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Primary School Students' Analogical Reasoning in Solving Open-ended Word Problems

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Abstract

This study aims to identify primary school students' analogical reasoning in solving open-ended word problems. This is qualitative research with a case study approach. The participants in this study were 25 fifth-grade primary school students selected using the purposive sampling technique to represent each category of analogical reasoning based on analogical reasoning tasks. Research instruments comprised of tests in analogical reasoning tasks and interview guidelines. Data analysis techniques included data reduction, presentation, and verification. Research results showed that there were three categories of students' analogical reasoning in solving word problems with close-ended source problems and open-ended target problems: (1) open comprehensive analogy, where students successfully solved the close-ended source problem and the open-ended target problem; (2) semi-open comprehensive analogy, where students successfully solved the close-ended source problem but did not successfully solve the open-ended target problem; and (3) failure in close-open analogy, where students did not successfully solve the close-ended source problem and the open-ended target problem. The results of this study suggest that educators, especially at the primary level, deepen students' ability to solve close-ended problems first so that students can solve open-ended problems with analogical reasoning.

Keywords: *analogical reasoning, problem-solving, open-ended, primary school.*

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Abstrak

Penelitian ini bertujuan untuk mengidentifikasi penalaran analogi siswa sekolah dasar dalam memecahkan *word problems* berbasis open-ended. Jenis penelitian yang digunakan adalah kualitatif dengan pendekatan studi kasus. Partisipan dalam penelitian ini sebanyak 25 siswa kelas lima sekolah dasar, untuk memilih subjek penelitian menggunakan teknik purposif yang mewakili setiap kategori penalaran analogi berdasarkan tugas penalaran analogi. Instrumen penelitian meliputi tes berupa analogical reasoning tasks dan pedoman wawancara. Teknik analisis data terdiri dari reduksi data, penyajian data, dan verifikasi data. Hasil penelitian menunjukkan bahwa terdapat tiga kategori penalaran analogi siswa ketika memecahkan *word problems* dengan masalah sumber close-ended dan masalah target open-ended, yaitu: (1) Analogi *open comprehensive,* siswa berhasil memecahkan masalah sumber close-ended dan masalah target open-ended; (2) Analogi *semi-open comprehensive,* siswa berhasil memecahkan masalah sumber close-ended tetapi tidak berhasil memecahkan masalah target yang open-ended; (3) Kegagalan analogi *close-open*, siswa tidak berhasil memecahkan masalah sumber close-ended dan masalah target open-ended. Hasil penelitian ini menyarankan kepada para pendidik khususnya di tingkat dasar untuk memperdalam kemampuan siswa dalam memecahkan masalah close-ended terlebih dahulu agar siswa bisa memecahkan masalah open-ended dengan penalaran analogi.

Kata kunci: *penalaran analogi, pemecahan masalah, open-ended, sekolah dasar*.

INTRODUCTION

Analogical reasoning has long been regarded as essential to improving problem-solving ability (Lailiyah, Nusantara, Sa'dijah, Irawan, Kusaeri, & Asyhar, 2018; Liang, Zhang, & Zhang, 2022). Problem-solving using analogical reasoning refers to the transfer of previously known knowledge (base problems) as initial knowledge to solve new problems (target problems) (Kristayulita, Nusantara, As'ari, & Sa'dijah, 2019; Vamvakoussi, 2017; Lailiyah, et.al., 2018). When students encounter a new problem, they may remember a problem they have solved before, take the solution, and use it with some adaptation to solve the new problem (Wong, Ng, Tempel, & Lim, 2017). There are two activities of analogical reasoning in problem-solving, namely: (1) identifying the similarity of the relationship and the suitability of information between the problem at hand (target problems) and the knowledge that has been owned (base problems); and (2) knowing the problem-solving procedure in the base problem to solve the target problem (Iqlima & Susanah, 2020). Thus, analogical reasoning is essential in problem-solving because it involves base problems as initial knowledge to solve target problems. This shows that analogical reasoning can make it easier to find problem-solving solutions (Gentner & Maravilla, 2018; Sarjoko, Demitra, & Rinawati, 2020).

School problem-solving is usually realized through word problems (Prasetyaningrum, Amir, & Wardana, 2022). The results of previous studies also show that word problems can be used to measure students' ability to solve mathematical problems (Zalima, Njanji, Lasmiatik, & Agustina, 2020). Word problems are crucial and considered the most difficult and challenging mathematical problems that students must solve (Verschaffel, Schukajlow, Star, & Dooren, 2020). Word problems are mathematical problems presented as narratives related to real-life situations (Nailia, Setiawan, & Purbasari, 2023). Using word problems since primary school can help students solve problems (Prasetyaningrum et al., 2022). Thus,

proficiency in solving word problems proves essential for students, enabling them to solve various complex problem situations to succeed in school and beyond (Agustianingsih & Mahmudi, 2019; Powell, Berry, & Benz, 2020).

Word problems are classified into two types, namely, close-ended and open-ended problems. Close-ended problems are structured problems requiring only one correct answer, resulting in students not being trained to develop their reasoning (Ariani, Candiasa, & Marhaeni, 2014). In comparison, open-ended problems are problems that can be solved in various ways and have multiple correct answers (Fitriani & Salsinha, 2021). Hence, it requires high reasoning to solve it. This makes open-ended problems suitable if implemented in problem-solving. Open-ended problems are an essential element in developing students' problem-solving skills (Medová, Bulková, & ˇCeretková 2020; Rosidah, Parta, & Sisworo, 2022; Fitriani & Salsinha, 2021).

