EduHumaniora: Jurnal Pendidikan Dasar | p-ISSN 2085-1243 | e-ISSN 2579-5457
Vol. 10 No.2 Juli 2018 | Hal 140-147

POLYA'S STRATEGY: AN ANALYSIS OF MATHEMATICAL PROBLEM SOLVING DIFFICULTY IN 5TH GRADE ELEMENTARY SCHOOL

Nunuy Nurkaeti[1]
Universitas Pendidikan Indonesia

Abstract:. *Problem solving is one of ways to develop higher order thinking skills. Strategy of problem solving that can be developed in mathematics learning is Polya's strategy. This study aims to analyze the problem solving difficulties of elementary school students based on Polya strategy. To support this research,descriptive analysis is used on seven elementary school students . The results show that, the difficulty of mathematical problems solving of elementary school students consist of the difficulty of understanding the problem, determining the mathematical formula/concepts that is used, making connections between mathematical concepts, and reviewing the correctness of answers with questions. These happened because the problem presented is in a story problem, that is rarely studied by the students. Students usually solve mathematical problems in a form of routine questions, which only require answers in a form of algorithmic calculations.*
Keyword: *Problem Solving Difficulty, Polya's Strategi, Word Problem.*

Abstrak: Pemecahan masalah adalah salah satu cara dalam mengembangkan kemampuan berpikir tingkat tinggi. Salah satu strategi pemecahan masalah yang dapat dikembangkan pada pembelajaran matematik adalah strategi Polya. Penelitian ini bertujuan menganalisis kesulitan pemecahan masalah siswa sekolah dasar berdasarkan strategi Polya. Untuk mendukung penelitian ini digunakan analisis deskriptif pada tujuh orang siswa sekolah dasar. Hasilnya menunjukkan bahwa, kesulitan pemecahan masalah matematik siswa sekolah dasar meliputi, kesulitan memahami masalah, menentukan rumus/konsep matematik yang digunakan, membuat koneksi antar konsep matematika, dan melihat kembali kebenaran jawaban dengan soal. Hal tersebut disebabkan, masalah yang disajikan berupa soal cerita yang jarang dipelajari siswa. Siswa biasanya menyelesaikan masalah matematik berupa soal rutin, yang hanya menuntut jawaban berupa perhitungan algoritmik.
Kata Kunci: Kesulitan Pemecahan masalah, Strategi Polya, Masalah Kata.

INTRODUCTION

Problem-solving is one of the mathematical skills that should be had by the student at the elementary school. Polya's strategy can be used to solving a problem. However, in reality, many students are still struggling to solve mathematical problems.

The result of PISA Indonesia test in 2015 shows the average score of mathematics ability of 15-year-old students is 386, the score is still at level two of math ability (OECD, 2016). Such capabilities have not yet reached the ability to conclude and solve problems from diverse information, and the use of diverse algorithms in solving problems. In line with this, Suharta (2016) argues that students are still weak in solving mathematical problems, especially in solving realistic problems, numerical operations, and provide realistic reasons and considerations.

Regardless the kind of realistic and non-realistic problems used, students are still weak to solve the word problem. According to Nenden (Hidayat & Irawan, 2017) students difficulty in solving the problem that a form of a word problem. In addition, Amir (2015) argued that students have difficulty in solving the word problem. Students' difficulties in solving problems can arise because of several factors, such as the learning environment

[1]Universitas Pendidikan Indonesia, Email: nnurkaeti@student.upi.edu

that includes learning approach used, motivation, use of the problem type, as well as teaching materials that do not support students to develop problem-solving. In fact, important problem solving is owned by students and accustomed by the teacher, as one way in developing higher order thinking.

Development of higher order thinking skills such as communication, collaboration, critical, and creative certainly involves a problem-solving context. Indirectly if students' higher order thinking skills are developed, students will be involved in a problem-solving. This is in line with Kusuma's opinion, et al. (2017); Abosalem (2016); Widodo & Kadarwati (2013) higher order thinking activities can one be developed through problem-solving.

