1 was able to apply four indicators to solve Polya's problem in answering the ethnomathematics nuanced Sipirok woven fabric pattern. The first indicator is identifying the problem. S1 was able to identify the problem by presenting what has been known: the area of the Sipirok woven fabric motif in the form of a rhombus which is 96 and its diagonal 2 is 12. S1 wrote down the thing requested from the question, namely finding the length of diagonal 1 of the rhombus. Then, based on the results of the S1 interview, S1 was able to explain completely and precisely what has been known and what was asked in the questions. This is supported by (Agustina et al., 2021) who explained that the students with high category problem-solving skills have no difficulty understanding problems. They are able to show and explain things that are known and asked for in questions well. Further, the stage of arranging solution indicator. S1 could arrange solution plan arrangement by making area formula of the rhombus: $L = \frac{d_1 \times d_2}{2}$. According to (Aspiandi et al., 2020), the students with high category of problem-solving ability could answer the question correctly.

The, it is the stage of implementing solving problem indicator. S1 could implement the solving problem plan of the question completely and correctly. It is done by substituting the area and diagonal length 2 into the area formula. It becomes $96 = \frac{d_1 \times 12}{2}$, and then 12 is divided with 2 resulting 6, so $96 = d_1 \times 6$. To find d_1, move the segment from right to left so it is found that d_1= 16 cm. Based on the interview results, S1 was able to explain the calculation steps correctly and completely. (Fitriana & Mampouw, 2019) stated that students who have a high category of solving skills are able to work on problems using plans that have been prepared beforehand. In the review indicator, students can rewrite the answers obtained by writing the correct conclusion, namely diagonal 1, the space pattern of Sipirok's typical woven fabric in the shape of a rhombus, which is 16 cm. Therefore, S1 can use Polya's four stages in working on answers to solving problems of ethnomathematics nuanced of Sipirok's typical woven fabric. This is supported by (Fatmala, et al., 2020) which suggests that students with high problem-solving skills will be able to answer questions well.

Analysis of Students' Problem-Solving Ability with Moderate Category

The researcher analyzed students' problem-solving ability with indicators of problem-solving ability in plane figures with ethnomathematics nuances of Sipirok's typical woven fabric pattern, along with a description of these abilities for questions number 2 and 3 in S10. Following are questions number 2 and 3 as well as S10's answers.

2. Take a look at the following picture!



From the picture above, the Singap pattern in the Sipirok woven fabric pattern has equilateral triangle shape. If the equilateral triangle has a side of 10 cm and an area of 10 cm then find the height of the triangle!

S10's answer for question number 2

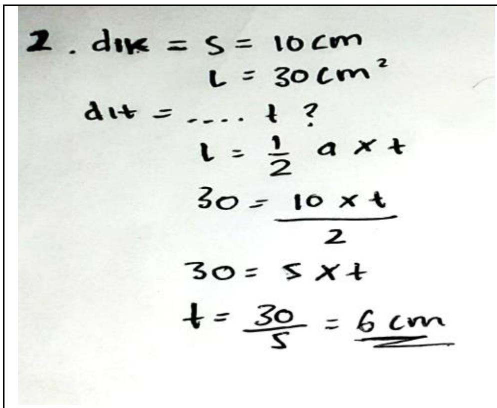
	2. Is known : S=10cm L=30cm^2 Asked: ….t? $L = \frac{1}{2} a \times t$ $30 = \frac{10 \times t}{2}$ $30 = 5 \times t$ $t = \frac{30}{5} = 6\text{cm}$

Figure 3. The result of S10 from the question number 2

Based on Figure 3, S10 was not able to apply the Polya problem-solving indicator in answering the ethnomathematics nuanced Sipirok woven fabric pattern. The first indicator is identifying the problem, S10 was able to identify the problem by including what he or has been known such as the size of the side of the Singap pattern which is triangular shape and the area of equilateral triangle is 30 cm. The student wrote down the thing asked in the question, namely finding the height of the equilateral triangle. Then based on the results of the interview S10 was able to mention correctly what has been known and what was asked for in the questions. The next indicator is arranging solution plan. S10 was able to arrange the plan of solving the problem by writing the formula of the triangle area: $L = \frac{1}{2} a \times t$, then S10 was also able to use the information from the question such as the length of the triangle base because the shape of Singap pattern in Sipirok woven fabric is equilateral triangle so it has the same length of each side include the base.