Primary school students often experience difficulties and failures in solving open-ended problems. Several studies that have been conducted prove the results that students have difficulty understanding the problems presented because they require high reasoning to solve them (Nailia et al., 2023). Primary school students also experience difficulties due to their lack of ability to understand the structure of mathematical problems embedded in the text of the problem (Utari, Wardana, & Damayani, 2019; Andri, Wibowo, & Agia, 2020; Ainia & Amir, 2021; Prasetyaningrum et al., 2022). Students' errors also occur in understanding and identifying information in the question (Putri & Pujiastuti, 2021), and often students are wrong in doing calculations (Elliyani, Setyawan, & Citrawati, 2020).

Researchers have noted that students have difficulty in solving open-ended problems (Im & Jitendra, 2020; Schukajlow, Krawitz, Kanefke, Blum, & Rakoczy, 2023; Zhang et al., 2022). The difficulties that students often experience when solving open-ended word problems can be overcome by using analogical reasoning to make it easier to solve them. Analogical reasoning can interpret the success of solving a problem (Sarjoko et al., 2020). Therefore, a more in-depth identification of the stages of analogical reasoning in problem-solving is needed. Some researchers have conducted analogical reasoning research on problem-solving with base problems and target problems presented are close-ended type (Azizah & Rooselyna, 2021; Kristayulita, Nusantara, As'ari, & Sa'dijah, 2018; Lailiyah et al., 2018; Kristayulita, Nusantara, As'ari, & Sa'dijah, 2020; Triasari & Asmarani, 2022; Pradita, Dwiyana, & Sisworo, 2019; Putri & Masriyah, 2022; Savitri & Amin, 2018; Nurma & Rahayu, 2021; Lailiyah, Kusaeri, Retnowati, & Erman, 2022; Wulandari & Setianingsih, 2018). Previous studies focused analogical reasoning on close-ended problem-solving. It did not analyze the stages of analogical reasoning in problem-solving for primary school students and open-ended word problems.

Hence, this research focuses on the stages of analogical reasoning in problem-solving in primary school students. The problems presented are word problems with close-ended base problems and open-ended target problems. This needs to be done to identify the analogical reasoning stages of students and whether they can be stimulated from close-ended problems to open-ended problems through problem-solving with analogical reasoning. Identification of analogical reasoning is essential so that problems are easier to solve (Kristayulita et al., 2018).

METHODS

This research method used qualitative with a case study approach. Qualitative methods produce descriptive data in speech, writing, and things observed naturally (Creswell, 2014). The case study approach explores a deeper understanding of an individual, group, institution, or setting (Nugrahani, 2014). The case identified explores the analogical reasoning stages of primary school students in solving open-ended word problems as a target based on close-ended word problems as a source.

The participants of this study were 25 fifth-grade students at a primary school in Sidoarjo, East Java, Indonesia. The research subjects were selected using purposive techniques, in each category, two students were selected as research subjects. The purposive criterion in this study is to see the results of students' analogical reasoning task answers that can represent each category.

Indicators of analogical reasoning stages were adapted from Ruppert (2013), namely structuring, mapping, applying, and verifying (see Table 1). Adaptation is done by modifying the components of the analogical reasoning process that are general in nature, making it possible to analyze open-ended target problems.

Table 1. Indicators of analogical reasoning stages

Stages → Descriptor	Indicators
Structuring: Identifying mathematical objects by encoding objects or their characteristics and finding relational connections between base problems and target problems	Identifying the structure from base problems to target problems
	Identifying each mathematical object by creating codes in base problems and target problems
Mapping: Finding identical relationships of character codes between base problems and target problems, establishing a commonality of relationships, and mapping the commonality of relationships to target problems	Looking for similarities in the relationship between base problems and target problems
	Concluding the similarity of relationships and being able to explain the analogies that occur
Applying: Solving the target problem by using procedural steps to solve the base problem	Applying the base problem-solving procedure to solve the target problem
	Solving the target problem using the same method/concept as the base problem
Verifying: Checking the answer to the target problem by checking whether the target problem is consistent with the base problem	Checking the results obtained from target problems with base problems
	Checking the suitability of the results obtained with the given problem

Adaptation of Ruppert (2013)

The instruments used were analogical reasoning tasks and interview guidelines. Analogical reasoning tasks in word problems consisted of two problems on arithmetic material. Problem 1 is a base problem with a close-ended problem type and problem 2 is a target problem with an open-ended. The analogical reasoning task adapted from Liang et al. (2022) modified the material adapted to the arithmetic material in fifth-grade primary school (see Figure 1). The interview guideline is in the form of questions that will be asked to the research subject.

The credibility of categorizing the results of student answers in this study is based on source triangulation. Source triangulation is a method to test the validity of data from various

sources in various ways and at multiple times (Creswell, 2014). In this case, the presence of one problem 2 as a target can be seen to justify the change in analogical reasoning that occurs from one problem 1 as a source (Kristayulita et al., 2020).

Base problem (close-ended)	Target problem (open-ended)
On Eid al-Fitr, Adam received an allowance from his grandfather of Rp. 100.000. Some of allowance from his grandfather is put into his piggy bank of Rp. 50.000 and the rest is put into his wallet. Then, Adam received another allowance from his uncle (1) of Rp. 50.000 and from his uncle (2). But the amount of allowance from his uncle (2) is unknown because the money is immediately put by Adam into his wallet so that it is mixed together. If the total amount of money in Adam's wallet is Rp. 180.000, then how much allowance did uncle (2) give Adam?	At the time of frying the chicken for the big family meal on Eid al-Fitr, the mother ran out of oil in the kitchen. The mother told her son to buy 12 liters of oil from an oil dealer. The oil trader has the following measurements: 2 liters, 3 liters, 4 liters, and 5 liters. How many ways can the merchant measure 12 liters of oil?