Study of analysis mathematical problem-solving analysis of elementary school students is important, as a first step in developing problem-solving skills. As according to Ulya (2016) that the ability of students in solving problems needs to be studied by the teacher. This indicates that when the teacher will develop problem-solving skills, the teacher must first understand how far the ability of problem-solving students, through the analysis of student difficulties in solving problems. One of them in the context of word problem.

Dari & Budiarto (2016) analyzed mathematical problems based on Polya's strategy in junior high school with various levels of emotional intelligence and mathematical ability. The results show the various problem about difficulty of solving problem. This is why students are wrong in doing calculations, although the steps are quite appropriate. Based on the above, there needs to be an analysis also concerning the problem of the mathematical problem of students in primary school.

Problem-solving difficulties of students in elementary schools can be seen based on indicators of problem-solving abilities. Indicators of problem solving capabilities are described based on aspects or steps problem-solving according to Polya. Therefore, this study will answer the question "How is the difficulties problem solving to solve word problem in 5th grade students of elementary school?" The question will guide the analysis of mathematical problem solving of 5th grade elementary school students with Polya's strategy.

LITERATURE REVIEW

According to NCTM (Dari & Budiarto, 2016 and Mustika & Riastini, 2017) that problem solving is an integral part and not separate from mathematical learning. The statement shows that in every mathematical learning involves solving the problem. Polya (Lidinillah, 2008) mentions that problem solving is an important aspect of intelligence, where problem solving can be understood as an important character for humans and can be learned by imitation or experimentation. Imitation and experiment activities can be facilitated by routine and nonroutine problems. So it can be said that, mathematical problems ability is the ability of a person in solving mathematical problems both routine and nonroutine problems. As according to Lestari & Yudhanegara (2017) that problem solving ability is the ability to solve routine and non routine problems both applied and non applied in the field of mathematics. The type of mathematical problem given will lead the student to perform the problem solving procedure. The routine and non-routine procedure of solving the problem is certainly different in its calculation practice. The non-routine problem requires planning problems that are not merely applications of formulas, theorems, propositions, as well as routine problems that require more algorithmic calculation.

Problem-solving can be used as a way to develop student problem solving. Word problem is one form of presentation problem solving on a words or a story. According to Dewi, Suarjana, & Sumantri (2014) in solving the word problem, students required to think high order

thinking, whereas student must determine something known, asked, the mathematical model used, and perform calculations according to a predetermined mathematical model. The activity in solving the problem is in line with Polya's strategy to solve the problem. It is considered to be able to help students in solving mathematical problems.

There are four steps of the problem-solving process that can be used as an aspect of measuring/analyzing problem-solving according to Polya. Polya (Anglin, 2004) proposed four problem-solving steps: understanding the problem, devise a plan, carry out the plan, and look back over the result. Understand the problem, can be a reading problem, determine the keyword/information/elements of the problem. Devise a plan, can take the form of drawing/form mathematics based on the problem, determine the question, determine the concept/formula/mathematical ideas to be used in problem-solving. Carry out the plan, can be a mathematical operation to get the result of completion. Look back over the results, confirm the answer with the problem, check the problem with the given solution, check the mathematical keywords in the problem with the solution, and be sure about the answer was given. Based on the above description, the aspect and indicators of problem solving difficulty analysis refer to Polya's opinion, which is arranged in table 1.

Table 1. Aspects and Indicators of Problem Solving

Aspects of Problem Solving Ability (Polya)	**Indicators**
Understand the problem	Identify aspects that known on the problem.
	Mention the question based on the problem.
	Connect the problem with another topics on mathematics.
Devise a plan	Make the mathematical problem based on problem.
	Show mathematical concept that would be used to solving problem.
Carry out a the plan	Analyze the process of problem solving based on a plan.
Look back over the result	Check the accuracy of answers with questions.

