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AN ANALYSIS OF GRADE VIII STUDENTS' DIFFICULTIES IN SOLVING CIRCLE STORY PROBLEMS: A STUDY BASED ON POLYA'S PROBLEM-SOLVING THEORY

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Abstract

This study aims to explore the difficulties experienced by students of grade VIII of junior high school in solving circle story problems based on Polya's Theory. The research approach used is a qualitative approach. This type of research is qualitative descriptive research. This research was conducted in one of the junior high schools in North Central Timor Regency. The subjects of this study were grade VIII consisting of 20 students. The instruments used were 4 circle material test questions and interviews to determine the factors that cause students to have difficulty working on the questions. Data analysis techniques through the stages of test data analysis, data reduction, data display and conclusion drawing. The results of this study indicate that the difficulties faced by students are 1) difficulty understanding the problem, namely students have difficulty in positioning the function of the symbol on the known and asked parts of the question, 2) difficulty making a solution plan, namely students have difficulty connecting the known and asked elements so that students do not fully understand the strategy that will be used to plan the solution, 3) difficulty completing the solution plan, namely students have difficulty writing a complete formula to be used in solving the problem so that they do not find the results requested by the question, 4) difficulty re-checking, namely students do not know how to make conclusions from the results of their work..

Keywords: Circle story problems, Difficulty solving problems, Polya's theory.

Abstrak

Penelitian ini bertujuan untuk mengeksplor kesulitan yang dialami siswa kelas VIII SMP dalam menyelesaikan soal cerita lingkaran berdasarkan dari Teori Polya. Pendekatan penelitian yang digunakan adalah pendekatan kualitatif. Jenis penelitian ini adalah penelitian deskriptif kualitatif. Penelitian ini dilakukan di salah satu SMP di Kabupaten Timor Tengah Utara. Subjek penelitian ini adalah siswa kelas VIII yang berjumlah 20 siswa. Instrumen yang digunakan adalah soal tes materi lingkaran sebanyak 4 soal dan wawancara untuk mengetahui faktor penyebab siswa mengalami kesulitan dalam mengerjakan soal. Teknik analisis data melalui tahapan reduksi data, display data dan penarikan kesimpulan. Hasil penelitian ini menunjukkan bahwa kesulitan yang dihadapi oleh siswa adalah 1) kesulitan memahami soal yaitu siswa kesulitan dalam memposisikan fungsi simbol pada bagian yang diketahui dan yang ditanyakan pada soal, 2) kesulitan membuat rencana penyelesaian yaitu siswa kesulitan menghubungkan unsur yang diketahui dan yang ditanyakan sehingga siswa kurang memahami strategi yang akan digunakan untuk merencanakan penyelesaian secara menyeluruh, 3) kesulitan melengkapi rencana penyelesaian yaitu siswa kesulitan menuliskan rumus yang lengkap yang akan digunakan dalam menyelesaikan soal sehingga tidak menemukan hasil yang diminta soal, 4) kesulitan memeriksa kembali yaitu siswa tidak mengetahui cara membuat kesimpulan dari hasil pekerjaannya.

Kata kunci: Kesulitan menyelesaikan masalah, Soal cerita lingkaran, Teori Polya.

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INTRODUCTION

In the process of learning mathematics, students often experience difficulties. Learning difficulties experienced by students can be seen from their learning achievements (Enlisia et al., 2020). This is in line with Hafid et al. (2017) who explained that students' learning difficulties have an impact on students' learning achievements because to obtain good achievements can be found from learning outcomes at school or outside school based on students' willingness and efforts in learning.

In solving a problem encountered in everyday life, mathematics has an important role. After studying and understanding mathematics, it is mandatory for students to master an important skill, namely problem solving. The importance of mastering problem solving by students is to develop themselves and also students to be able to solve a mathematical problem that they encounter in everyday life. By understanding the problem, students can be helped to explore the problem situation, formulate problem statements, select facts, and determine the relationships of the selected facts (Mawaddah & Anisah, 2015; Nurmaya et al., 2022).