Figure 1. Analogical reasoning task instrument

The data analysis technique used data reduction, data presentation, and data verification. (Miles & Huberman, 1994). Each analysis technique has the following procedures. Data reduction, (1) classifying written results that successfully solve the source problem, (2) classifying written results that successfully and unsuccessfully solve the target problem, (3) identifying interview transcripts that are not per the analogical reasoning process components. Data presentation, (1) coding written results that successfully and unsuccessfully solve the target problem based on the analogical reasoning process components, (2) coding interview transcripts that successfully and unsuccessfully solve the target problem based on the analogical reasoning process components, (3) presenting the coding results of written results and interview transcripts. Data verification, (1) verifying the coding results by confirming the research subject, (2) verifying the coding results by discussing between researchers, (3) drawing conclusions of analogical reasoning based on process components.

RESULTS AND DISCUSSION

Referring to the theory proposed by Ruppert (2013), the results of students' analogical reasoning tasks identified three categories of students' analogical reasoning when solving word problems with close-ended base problem and open-ended target problem. The findings of the three categories in this study are presented in Table 2.

Table 2. Analogical reasoning categories of students solving word problems base problem close-ended, target problem open-ended

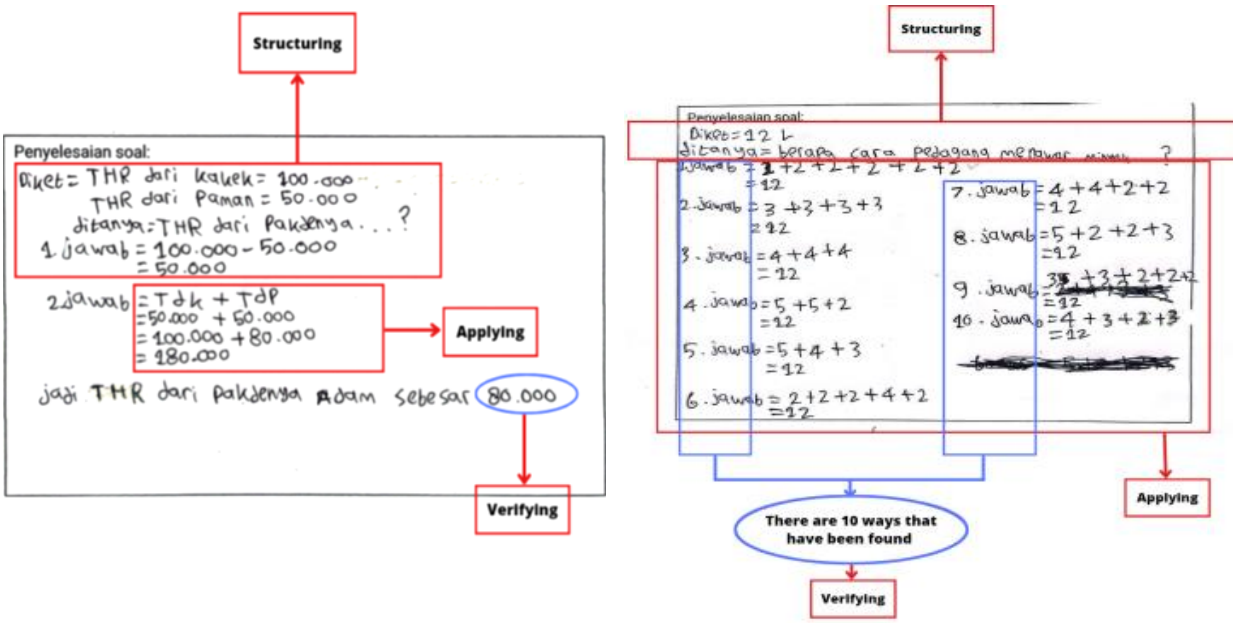
Analogical reasoning categories	N	%	Subjects
Open comprehensive analogy	2	8%	P1 and P2
Semi-open comprehensive analogy	11	44%	P3 and P4
Failure close-open analogy	12	48%	P5 and P6

Description:
n = the number of students in each category
P1-P6 = Research subjects in each category

Table 2 shows 2 students in the open comprehensive analogy category, 11 in the semi-open comprehensive analogy category, and 12 in the close-open analogy failure category. Based on this classification, two students in each category were selected to be the subjects in this study. The open comprehensive analogy category is represented by Participant 1 (P1) and Participant 2 (P2), the semi-open comprehensive analogy category is represented by Participant 3 (P3) and Participant 4 (P4), and the close-open analogy failure category is represented by Participant 5 (P5) and Participant 6 (P6).

Open Comprehensive Analogy

In the open comprehensive analogy category, students successfully solve the close-ended base problem and open-ended target problem. This demonstrates that students successfully transfer prior knowledge from close-ended base problem to open-ended target problem. Two students, constituting 8% of the participants, fall in the open comprehensive analogy category. The results of students' analogical reasoning tasks are illustrated through the results of Participant 1 (P1) and Participant 2 (P2). The results of P1 are shown in Figure 2.