RESEARCH METHOD

This research is a descriptive study on problem-solving analysis of difficulty mathematical problem-solving in elementary school students. Problem-solving difficulties were analyzed according to Polya's steps. The sample of this study is students of 5th grade at the elementary school in Bandung, which amounted to seven students. Data were collected by tests and interviews. Instrument test is arranged based on steps Polya's strategy into an indicator, which is poured in the word problem. After the test, students are interviewed.

FINDING AND DISCUSSION

Analysis of problem-solving difficulties was done in 5th grade elementary school students. Some findings of the analysis are related to solving problem of the word problem, which requires planning in solving the problem. The analysis is based on the problem solving aspect according to Polya.

Aspects of understanding the problem, measured by three indicators are: 1) identifying the known aspects of a problem; 2) mentions the questions asked based on the given problem; and 3) connect the issues with other mathematical topics. The results of the analysis show that as follows.

1) Students already understand the problems in the matter and perform mathematical calculation operations appropriately.
2) Students do not understand the problem in the matter but have been able to perform mathematical counting operations.
3) Students do not understand the problem in the matter and have not been able to perform mathematical counting operations.
4) Students are able to understand problems based on interrelationships

between topics and perform mathematical operations correctly.

5) Students have understood the problem based on interrelationship between topics but have not been able to perform mathematical operations.
6) Students are not able to understand the problem based on interrelationship between topics and unable to perform mathematical operations.

In general, students have been able to identify the known aspects of the problem and mention the questions asked in the problem, but the students have not understood the intention/relationship of every aspect known in the problem when solving the problem.

Question 1:

Mother's age is 2/3 from father's age. Dodi's age is 1/3 from mother's age. Dodi is 10 years old. Based on the problem above:

a) What is known about the problem?
b) Before counting father's age, is there anything to be determined first? Explain it!

Figure 1: Question 1

Student's Answer:

d) Age.
e) Mother's age.
f) MA: 2 + 3 = 5

$\frac{2}{5} \times 10 = 4 \times 10 = 40$

FA: 3 + 2 = 5

Figure 2: Student Answer about The Difficulty of Understand The Problem

In Figure 2 the students had difficulties to identifying the mathematical aspects of the problem. It looks at the answer to the section "a" that the students only answer the age, whereas what expected is the meaning of the ratio about ages of Dodi, Mother, and Father. In addition, students have difficulty determining the value of mother and father's age ratio, because he does not understand the problem. Finally, students just counting the age of mother and father based on Dodi's age.

Many students are unable to determine the interrelationships between math topics. So many errors occur when working on problems related to the difference in unit length. Where students are not able to change the type unit of length and change the type of fraction.

Question 2:

During art class, 5th-grade students get the task to bring ribbon. The ribbon will be made flowers. For one flower requires a ribbon that is 30 cm. Rara carrying 0.75 m of ribbon, Yesa carrying 1 1/2 m of ribbon, Lira carrying 90 cm ribbon. Based on the problem, you can find:

a) Who can make the most flowers? Explain it!
b) Make an order of students from a little to many based on flowers their have made!

Student's Answer:

a) 90 cm, 75 m, 112 m × 100 = 1120, 75 × 100 = 750
Yesa karena 1120 cm
b) Lira (90 cm), Rara (750 cm), Yesa (1120 cm)

Figure 3. The Student's Difficulty to Make Connection Between Mathematical Topics

In Figure 3, students have difficulty making conversions from units of meters length to centimeters. In addition, students have difficulty in the multiplication of integers with decimals, so problem-solving is less precise. It shows the connection between the mathematics topic of students is still lacking. The student's way of determining the problem/question is also still wrong, where the student should do the sequence based on the number of flowers, but it happens they sort by the length of ribbon. It is clear that students' understanding of problems in the word problems is still get difficulties.

Aspects of devise and carry out the plan, these two aspects into an integrated entity. However, it is measured using two different questions for the same problem. The indicators include 1) create a mathematical model based on the given problem; 2) shows the mathematical concepts to be used in problem-solving, and 3) describes the problem-solving process based on the plan that have been made. The results of the analysis show the following.