Problem solving skills are very important in learning mathematics because mathematics is widely applied in other fields of study and also in everyday life. However, in solving problems, students still make mistakes in solving questions. The importance of problem solving was also expressed by Son et al. (2020) that problem solving skills are very important in Mathematics Education, not only for those who later study or learn mathematics, but also for those who will apply it in other fields of study and in everyday life.

According to the above view of problem-solving ability, it can be concluded that in a mathematics learning process, students are expected to have the ability to solve mathematical problems. This is in accordance with its purpose, problem-solving ability is one of the ideas that students need to master in mathematics learning. Because problem-solving ability has an important role in mathematics learning that can improve students' learning process. In mathematics learning, students are required to be able to apply ideas in solving everyday problems related to the material.

Math story problems are problems related to everyday life that can provide a real

picture of a problem in everyday life that is related to the material in the story problem, which uses mathematical sentences. The story problems in question are problems that can be given to students about the benefits of mathematics to train students' abilities in solving story problems, with this method students are expected to have a sense of enjoyment in learning mathematics so that they are able to solve story problems on the material.

Polya (1957) said that the stages in problem solving include: (1) understanding the problem, students must have an understanding to be able to understand the conditions of the problem or problem contained in the problem; (2) devising a plan, students must have a strategy to solve the problem with any steps that are important to be able to solve the problem at hand; (3) carrying aut the plan, students must be able to form a clearer systematic problem, in terms of being able to use formulas that are in accordance with those needed in the problem; and (4) looking back, students must re-check the steps in solving the problem.

Learning difficulties in mathematics begin to appear since students are in elementary school. There are many factors that influence students' learning difficulties in mathematics, such as lack of interest and motivation in mathematics and inappropriate learning in teaching mathematics (Rofiqi & Rosyid, 2020). When students' learning difficulties in mathematics are left unchecked, their interest in learning the subject matter will decrease. Mathematics will continue to be a bugbear and will always feel boring and easily bored in learning (Rofiqi & Rosyid, 2020).

To overcome these difficulties, students need help, both in understanding a subject matter and in overcoming other obstacles. Students' learning difficulties must be identified and overcome as quickly as possible, so that the learning objectives can be achieved. The action that must be taken to determine students' learning difficulties is by means of diagnosis. Through diagnosis, it is possible to determine the difficulties faced by students and then determine the appropriate assistance for the difficulties faced by students in order to obtain maximum learning outcomes (Nursalam, 2016; Yasin & Netriwati, 2019).

The emergence of difficulties in solving problems can be seen from many students who make mistakes in working on problems, which causes student achievement to be low and unsatisfactory. Many factors cause students to experience learning difficulties or difficulties in solving problems. These factors come from within and outside the student.

Internal factors include: interest, attention, health, emotions, attitudes and knowledge abilities of students. While external factors of students are influenced by family conditions, teachers, tools, schools, classroom conditions, and the surrounding environment (Dwi & Audina, 2021; Kholil & Zulfiani, 2020). Without us realizing it, many students have difficulty in solving problems. In every school from elementary school, junior high school, high school, or at various other levels, there is also the possibility that many students have difficulties in learning or in working on problems. Problems like this are also felt by modern schools in cities and schools in rural areas.

Based on the interview results that I obtained from one of the 8th grade mathematics teachers, that students have great difficulty faced with questions related to problem solving, because in solving story problems students need guidance from the teacher. Not all students are able to solve problems in the circle material well. In general, students are able to identify what elements are known and what is asked. However, students have not been able to use the right strategy to solve problems, because students tend to always memorize formulas rather than understand the ideas.