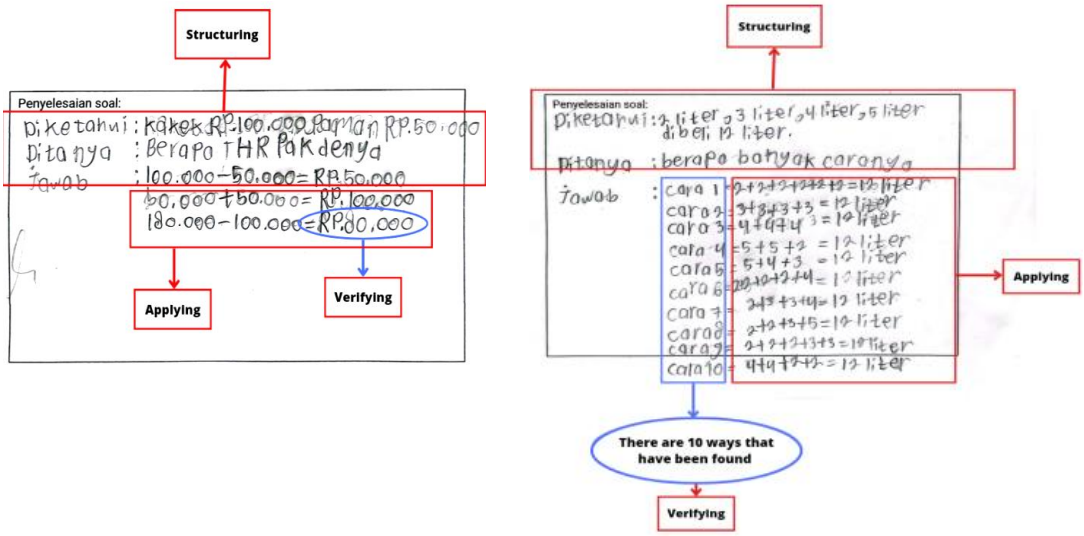
Base problem (close-ended) Target problem (open-ended)

Figure 2. Open comprehensive analogy result by P1

Figure 2 shows that P1 demonstrates the ability to solve the base problem. P1 identified what was known from the problem by writing down the mathematical object codes in the base problem, then calculated to match the requested final result amount of Rp. 180.000 and managed to find the answer, which was Rp. 80.000 with the right calculation. Next, P1 solved the target problem.

P1 conducted a mapping process to understand the meaning of the target problem. At the structuring stage, P1 found a structure that could solve the target problem. At the applying stage, P1 solved the target problem with the same solution structure as when solving the base

problem. Based on the interview results, P1 solved the target problem by adding up the size of the oil measure to measure as much as 12 liters, and the method was the same when solving the base problem by adding up the nominal money that could meet Rp. 180.000. P1 did the verifying stage because the results of P1's answer were right following the problem presented. Furthermore, the results of P2's analogical reasoning task are shown in Figure 3.



Base problem (close-ended) Target problem (open-ended)

Figure 3. Open comprehensive analogy result by P2

Figure 3 shows that P2 demonstrates the ability to solve the base problem. P2 starts writing what is known from grandfather and uncle. P2 calculated by subtracting from the total known amount of Rp. 180.000 minus the amount of grandfather and uncle (Rp. 100.000) and managed to find the nominal money of Rp. 80.000. P2 managed to find the answer with the right calculation. Next, P2 solves the target problem.

P2 does the mapping process to understand the meaning of the target problem. At the structuring stage, P2 identifies the known mathematical objects, namely the size of the oil measure (2 liters, 3 liters, 4 liters, 5 liters). P2 successfully identified the solution at the applying stage by adding the oil measure size to 12 liters. Based on the interview results, P2 solved the target problem the same as the base problem, namely, both looking for a value to match the available total (Rp.180.000 and 12 liters). P2 can find answers with the right calculations in the verifying stage according to the problem presented. Based on the results of analogical reasoning tasks and interviews, P1 and P2 perform analogical reasoning. The analogical reasoning structure formed from the answers of P1 and P2 (see Figure 4).

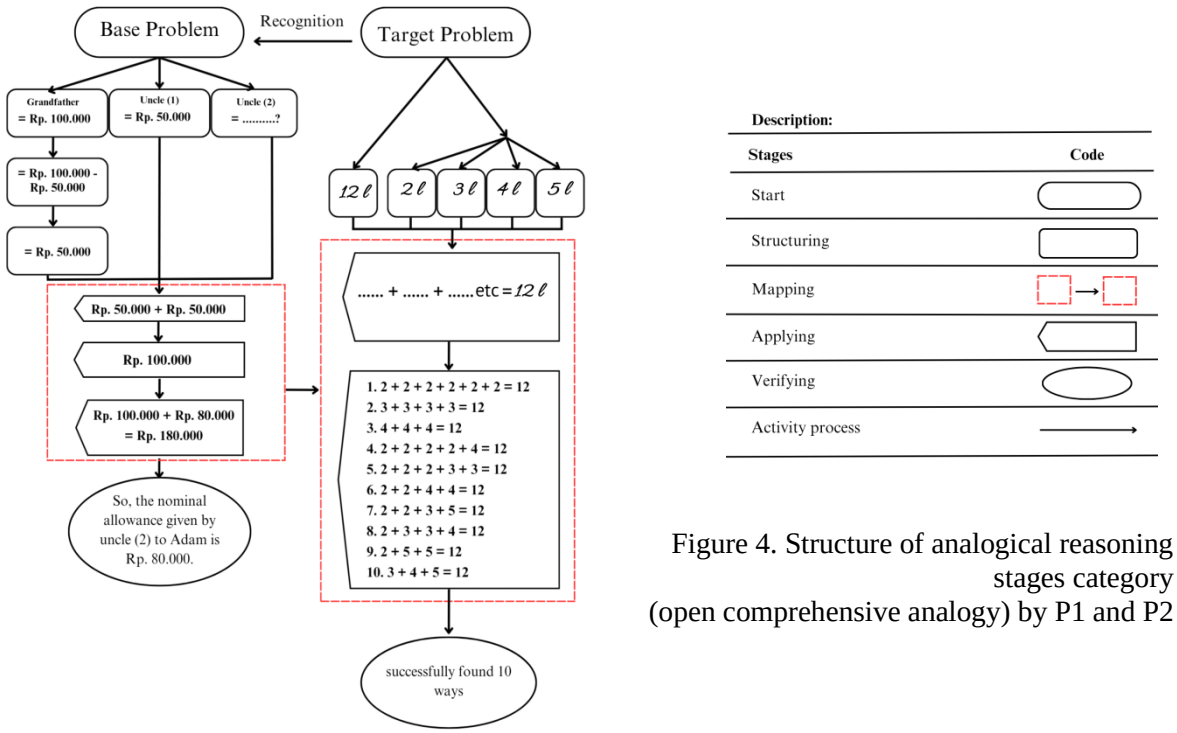
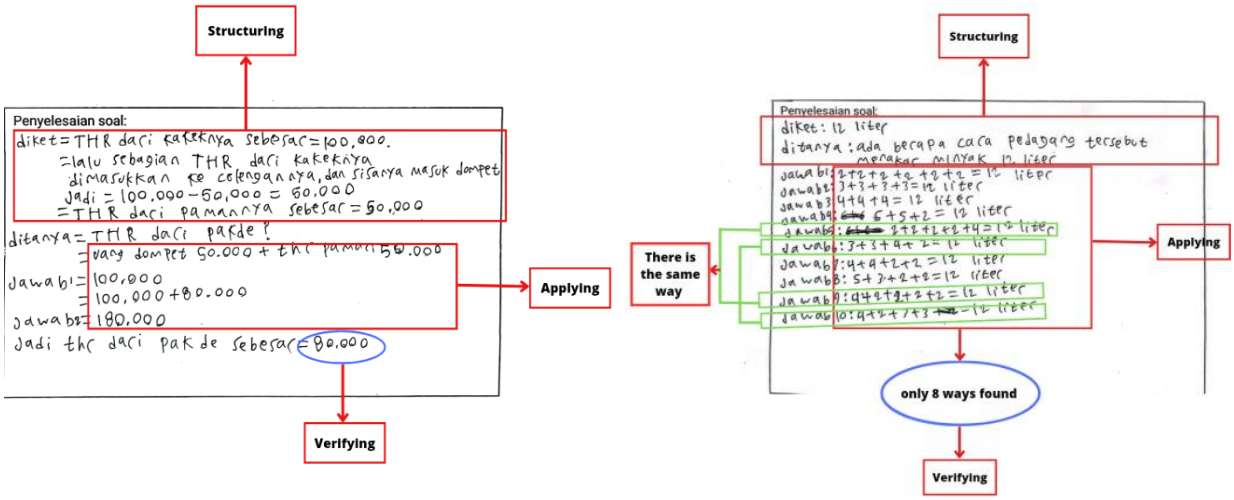