1) Students are able to make a plan and implement problem-solving plans.
2) Students are able to make a problem-solving plan but not yet able to solve the problem.
3) Students have not been able to make a problem-solving plan and have not been able to implement the problem-solving plan.

From the above, it can be seen that students have difficulty in making a problem-solving plan and do a good problem-solving plan based on a word problem. In general, students are able to make interpretations in the form of models / drawings of mathematical concepts of the problems given. However, students have difficulty choosing and determining what concepts/form should be used in solving the problem.

Question 3:

A breeder has 13 square-shaped zinc pieces that are 4 meters in length. He will make 4 square goat cages with the same area. Based on the problem above:

a) What is the shape of the four goat cages that the breeder makes?
b) What can be used to calculate the area of each cage?
c) Calculate the area of each goat cage that is made!

Student's Answer:

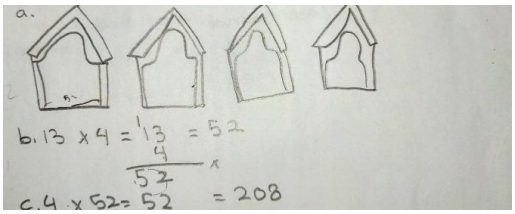

Figure 4: Student's Difficulty on Devise a Plan and Solve The Problem.

From picture 4, already seen that the students can be interpreted from the given problem. However, students still have difficulties in drawing up plans, which students are still deformed when determining the formulas to be used in problem-solving. We have known from the answer above "b" the student just multiplying the problem without looking at the mathematical context used (square). The impact of these difficulties, students also ger errors in problem-solving.

From the student answers in figure 4, the core difficulties gotten students in solving problems is the difficulty when making problem-solving plans and understand the context of the problem. This means that understanding aspects of the problem is very influential in the problem-solving procedure.

An aspect of looking back at results, measured by indicators checking the accuracy of answers with questions. In this aspect, almost all students are less precise in determining the accuracy of the answers to the problems presented. This is because students do not understand the image representation given and do not understand the word problem described. Even some students do not answer because there is no number that can be operated. Their reason that mathematics is identical with numbers.

Students are unable to look back on the truth of answers with questions. When looking back at the answers, word problem, and the figure that have given, they think that was no difference context between the solution and the problem. Where in the problem have a differences size of small, medium, and large bricks, but students only review the bricks are small and large only. As stated in the following interview results.

A: What's the figure in number for?
B: Bricks.
A: With use the bricks. What is she want make?
B: Create a small garden.
A: From that figure how many small bricks?
B: It's still big, so I drew line to let me be small.
A: Oh, you drew the line to make a small bricks?
B: Yes, I drew the line from up to down, so I get small bricks.
A: So, how many small bricks are there?
B: There are twenty for small bricks.
A: So, your solution is cut a big bricks to get a small bricks?
B: Yes

Question 4:
Look at the figure below!

Ibu Ani uses the all former bricks to create a small garden. The size of former bricks is small, medium, and large. If she uses only a small size, how many small bricks on it that she can used?

Student's Answer:

24

Figure 5: The Student's Difficulty on Looking Back at The Result

From figure 5 and the conversation, the results of the interview show the student has not been able to assess the truth of the answer given to the problem. This is because students do not look back at the context of the given problem, by differentiating the size of the bricks in the figure. In the problem described three are sizes of bricks that are small, medium, and large. So students should determine the size of existing bricks into small, medium, and large sizes. However, students only determine small stone stones, then draw a line to form the existing bricks into small size. Whereas students should be able to see the comparison of the size between small, medium, and large bricks so that the student's review of answers and questions is appropriate and appropriate.