In addition, when students carry out calculations, there are also students whose calculation steps are wrong or are not careful enough in using mathematical symbols, so the solution is not correct. This shows that students experience problems because they have difficulty in solving math problems. This problem is supported by research by Son et al. (2019) which concluded that students' mathematical problem-solving abilities are still relatively low. This is indicated by the frequent occurrence of basic errors, namely not understanding the problem, not being able to formulate a solution plan, not being able to work on the solution plan, and not being able to review the results and processes. Based on this problem, this study was conducted to explore the difficulties experienced by students in solving circle story problems based on Polya's theory.

RESEARCH METHODS

The method used in this study is a qualitative method. The type of research used in this study is qualitative descriptive research. This research was conducted in one of the junior high schools in North Central Timor Regency, In the odd semester of 2024. The subject of this study is based on the results of the student difficulty test in solving circle story problems given to 20 grade VIII students and 6 students were interviewed. The research procedure was carried out through stages as illustrated in Figure 1.

The data collection instrument is divided into two parts, namely a test instrument for students' difficulties in solving story problems which has been validated by experts and an interview guide instrument which aims to obtain a deeper picture of students' difficulties in solving story problems in circle material as viewed from polya theory. The data collection technique used in this research is data in the form of written tests and interviews. The written test method comes from the results of written tests to analyze the difficulties faced by students in solving story questions on circle material by paying attention to the polya steps and conducting interviews with subjects selected by the researcher to obtain data regarding students' difficulties in solving test questions on circle material provided by the researcher.

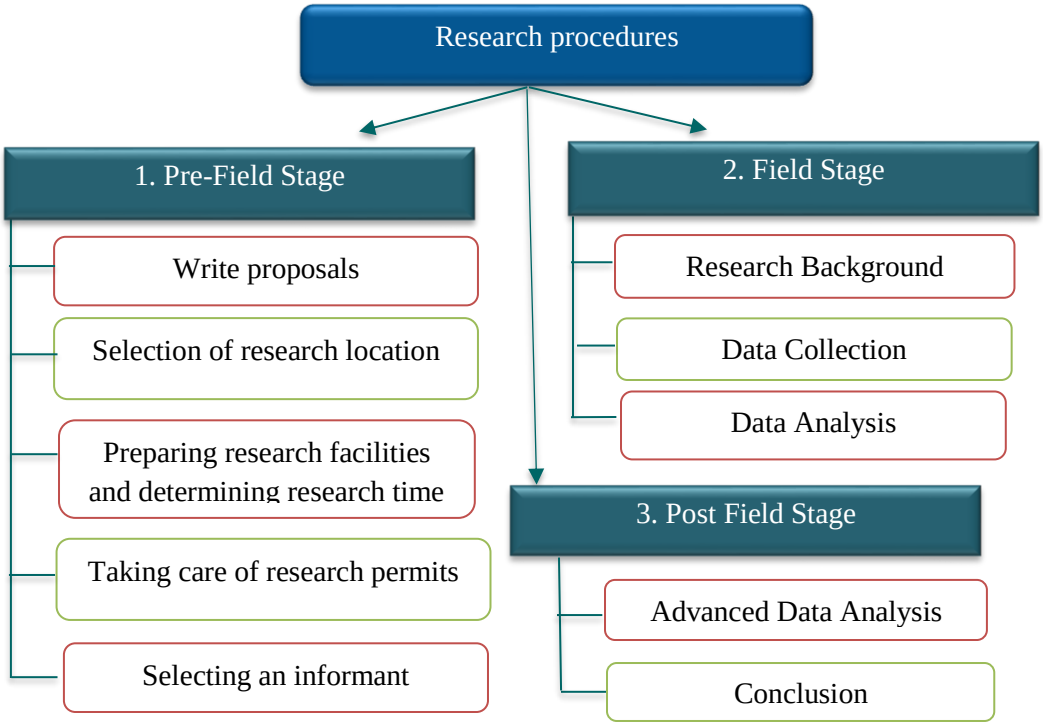


Figure 1. Research Produre

Several technical stages are carried out in data analysis according to Miles and Huberman (1984), namely 1) The data reduction stage in this research is correcting the results of student work which are then grouped into high, medium and low categories. Next, the students' work results are analyzed and the difficulties experienced by students are grouped based on polya theory. 2) The Data Display stage is research data that has been arranged in detail to provide a complete picture of the research. The data is collected

in detail and thoroughly for further conclusions to be drawn. To present the data at the next stage, it is arranged in the form of a description. 3) The Conclusion Drawing stage is carried out based on the data that has been obtained from the data reduction and display process. Drawing conclusions leads to the difficulties experienced by students in solving problems.