Furthermore is implementing the plan of completion. S10 could implement the planning of question completion very well. S10 subtituted the length of the base and the area into the triangle formula. It is $30 = \frac{10 \times t}{2}$, and then divided 10 with 2 is equal to 5, so $30 = 5 \times t$. To find t, move the segmet from right to left into $t = \frac{30}{5}$, so we can find $t = 6\ cm$. Then, from the interview result, s10 could explain the counting strategy correctly. Further, review indicator, S10 could not rewrite the obtained answer by not writing the conclusion. From the interview, S10 did not recheck because he/she assumed that the answer has completed. S10 did not noticed the instruction of reviewing the answer. According to (Akbar et al., 2017), the students who do not review their answer because they are sure with their correct answer. In addition, (Nafisah et al., 2022) explained that most of the students do not notice to the instruction of reviewing the answer because the students have got the final result without analyzing and reviewing. So it can be concluded that S10 could not implement the four stages of Polya correctly in solving the problem of the ethnomathematics nuanced Sipirok plane figure question.

3. Take a look of the following picture!

From the picture above, the pattern of rose flower in Sipirok woven fabric has shape of parallelogram. If the parallelogram has parallel sides where each of it is 24 cm and 15 cm. Determine the circumsference of the parallelogram!

S10's answer for question number 3

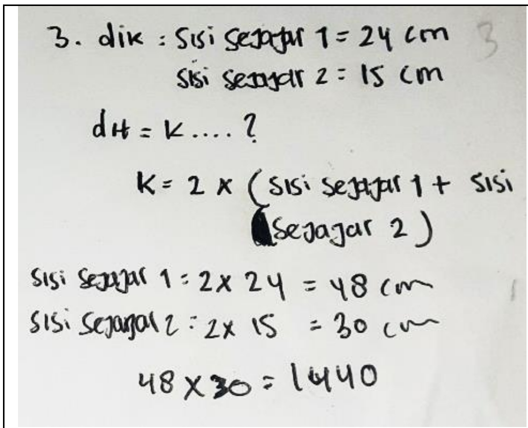
 3. dik : sisi sejajar 1 = 24 cm sisi sejajar 2 = 15 cm dit = K....? K = 2 x (sisi sejajar 1 + sisi sejajar 2) sisi sejajar 1 = 2x 24 = 48 cm sisi sejajar 2 = 2x 15 = 30 cm 48 x 30 = 1440	3. Is known : parallel sides 1=24cm parallel sides 2=15cm Asked: K…? $K = 2 \times (parallel\ sides\ 1 + parallel\ sides\ 2)$ $parallel\ sides\ 1 = 2 \times 24 = 48cm$ $parallel\ sides\ 2 = 2 \times 15 = 30cm$ $48 \times 30 = 1440$

Figure 4. The result of S10 for the question number 3

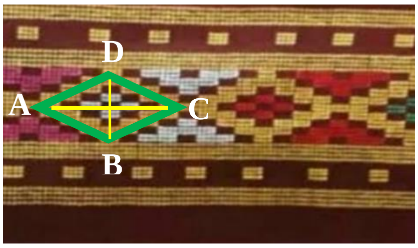
Based on the figure above, S10 was not able to implement the Polya stages in answering plane figure with ethnomathematics nuanced in Sipirok woven fabric pattern. The stage of defining problem, S10 was able to define the problem by stating some known information by writing the size both parallel sides in Rose flower pattern in Sipirok woven fabric, the parallel side 1 is 24 cm and parallel side 2 is 15 cm and then wrote down what should be found from the question. It is the circumsference of the parallelogram. Based on the interview result, S10 was able to explain what has been known and should be found in the question. Further, in completion plan indicator, S10 was able to plan the completion by writing the circumsference of parallelogram: $K = 2(parallel\ sides\ 1 + parallel\ sides\ 2)$.