Figure 4. Structure of analogical reasoning stages category (open comprehensive analogy) by P1 and P2

Semi-Open Comprehensive Analogy

In the semi-open comprehensive analogy category, students succeeded in solving close-ended base problems but did not succeed in solving open-ended target problems. This shows that students cannot successfully transfer prior knowledge from close-ended base problem to open-ended target problem. There are 11 students (44%) who fall in the semi-open comprehensive analogy category. The results of students' analogical reasoning tasks are illustrated through the results of Participant 3 (P3) and Participant 4 (P4). P3 results are shown in Figure 5.



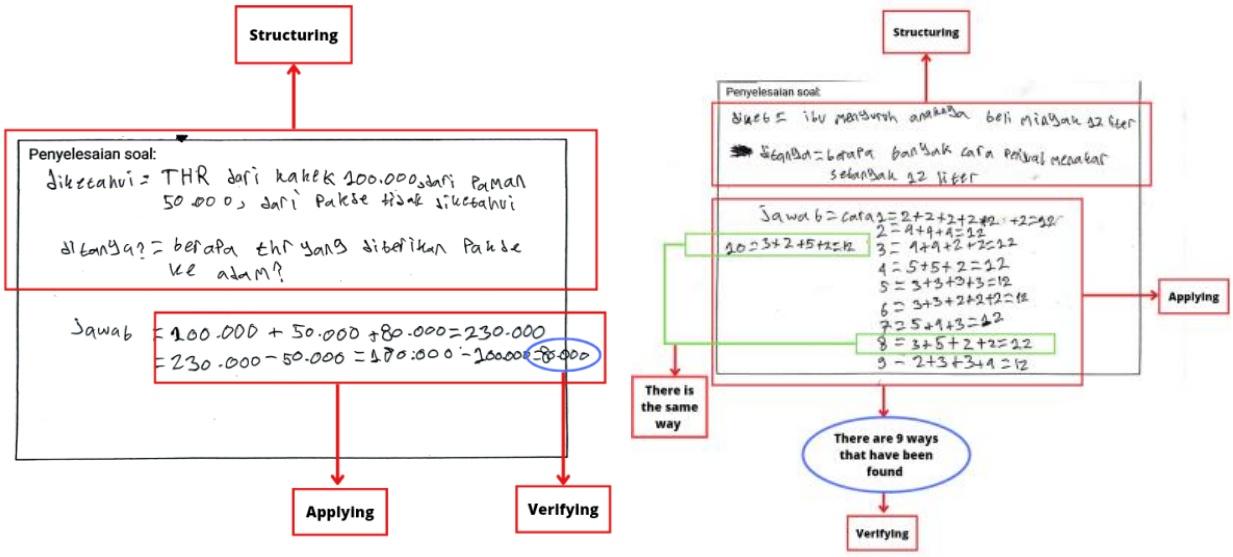
Base problem (close-ended) Target problem (open-ended)

Figure 5. Semi-open comprehensive analogy result by P3

Based on Figure 5, P3 solved the base problem by using the representation of known mathematical objects in narration and obtained the correct answer of Rp. 80.000. Then P3 solves the target problem. P3 identified the target problem at the structuring stage. However, the failure to solve the target problem is seen at the applying stage. It is found from P3's answer that there are two answers in the same way (number 5 is the same as number 9,

number 6 is the same as number 10). It can be seen that P3 is confused in finding answers in the target problem, so that it has not found the method in the target problem as a whole. Based on the interview results, P3 experienced confusion because there were many answers. P3 had difficulty in examining the answers one by one.