RESULT AND DISCUSSION

Based on the results of tests and interviews conducted on six subjects, namely three students with moderate abilities and three students with low abilities. The data is described based on Polya's theoretical steps, namely: 1) understanding the problem, 2) devising a plan, 3) carrying aut the plan, 4) looking back.

In this section, the author only displays 1 student answer and interview from each research subject. The following is a description of the results of the work and interviews with students. Information R is a Researcher and S1, S2, ..., are Subjects 1, Subjects 2 and so on. The following is the answer to question number 2 from student S1.

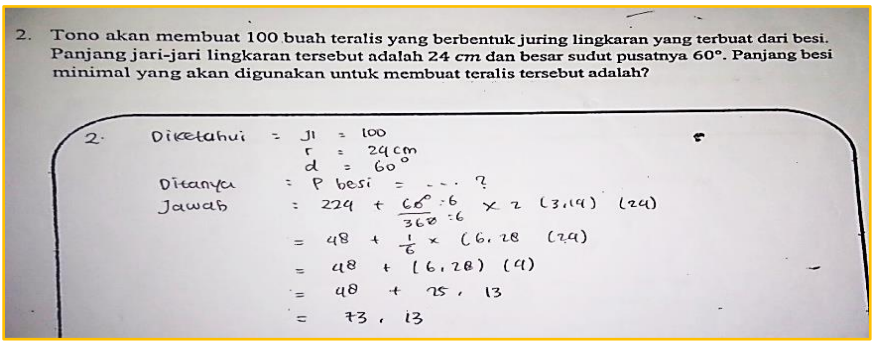


Figure 2. Answer to question number 2 student S1 (moderate category)

Based on Figure 2, students have difficulty in determining formulas, completing solution plans and looking back. The results of interviews conducted with subject 1 are as follows:

R : What are the known and asked questions in question number 2?
S1 : Known is J = 100, r = 24 cm, d = 60 degrees. Asked: the length of the iron?
R : What strategies do you use to solve the problems in the question?
S1 : The first is to find the known, put in the formula and solve
R : What formula do you use to solve the problems in the question?
S1 : I don't know the formula
R : After you work on the question, do you check the calculations you have done?

S1 : Yes, check again
R : What is your conclusion from the question?
S1 : So, the length of the iron that will be used to make the trellis is 73.13 cm
R : Why are there no units and conclusions in the results of the solution, but there is a conclusion during the interview?
S1 : Forgot to make a conclusion

Based on test and interview results that have been reduced, it shows that students with moderate abilities: a) S1 is able to write down what is known and what is asked in the problem correctly. b) S1 is unable to make a devising a plan based on the information from the solution results above. This means that S1 has difficulty remembering and implementing the mathematical postulates in the problem. c) in completing the solution plan, S1 makes mistakes in the calculation process so that the final result is not correct or wrong and S1 is also unable to write the units in the final result. This means that S1 has difficulty in identifying and is unable to use algorithms in solving math problems. d) S1 has difficulty in rechecking the results of his solution. This means that S1 has difficulty in drawing conclusions.