Furthermore, the indicator of implementing the completion plan, S10 could not use the problem-solving because of carelessness in implementing the formula. S10 writes $parallel\ sides\ 1 = 2 \times 24 = 48$cm and $parallel\ sides\ 2 = 2 \times 15 = 30$cm, then $48 \times 30 = 1440$ where the correct answer is $K = 2\ (\ 24 + 15)$, and then $K = 2 \times 39$ and the result is $K = 78\ cm$. It is inline with (Yuwono et al., 2018), where a failure in using the completion plan of a question is due to the carelessness of the students so it is important to control the planning in solving the problem. The next indicator is review. S10 could not review or rewrite the obtained answer by dismissing the conclusion. Based on the result of interview, S10 perceived that after finding the answer, the task is completed. There is no need to review and recheck the instruction of the question. According to (Nafisah et al., 2022), most of the students do not pay attention on the question instruction to review the answer because they consider that the problem is solved. In line with the opinion from (Timutius et al., 2018), majority of the students do not recheck their answers consequently their answer do not correlate with the questions. It can be concluded that S10 has not implemented the four stages of Polya correctly in answering the plane figure.

Analysis of Students' Problem-Solving Ability with Low Category

The researcher examined students' problem-solving skills with Polya indicators of problem-solving ability on the ethnomathematics nuanced woven fabric pattern typical of Sipirok, along with a description of these abilities for question number 4 and question 5 at S14. The following are questions number 4 and number 5 and answers to S14.

4. Take a look at the following picture!



The picture above is the pattern of Akar Cino on the Sipirok woven fabric in the form of rhombus. If the length of AC = 20 cm and BD = 17 cm, determine the area of that plane figure!

S14's answer for the question number 4

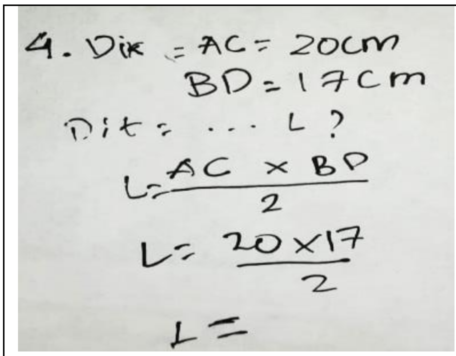
	4. Is known : AC=20cm BD=17cm Asked: …L? $L = \frac{AC \times BD}{2}$ $L = \frac{20 \times 17}{2}$ $L =$

Figure 5. The result from S14 for the question number 4

From figure 5, S14 was unable to implement the Polya problem-solving in answering the question about plane figure with ethnomathematics nuanced in Sipirol woven fabric pattern. The first indicator is problem identification. S4 identified the problem by writing the known information such as the length from $AC = 20\ cm$ and $BD = 17\ cm$ which is diagonal 1 and diagonal 2 of the Akar Cino pattern in Sipirok woven fabric in the form of rhombus. Then, the indicator of completion plan arrangement, S14 is able to arrange the completion plan by writing the formulas rhombus in the question $L = \frac{AC \times BD}{2}$. The Akar Cino pattern in the Sipirok woven fabric is rhombus. From the result of interview, it is known that S14 could present the formulat used to answer the question. S14 is also able to visualized the Akar Cino pattern in the Sipirok woven fabric in the form of rhombus.