At the verifying stage, P3 did not succeed in providing the right answer to the target problem because it was only able to find as many as 8 ways out of 10 ways (the correct answer). Furthermore, the results of P4's analogical reasoning task are shown in Figure 6



Base problem (close-ended) Target problem (open-ended)

Figure 6. Semi-open comprehensive result by P4

Figure 6 shows that P4 started to identify what is known from the base problem, namely allowance from grandfather and uncle, solved the base problem and obtained the correct answer, Rp. 80.000. Then P4 solved the target problem. At the structuring stage, P4 identified the target problem. However, the failure to solve the target problem can be seen in the applying stage where P4 found one answer with the same calculation method (in answers numbers 8 and 10). This shows P4's lack of accuracy in finding answers to the target problems so that the answers are similar and have not found the answers to the target problems as a whole. Based on the interview results, P4 did not realize that the method produced was the same in other numbers.

At the verifying stage, P4 did not succeed in giving the right answer to the target problem because it was only able to find 9 ways out of 10 ways (the correct answer). The analogical reasoning structure formed from the answers of P3 and P4 can be seen in Figure 7.

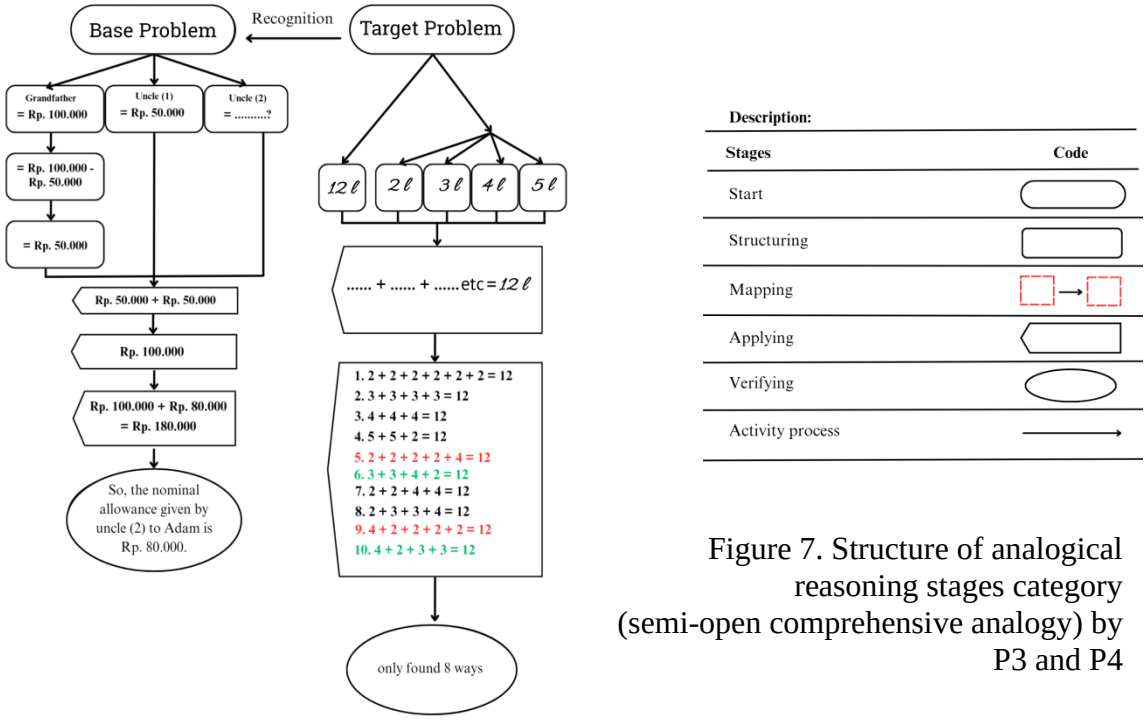
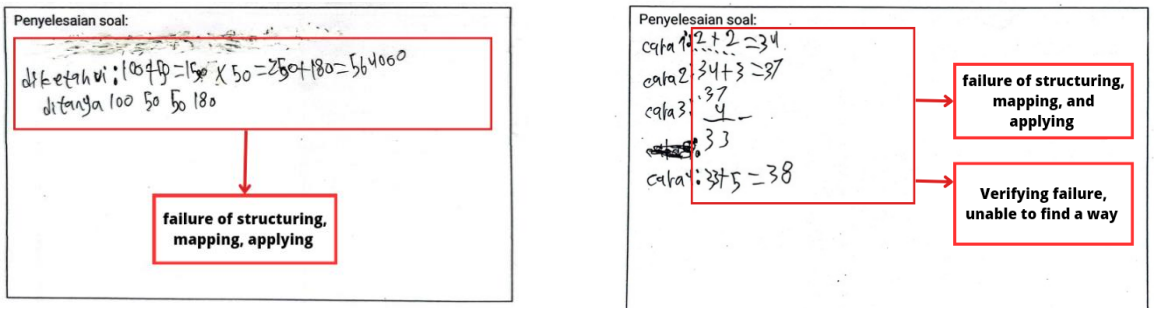


Figure 7. Structure of analogical reasoning stages category (semi-open comprehensive analogy) by P3 and P4

Failure Close-Open Analogy

In the failure close-open analogy category, students did not manage to solve the close-ended base problems and open-ended target problems. This shows that if students do not solve initial knowledge in close-ended base problems, then students will not succeed in solving open-ended target problems because there is no knowledge transfer. There are 12 students (48% of participants) who fall into the close-open analogy failure category. The results of students' analogical reasoning tasks are presented from the results of Participant 5 (P5) and Participant 6 (P6). The result of P5 is shown in Figure 8.