This student experienced difficulties starting from the second stage, namely devising a plan. The cause of students' difficulties at this stage is that students do not fully understand the strategy that will be used to solve the problem of the solution plan. The step of making a solution plan is the same as the step of understanding the problem because a problem cannot be solved correctly if students do not understand what plan will be used to solve the problem in the question. The reason students do not fully understand the strategy to be used is that students do not have prior knowledge in implementing strategies in solving circle story problems. This is in line with the opinion of Enlisia et al. (2020) that students are said to have difficulty in the step of making a plan if students do not understand how to model mathematics according to what is known and what is asked in the problem, students are also less able to understand the problem so that students have difficulty in designing a solution plan. There is also an opinion Nurcholis and Istiningsih (2021) which states that students are said to be able to carry out the plan if students are able to apply the strategy or approach that has been planned to get a solution to the problem.

The following is the answer to question number 2 for student S2.

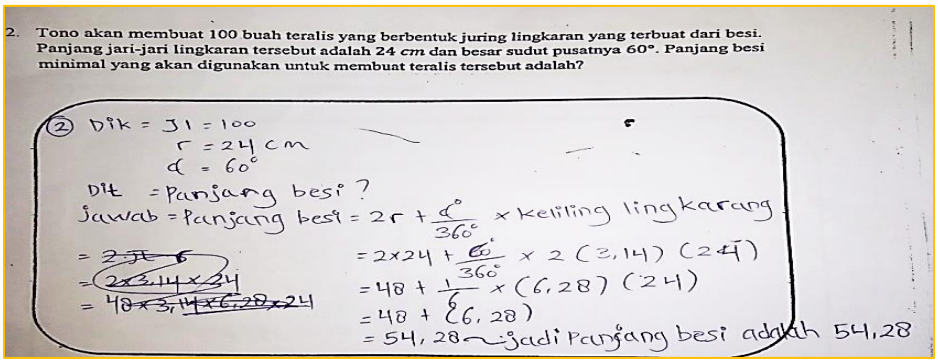


Figure 4. Answer to question number 2 for student S2 (moderate category)

Based on Figure 4, students have difficulty in making a solution plan. The results of the interview conducted with subject 2 are as follows:

R : In this question, what are the known and asked questions in question number 2?
S2 : What is known: J1 = 100 cm, the radius is 24 cm, the diameter is 60° and what is asked is the length of the iron
R : What steps do you use to solve the question?
S2 : First, we look for what is known and asked, enter the formula according to the problem in the question, then the solution
R : What formula do you use to solve the question?
S2 : length of iron = 2 times the radius + a / (360°) x circumference of the circle
R : After working on the question, do you check what you have done?
S2 : Yes,
R : What is your conclusion from the question?
S2 : Yes, the conclusion is that the minimum length of iron that will be used to make the trellis is 54.28 cm.

Based on test and interview results with students with moderate ability categories, it was obtained: a) S2 was able to write down what was known and what was asked in the question that was in accordance with the information obtained from the question. b) S2 was able to make a solution plan based on the information obtained from the question, but the formula was incomplete. This means that S2 had difficulty in understanding the meaning of the symbol and was less able to transform numbers into formulas. c) S2 was able to complete the solution plan based on the solution steps regularly and correctly in accordance with what was previously planned. However, in the solution process there was an error in the calculation so that the final result was wrong. This means that S2 had difficulty in identifying and was unable to use the algorithm in solving math problems. d) S2 was able to make conclusions but the final result of the solution was wrong, so the conclusion was still wrong. This means that S2 had difficulty in drawing conclusions or

S2 did not understand the keywords in the question.

The cause of students' difficulty in understanding the problem is that students do not write what is known completely and do not write what is asked, students are also not accustomed to working on questions in the form of circle material stories, if students really understand what is known and asked in the question, it will make it easier for students to determine what is known and asked in the circle story problem. This is in line with the opinion of Yuwono et al. (2018) in their research that students' difficulties in understanding problems are caused by students lack of understanding of the material being studied.

The following is the answer to question number 3 for student S3.