Referring to analysis problem solving above, there are some difficulties found based on the students' ability to solve the problem. *First*, students do not understand the problems given. This is caused the given problem in a word problem. The students rarely solve problems in a word problem, so they are not trained in reading and interpreting problems. This is in line with the opinion of Osterholm (Pratiwi, 2015) that students have difficulty articulating in reading comprehension, in this case, a matter of word problem. This opinion is reinforced by Dewi, Suarjana & Sumantri (2014) that research results are students solve the word problem with unstructured way, it is caused by the lack of understanding of students about how to do the word problem and problem-solving model used by the teacher is less precies.

Second, students have difficulty determining problem solving plan. This is because students are accustomed to work procedurally, so when asked the right concepts and mathematical formulas to solve students' confusion problems. Students tend to solve problems by operating each number on the problem algorithmically. This finding is confirmed by research Suharta (2016) that students tend to solve problems by taking into account the numbers that exist, regardless of the intent of the problem. Student difficulties in determining the problem solving plan are also supported by Lidinillah (2008) opinion that teachers usually provide the same strategy in solving problems and often students ask about "What is used formula to answer this problem?". Frequently the question arises indicating that students have difficulty determining the mathematical formula / concepts used in solving problems. In addition, a relatively similar problem-solving strategy, showing less creative students in solving problems.

Third, students have difficulty making connections between mathematical concepts. This difficulty has an impact on problem-solving and the withdrawal of wrong conclusions because students are not keen on differences in mathematical concepts. This is in line with the research results of Mustika & Riastini (2017) that students are not able to solve the story problem about the conversion unit of the length, although the problem is quite easy. The results of this study clearly related to the difficulties students make connections between mathematical concepts. Toward

the connection of solving a problem and mathematical concepts is very important, especially in the word problem that requires a lot of interpretation. As according to NCTM (Dewi, Suarjana, & Sumantri, 2014) that the development of mathematics necessarily involves various connections of mathematical ideas, understanding interrelated mathematical ideas in constructing mathematical understandings, and using mathematics in contexts outside of mathematics.

Fourth, students have difficulty in looking back to the truth of answers to questions. Difficulty in looking back on the truth of answers with problems gotten students is caused by understanding, planning, and implementing problem-solving erroneously. This means that the difficulty in looking at the answer aspect will not happen, if the student is correct in understanding the problem, planning the settlement, and solving the problem.

Alternative ways that can be done to overcome student difficulties in solving problems, one of them by using a problem-based approach to learning. Presentation of learning problems with different types of problems can train students to solve problems. As Arifin (2016) argued that problem-based learning that presents practical problems such as ill-structured or open-ended can provide stimulus to students in learning, so as to improve learning outcomes. In addition, habits in training skills in understanding and solving problems need to be given to students (Abdillah & Budiarto, 2017). With the exercise and habituation of understanding and solving the problem, will make students familiar and understand problem-solving strategies.

Problem-solving difficulties also cannot be separated from the way teachers convey learning and use of teaching materials. According to Mustika & Riastini (2017), the results of his research shows the rarity of teachers giving nonroutine problems in learning to train problem-solving students and students tend to be passive in learning. it is important to use various problems mainly in the form of non-routine questions. Non-routine questions can encourage students to play an active role in solving problems and building knowledge. In line with that, the development of LKS teaching materials with Realistic Mathematics Education approach can develop problem-solving abilities (Hidayat & Irawan, 2017).

CONCLUSION

Mathematical problem solving of fifth-grade elementary school students still needs attention. Based on the problem-solving steps proposed by Polya, students are still having difficulty in solving the mathematical problem. Difficulties of the students especially in understanding the problem, determining the problem-solving plan so that the settlement is also wrong/difficulty, making connections between mathematical concepts, and reviewing the truth of the answers with questions. The difficulties are caused by several factors including, the students who are not accustomed to solving problems in a word problem, and learning does not develop problem-solving. Therefore, in the learning of students should be given a variety of problems, especially that can provide opportunities for students to explore issues such as open-ended problems. Alternatively, learning can use a problem-based approach, an open-ended approach, a mathematical realistic approach, and other approaches that provide students with opportunities to solve mathematical problem.