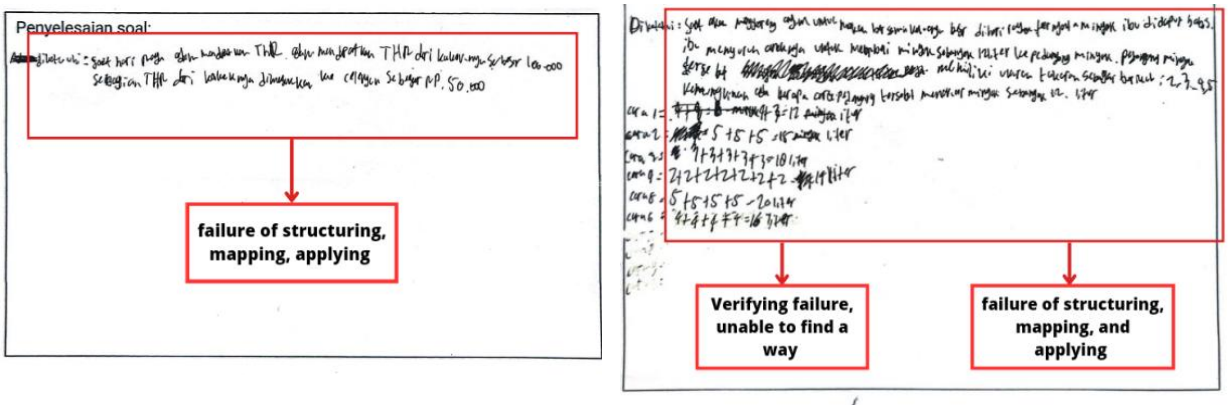
Base problem (close-ended) Target problem (open-ended)

Figure 8. Failure close-open analogy result by P5

Figure 8 shows that P5 directly solved the close-ended base problem without coding the known mathematical objects. It can be seen that the structure of the solution used by P5 is unclear, so it does not succeed in finding the correct answer. In this case, P5 failed to solve the base problem, then P5 attempts to solve the target problem.

At the structuring stage, P5 did not identify the structure of the target problem. At the applying stage, P5's solution was out of context (the presence of numbers 33, 34, 37) from the given problem. It was seen that P5 was unable to identify the available information, so P5 failed to find answers to the target problems. Based on the interview results, P5 did not understand what was meant by the problem, so P5 could not work on the target problem.

At the verifying stage, P5 could not check the results of his answers because understanding the structure of the problem and the way of solving P5 was not following the situation presented. In this case, P5 failed to solve the target problem. Furthermore, the result of P6's analogical reasoning task is shown in Figure 9.



Base problem (close-ended) Target problem (open-ended)

Figure 9. Failure close-open analogy result by P6

Figure 9 shows that P6 did not identify the problem or write a structure for solving the base problem, so no answer was found. In this case, P6 failed to solve the base problem. Then P6 solved the target problem.

At the structuring stage, P6 did not identify the structure of the target problem. P6 only rewrote the given situation. At the applying stage, P6's solution was incorrect. P6 added up the measurements not following the instructions of the given problem because it exceeded the requested measurement of 12 liters. In this case, P6 experienced a calculation error, so P6 failed to find the answer in the target problem. Based on the interview results, P6 did not understand the problem and added it up carelessly. At the verifying stage, P6 was unable to produce the right answer. Therefore, the solutions of P5 and P6 did not form the structure of the analogical reasoning stage (see Figure 10).

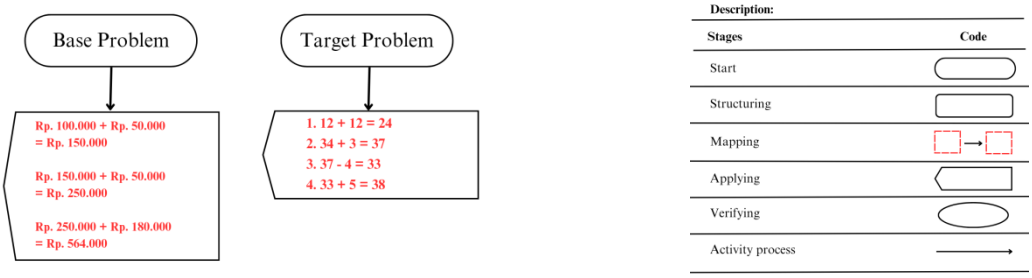


Figure 10. Structure of failure close-open analogy by P5 and P6

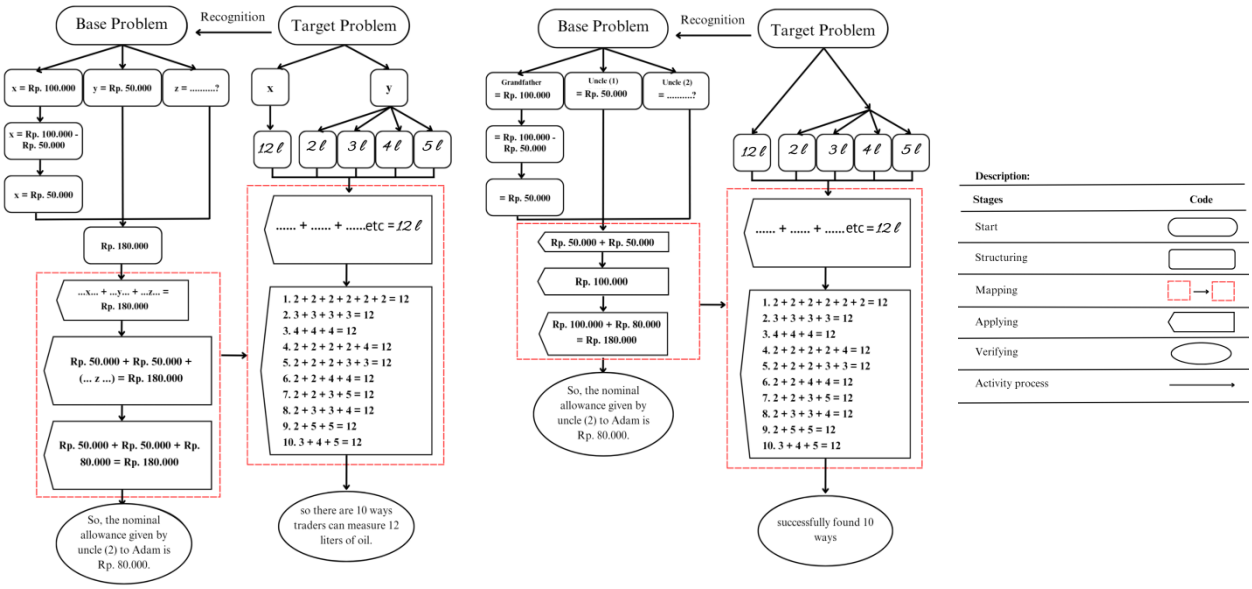
A more detailed discussion of the research results shows three findings of students' analogical reasoning categories when solving word problems with close-ended base problem and open-ended target problem.