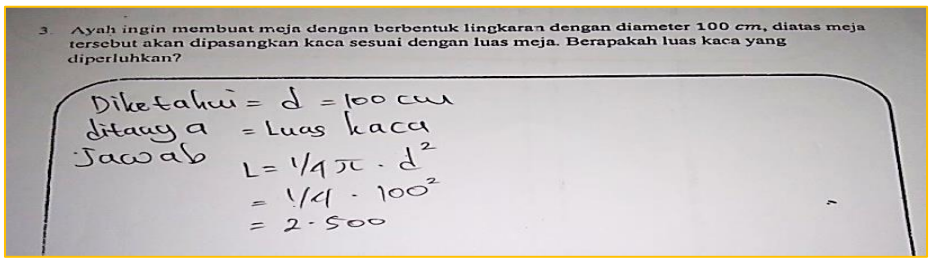


Figure 5. Answer to question number 3 for student S3 (moderate category)

Based on Figure 5, students have difficulty in completing the completion plan and rechecking. The results of the interview conducted with subject 3 are as follows:

R : In this question, what are the known and asked questions in question number 3?
S3 : What is known in the question is the diameter = 100 cm and the area of the glass is asked
R : What steps did you use to solve the question?
S3 : First, we look for what is known and asked, then the solution
R : What formula did you use to solve the question?
S3 : $L = 1/4\ \pi . d^2$
R : After working on the question, did you check what you had done?
S3 : Yes,
R : Are you sure that the solution on your answer sheet is correct?
S3 : Not sure about the formula
R : What is your conclusion from the question?
S3 : I did not make a conclusion

Based on test and interview results with students with the moderate ability category, it was obtained: a) S3 was able to write down what was known and what was asked correctly. b) S3 was able to make a solution plan based on information obtained from the

problem. c) S3 was unable to complete the solution plan correctly. This means that S3 had difficulty in identifying and was unable to use algorithms in solving math problems. d) S3 had difficulty in rechecking the results of his solution. This means that S3 had difficulty in drawing conclusions.

The following is the answer to question number 1 for student S4.

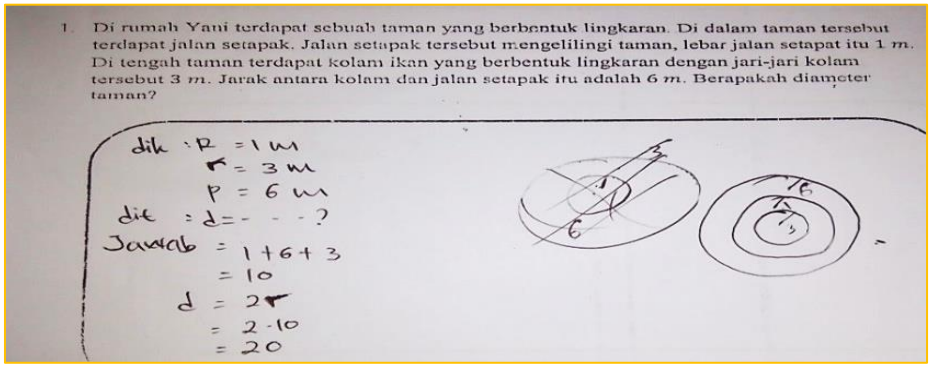


Figure 6. Answer to question number 1 for student S4 (low category)

Based on Figure 6, students have difficulty in rechecking. The results of the interview conducted with subject 4 are as follows:

R : In this question, what is known and asked in question number 1?
S4 : Known here is the width of the footpath is 1m, the radius of the pool is 3m and the distance between the pool and the footpath is 6m and the question is what is the diameter of the garden.
R : What steps did you use to solve the question?
S4 : Add and multiply
R : What formula did you use to solve the question?
S4 : Here the formula I use is $d = r^2$
R : After working on the question, did you check the calculations you had done?
S4 : Yes, check again
R : What is your conclusion from the question?
S4 : Don't know the conclusion.