The next indicator is implement the completion plan. S14 could not implement the completion plan because she/he has not yet found the solution or the correct answer. The answer should be $L = \frac{20 \times 17}{2}$ so the result is $170\ cm^2$. Based on the result of interview, S14 did not write the answer because she/he confused to operate the calculation. In line with the result of the research conducted by (Rahman & Nur, 2021), the response from the students, it can be seen that the failure in implementing the question plan is caused by the student's difficulty in operating the math and lack of basic operation exercise and complexity of the mathematics. Further, the indicator of review, S14 did not rewrite the answer was obtained without conclusion. So it can be concluded that S14 could not implement all stages of Polya systematically in answering the plane figure with ethnomathematics nuance of Sipirok woven fabric pattern.

5. Take a look at the following picture!

From the picture, the pattern of Lus-lus of Sipirok woven fabric has a shape of plane figure, it is a rectangle. If the circumstance of that plane figure is 58 cm and the length is 18 cm. determine the area of the plane figure above!

S14's answer for the question number 5

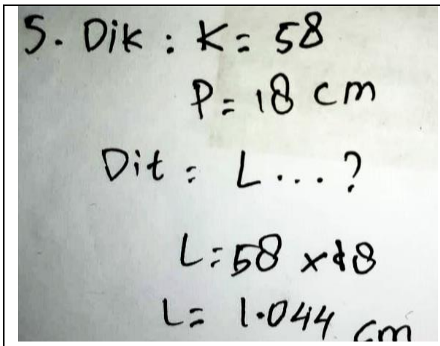
 	5. Is known : K=58 p=18cm Asked: L…? $L = 58 \times 18$ $L = 1.044$ cm

Figure 6. The result of S4 for the question number 5

From figure 6 above, we can see that S14 could not implement the indicator of Polya problem-solving in answering the plane figure with the ethnomathematics nuanced of Sipirok woven fabric pattern. The first indicator is identifying the problem in this case is presenting what has been known. S14 could present the information of the circumstance and the length of the rectangle, they are 58 cm and 18 cm. S14 also could present what should be found, it is the area of the rectangle. The next, in the arrangement of the solution method, S14 did not write the formulas that will be used to find the solution. The formula that should be used is $L = p \times l$, it is the formula of rectangle area. From the interview result, S14 could not present and analyze the correct application of the formula. According to (Rofi'ah et al., 2019), the reason of solution planning failure of the task is the students' lack of knowledge about the material related to the question. So it is predictable that the students did not complete their understanding to the mastery of obligatory material before they continue to the new material.

Further, in the part of implementing the completion plan, S14 could not implement the completion plan of the question because the students had not found the correct answer due to the missing formulas to answer the question. The correct answer relates to the question about the area of rectangle by processing the known information such as the circumstance and the length. To know the circumstance the students should find the width first. So the students could use the formula of circumstance, it is $K = 2(p + l)$. After that the student could insert the circumstance and the length into the formula. It becomes $58 = 2(18 + l)$ sehingga $58 = 36 + 2l$ and $2l = 58 - 36$, then $l = \frac{22}{2} = 11$ next, insert the width to the area formula, so $L = 18 \times 11 = 198\ cm^2$.

For the review stage, S14 did not review or rewrite the obtained answer. It is because S14 could not implement the completion plan and implement that plan to the question. In line with (Ariani et al., 2018), she stated that the students could not arrange the plan and implement the completion plan arrangement are the factor that make the students did not review because they did not have the final answer. So it can be concluded that S14 is not able to implement all stages of four Polya indicator organizely in answering the question of plane figure with ethnomathematics nuance in Sipirok woven fabric pattern.

CONCLUSION

Based on the results of the analysis and discussion of the data, it was concluded that the average percentage of problem-solving abilities in plane figure with ethnomathematics nuances of Sipirok's typical woven cloth motifs for students from the four indicators of solving problems according to Polya includes: understanding the problem 80% of students can understand the problem which is classified as high, equal to 71 .2% of students were able to make a settlement plan which was classified as moderate, 51.2% of students were able to carry out problem solving which was classified as low and 19.2% of students were able to check again which was classified as low. So that from the whole it is obtained that the average percentage of problem solving ability is classified as low at 55.4%.

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