Open Comprehensive Analogy

The open comprehensive analogy is a category for students who successfully solve close-ended base problems and open-ended target problems. This underscores their ability to transfer prior knowledge from the base problem (close-ended) to the target problem (open-ended), which was successfully demonstrated by P1 and P2.

The open comprehensive analogy category shows that students successfully perform all stages of analogical reasoning in the given problem-solving, namely the structuring, mapping, applying, and verifying stages. This success occurs because students can identify similarities in the solution structure even though the base problems and target problems are different types of problems. The similarity of solution structures between base problems and target problems that students can identify through analogical reasoning can help students solve target problems appropriately (Kristayulita et al., 2018).

This finding is similar to the study's results that when students are given target problems different from the base problems, then students can solve the target problems correctly (Kristayulita et al., 2020). This shows that students have completed the analogical reasoning stage by finding similarities in the solution structure. Hence, the students can successfully solve open-ended target problem even though the base problem are close-ended. Thus, the results of this study show that analogical reasoning can be applied to close-ended problems to open-ended problems (see Figure 11).



Structure of analogical reasoning stages from close-ended to open-ended

Structure of analogical reasoning stages by P1 and P2

Figure 11. Structure of analogical reasoning stages from close-ended to open-ended

Semi-Open Comprehensive Analogy

The semi-open comprehensive analogy is for students who successfully solve close-ended base problems but not open-ended target problems. This shows that students failed to transfer their prior knowledge in the close-ended base problems to the open-ended target problems. It can be seen that in the analogical reasoning stage, students did the structuring stage because they were able to identify the mathematical objects contained in the target

problems. At the mapping stage, students could not match concepts between the two problems (close-ended base problems and open-ended target problems). There was no conceptual transfer from base problems to target problems. This affects the applying stage, the failure lies in the similarity of the methods produced by the students..

This type of error is not always caused by not knowing how to solve it. It can also be caused by a lack of accuracy, failure to apply strategies, and a lack of understanding of students' mathematical concepts (Pradita et al., 2019). This results in students not being able to solve target problems correctly. At the verifying stage, it is not done by students because students do not succeed in solving the target problems completely.

Thus, it is categorized as a semi-open comprehensive analogy because students can only perform one of the stages of analogical reasoning and experience errors in the combination of analogical reasoning stages, namely mapping, applying, and verifying. This result is in line with the research results of (Kristayulita et al., 2018), that in carrying out the stages of analogical reasoning, there can be errors in the combination of the stages of analogical reasoning. Students are still said to carry out the analogical reasoning stage despite the unresolved target problem. However, the four stages of analogical reasoning are not all carried out (Iqlima & Susanah, 2020).

Failure of Close-Open Analogy

Close-open analogy failure is a category for students who do not successfully solve close-ended base problems and open-ended target problems. Students failed in performing the stages of analogical reasoning, starting from structuring, mapping, and applying to verifying. When solving base and target problems, there is no description of the relationship between the information and mathematical concepts used. Students did not mention and explain the concepts used in solving the target problems, because they had failed at the beginning when solving the base problems. This failure can occur due to students' low mathematical ability and lack of ability to understand the information presented in the problem.

In line with the opinion (Putri & Pujiastuti, 2021) that failure can occur because students cannot interpret the command and cannot identify the available information. This finding is similar to the results of (Rendrayana, Suarsana, & Parwati, 2020; Rohmah & Rosyidi, 2022) that students failure in analogical reasoning when at the initial stage (structuring) students lack an understanding of concepts and lack of ability to observe the problems given, will affect the solution procedure at the next stage and result in the answers given not following what is expected. This shows that students fail to perform the analogical reasoning stage from close-ended base problems to open-ended target problems.

CONCLUSION

The research results delineate three categories of analogical reasoning of students when solving word problems with close-ended base problem and open-ended target problem: (1) Open comprehensive analogy, where students successfully solve close-ended base problem and open-ended target problem; (2) Semi-open comprehensive analogy, where students successfully solve close-ended base problem but fail to solve open-ended target problem; and (3) Failure in close-open analogy, where students fail to solve close-ended base problem and open-ended target problem. This suggest a correlation that when students understand the solution structure in close-ended base problem, they will successfully solve the open-ended

target problem. This proves that students' analogical reasoning stages can be stimulated from close-ended to open-ended problems through problem-solving with analogical reasoning. These findings provide implications for future research or practitioners in psychology and mathematics. They can be used as guidelines for identifying students' analogical reasoning with different types of problems between base and target problems. Educators at the primary level should first deepen students' close-ended problem-solving skills so that students can solve open-ended problems with analogical reasoning. It is necessary to facilitate problem-based learning that can stimulate students' thinking in constructing the knowledge they already have to be used as a solution in solving new problems.

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