Based on test and interview results with students with low ability categories, it was obtained: a) already able to write down what is known and what is asked. b) S4 was able to make a solution plan according to the existing problem. c) S4 was able to complete the solution plan based on the solution steps regularly and correctly according to what was previously planned. d) S4 did not recheck the solution that had been completed or did not make any conclusions at all from the problem. This means that S4 had difficulty in drawing conclusions or S4 did not understand the keywords in the problem.

The following is the answer to question number 3 for student S5.

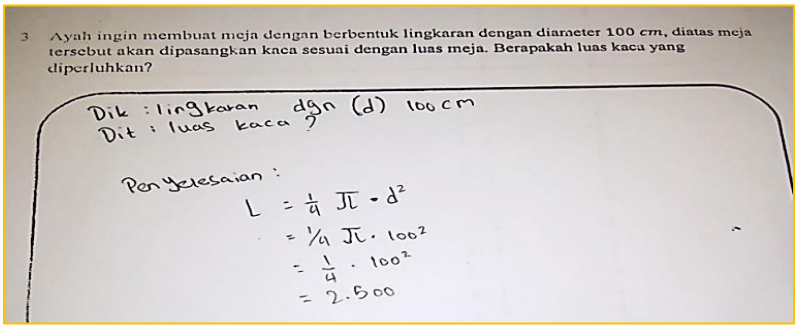


Figure 6. Answer to question number 3 for student S5 (low category)

Based on Figure 6, students have difficulty in completing the completion plan and looking back. The results of the interview conducted with subject 5 are as follows:

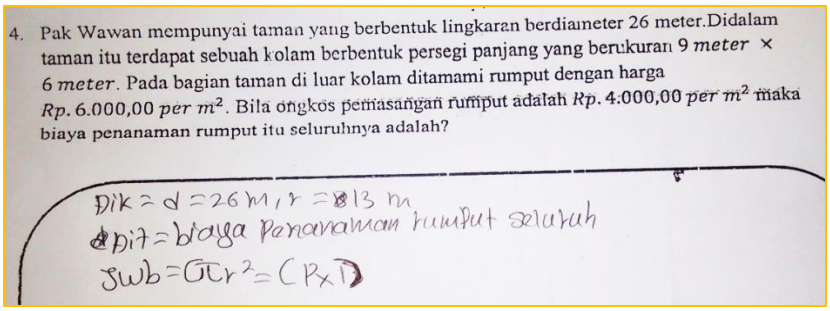
R : In this question, what are the known and asked questions in question number 3?
S5 : What is known in the question is the diameter = 100 cm and the area of the glass is asked
R : What steps did you use to solve the question?
S5 : First, we look for what is known and asked, then the solution
R : What formula did you use to solve the question?
S5 : L = 1/4 π. d^2
R : After working on the question, did you check what you had done?
S5 : Yes,
R : Are you sure that the solution on your answer sheet is correct?
S5 : Not sure
R : What is your conclusion from the question?
S5 : I did not make a conclusion.

Based on test and interview results with students with low ability categories, it was obtained: a) S5 was able to write down what was known and what was asked. b) S5 was able to make a solution plan according to the existing problem. c) S5 was unable to complete the solution plan. This means that S5 had difficulty in identifying and was unable to use algorithms in solving math problems. d) S5 did not recheck the solutions that had been completed or did not make any conclusions at all from the problem. This means that S5 had difficulty in drawing conclusions or S5 did not understand the keywords in the problem.

Students in the low category experience difficulties at almost every stage of problem solving according to Ploya. The conclusion from the test results and interviews with this student shows that this student experienced difficulties in the third indicator. The cause

of students' difficulties at carries out the plan was that in solving the problem, students were unable to complete the calculations correctly. Another difficulty was that students had difficulty in writing incomplete formulas to be used in solving the problem so that they did not find the results requested by the problem. This is in line with the opinion of Pirmanto et al. (2020) that students have difficulty making mistakes in the calculation process which results in wrong answers. This is due to a lack of understanding of the concept of a material. There is also the opinion of Enlisia et al. (2020) who explained that students are said to have difficulty at the stage of implementing the plan, namely students do not understand the problems given and students' solutions are not correct in implementing mathematical models so that students make mistakes in their calculations.