REFERENCE

Abdillah, A.S. & Budiarto, M.T. (2017). Profil kemampuan siswa dalam mengajukan masalah matematika kontekstual ditinjau dari gaya belajar vark. *Jurnal Ilmu Pendidikan Matematika, 2 (6)*, hlm. 16-25.

Abosalem, Y. (2016). Assessment techniques and students' higher-

order thinking skills. *International Journal of Secondary Education, 4 (1),* pp. 1 – 11.

Amir, M.F. (2015). Proses berpikir kritis siswa sekolah dasar dalam memecahkan masalah berbentuk soal cerita matematika berdasarkan gaya belajar. *Jurnal Math Educator Nusantara, 1 (2)*. hlm. 159 – 170.

Anglin, K. L. (2004*). Math Word Problem*. USA: Wiley Publishing.

Arifin, M. (2016). Penerapan model pembelajaran *problem-based learning* melalui metode penugasan dapat meningkatkan hasil belajar siswa kelas VI SD Negeri 3 Pamotan tahun 2015/2016 dalam pelajaran matematika tentang debit. *Didaktika PGRI, 2 (2)*, hlm. 268 – 277.

Dari, D.A.W. & Budiarto, M.T. (2016). Profil pemecahan masalah matematika siswa smp kelas VIII ditinjau dari tingkat kecerdasan emosional dan kemampuan matematika. *Jurnal Ilmiah Pendidikan Matematika, 1 (5)*, hlm. 14-20.

Dewi, S. K., Suarjana, M., & Sumantri, M. (2014). Penerapan model polya untuk meningkatkan hasil belajar dalam memecahkan soal cerita matematika siswa kelas v. *Jurnal Mimbar PGSD Universitas Pendidikan Ganesha Jurusan PGSD, 2 (1)*.

Hidayat, A. & Irawan, I. (2017). Pengembangan lks berbasis rme dengan pendekatan problem solving untuk memfasilitasi kemampuan pemecahan masalah matematis siswa. *Journal Cendikia: Jurnal Pendidikan Matematika, 1 (2)*, pp. 51-63.

Kusuma, et al. (2017). The development of higher order thinking skill (hots) instrument assessment in physics study. *IOSR Journal of Research & Method in Education (IOSR-JRME), 7 (1)*, pp. 26 – 32.

Lestari, K. E. & Yudhanegara, M. R. (2017). *Penelitian Pendidikan Matematika.* Bandung: Refika Aditama.

Lidinillah, D.A.M. (2008). Strategi pembelajaran pemecahan masalah di sekolah dasar. *Jurnal Pendidikan Dasar, (10)*.

Mustika, I.K. & Riastini, P.N. (2017). Pengaruh model polya terhadap kemampuan pemecahan masalah matematika siswa kelas V sd. *International Journal of Community Service Learning, 1 (1)*, hlm, 31-38.

OECD. (2016). *PISA 2015 result (volume 1): excellenge and equity in education.* Paris: OECD Publishing.

Suharta, I.G.P. (2016). Kemampuan siswa sekolah dasar dalam pemecahan masalah matematika real. *Jurnal Pendidikan dan Pengajaran, 49 (3)*, hlm. 137-147.

Pratiwi, D. D. (2015). Analisis kemampuan komunikasi matematis dalam pemecahan masalah matematika sesuai dengan gaya kognitif dan gender. *Al-Jabar: Jurnal Pendidikan Matematika, 6 (2)*, hlm. 131 – 141.

Ulya, H. (2016). Profil kemampuan pemecahan masalah siswa bermotivasi belajar tinggi berdasarkan ideal problem solving. *Jurnal Konseling Gusjigang, 2 (1)*, hlm 90 – 96.

Widodo, T. & Kadarwati, S. (2013). Higher order thinking berbasis pemecahan masalah untuk meningkatkan hasil belajar berorientasi pembentukan karakter siswa. *Cakrawala Pendidikan, 32 (1)*, hlm. 161 – 171.