The following is the answer to question number 4 for student S6.


4. Pak Wawan mempunyai taman yang berbentuk lingkaran berdiameter 26 meter.Didalam taman itu terdapat sebuah kolam berbentuk persegi panjang yang berukuran 9 *meter* × 6 *meter*. Pada bagian taman di luar kolam ditamami rumput dengan harga *Rp.* 6.000,00 *per* m^2. Bila ongkos pemasangan rumput adalah *Rp.* 4.000,00 *per* m^2 maka biaya penanaman rumput itu seluruhnya adalah?

Dik = d = 26 m, r = 13 m
Dit = biaya penanaman rumput seluruh
Jwb = πr^2 = (P x L)

Figure 7. Answer to question number 4 for student S6 (low category)

Based on Figure 7, students have difficulty in making a solution plan, completing the solution plan and rechecking. The results of the interview conducted with subject 6 are as follows:

R : What are the known and asked questions in question number 4?
S6 : *It is known that diameter = 26 meters, r = 13 meters*
R : In the solution results in number 4, you only wrote down the known and asked questions and wrote the formula but could not solve the question. Why didn't you do the question?
S6 : *It's hard to solve the question*
R : Why is it hard for you to solve the question
S6 : *Don't understand the question*

Based on test and interview results with students with low ability categories, it was obtained: a) S6 was able to write down what was known and what was asked in the problem. b) S6 was unable to make a solution plan or determine a formula. This means that S6 had difficulty in understanding the meaning of the symbols and was less able to

transform the symbols into the formula. c) S6 was unable to complete the solution plan or did not do calculations. This means that S6 had difficulty in identifying and was unable to use algorithms in solving math problems. d) S6 did not recheck the solutions that had been completed or did not make any conclusions at all from the problem. This means that S6 had difficulty in drawing conclusions.

Students in moderate and low categories experience almost the same difficulties. The only difficulty faced by all students in this study, both students in the moderate and low categories, was the difficulty of looking back. The cause of students' difficulties at this stage is that students are not careful in writing conclusions so that errors occur and there are also students who do not know how to draw conclusions from the results of their work, do not check their answers again and work on them. did not carry out the re-checking stage. This is in line with the opinion of Raudho et al. (2020) who said that the mistake in re-checking an answer is not understanding the reason or not knowing how to solve it, students re-check their solution and believe that the solution is correct even though in reality it is not. There is also the opinion of which say that students lack understanding of the available formulas, low understanding of the questions and not re-checking the answers after completing the questions (Septiahani et al., 2020).

CONCLUSION

Based on the results of the research that have been described, it can be concluded that there are difficulties experienced by students of class VIII of one of the junior high schools in the North Central Timor Regency in solving circle story problems based on Polya's theory. Difficulties in understanding the problem, making a solution plan, completing the solution plan and rechecking are as follows: In the first stage, students have difficulty understanding the problem, in difficulty understanding the problem, students have difficulty in positioning the function of the symbol on the known and asked parts in the problem. In the second stage, students have difficulty making a solution plan, in difficulty making a solution plan, students have difficulty connecting the known and asked elements so that students do not fully understand the strategy that will be used to solve the problem of the solution plan. In the third stage, students have difficulty completing the solution plan, in difficulty completing the solution plan, students have difficulty because they do not write the complete formula to be used in solving the problem so that they do not find the results requested by the problem. In the fourth stage,

students have difficulty rechecking, it can be seen from the results of the written test, namely students have difficulty in rechecking their work because students do not know how to draw conclusions from the results of their work, do not recheck the answers and do not carry out the rechecking stage.

It is recommended that mathematics teachers familiarize students with solving word problems. Future researchers should examine how to overcome students' difficulties in solving mathematics story problems.

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