



Comparing Students' Problem-Solving Processes on Probability Tasks: Well-Structured and Ill-Structured Tasks

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Abstract

This study aims to describe the differences in the problem-solving abilities of *well-structured problems* and ill-structured problems models related to the concept of opportunity for Grade VIII junior high school students. Two students with the same mathematical abilities were selected to be subjects according to our research objectives. The results show that the two samples find it more difficult to solve *well-structured problems* than ill-structured problems. When at the stage of understanding the problem students need to read the questions repeatedly and when asked to retell the students can't do it well. In the questions of the type of *well-structured problems* subject 1 can only mention what is asked, but it is not appropriate to state the conditions needed to solve the problem and in subject 2 it is found otherwise, while in ill-structured problems it is not appropriate to write down what is known but write down what is asked with precise and knowing the requirements to solve the problem. Subject 1 uses logical and logical reasoning strategies. Then, subject 2 uses a trial and error strategy with logical reasoning. The two subjects carried out problem solving according to plan, carried out the re-checking stage, and were able to find solutions to problems that did not require calculations in them but could not find solutions to problems that contained calculations and had to be solved by utilizing the probability theorem. These results can be used as an evaluation in the learning process or a reference for further research.

Keywords: Problem solving, ill-structured problems, well-structured problems

Abstrak

Penelitian ini bertujuan untuk mendeskripsikan perbedaan kemampuan pemecahan masalah model *well-structured problems* dan ill-structured problems terkait konsep peluang siswa SMP kelas VIII. Dua siswa dengan kemampuan matematika yang sama dipilih untuk menjadi subjek sesuai tujuan penelitian kami. Hasil menunjukkan bahwa kedua sampel lebih merasa kesulitan ketika menyelesaikan soal *well-structured problems* daripada *ill-structured problems*. Ketika di tahap memahami masalah siswa perlu membaca soal berulang kali dan ketika diminta untuk menceritakan kembali siswa tidak dapat melakukannya dengan baik. Pada soal tipe *well-structured problems* subjek 1 hanya dapat menyebutkan yang ditanyakan, namun tidak tepat dalam menyebutkan syarat yang diperlukan untuk menyelesaikan masalah dan di subjek 2 ditemukan sebaliknya, sedangkan di *ill-structured problems* kurang tepat dalam menuliskan yang diketahui tetapi menuliskan yang ditanyakan dengan tepat serta mengetahui syarat untuk menyelesaikan permasalahan. Subjek 1 menggunakan strategi penalaran logis dan logika. Kemudian, subjek 2 menggunakan strategi coba-coba dengan penalaran logis. Kedua subjek melaksanakan penyelesaian masalah sesuai yang direncanakan, melakukan tahap memeriksa kembali, dan dapat menemukan solusi pada soal yang tidak memerlukan perhitungan di dalamnya tetapi tidak dapat menemukan solusi pada soal yang mengandung perhitungan dan harus diselesaikan dengan memanfaatkan teorema peluang. Hasil ini dapat digunakan sebagai evaluasi dalam proses pembelajaran atau rujukan untuk penelitian selanjutnya.

Kata kunci: Pemecahan masalah, *ill-structured problems*, *well-structured problems*

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Introduction

The ability to solve mathematical problems is very important because problem solving is a general goal of teaching mathematics (Davita & Pujiastuti, 2020). The Big Indonesian Dictionary (KBBI) defines mathematics as the science of operational procedures used in problem solving. (Nurjamil & Kurniawan, 2017). Jonassen (2015, Cheng and Siow: 63) argues, "Problem solving is one of the most meaningful and important types of learning and thinking". Polya (Nazariah & Authary, 2021) divides the stages of problem solving into 4, namely understanding the problem, making plans, execute the plan and check back. Journal of Mathematical Pedagogy, an international journal, provides

a forum for publishing the original research articles, review articles from contributors, and the novel technology news related to mathematics education.

Polya (1973), classifies problems into "routine" or "non-routine" problems. Routine means, problem solvers can find easy solutions by applying their skills without much difficulty, whereas non-routine questions are more challenging problems that require high skill to solve. However, students may have individual perceptions, where a problem may be perceived as routine to one person, but as non-routine to another. (Nurjamil & Kurniawan, 2017). Then, Davidson & Sternberg also argue that problems with clear directions are called *well-structured problems*, conversely problems with no ambiguity regarding directions in solving them are called ill-structured problems (Al -Ghofiqi et al., 2019). The unclear flow of ill-structured problems means that these problems cannot be solved only by general procedures (Al -Ghofiqi et al., 2019).

Chen & Li (2015: 920) defines a *well-structured problems* as having a single answer, optimal solution, and structured goals. Problem solving using *well-structured problems* usually involves representing the problem, finding solutions and implementing solutions. Meanwhile, ill-structured problems are defined as problems that have clear goals that allow resolution with several answers and ways of solving them. (Nurjamil & Kurniawan, 2017).

Problem solving abilities have become an interesting research focus. Students use most of their previous experiences and knowledge to facilitate strategies for finding solutions in solving ill-structured problems (Al -Ghofiqi et al., 2019). However, many students have difficulty solving *ill-structured problems*. Difficulties experienced by students in solving *ill-structured problems*, namely difficulty understanding questions, lack of students' understanding of the prerequisite material, difficulty building solving strategies, and difficulties in drawing conclusions (Mahmud & Pratiwi, 2019).

The development of mathematical reasoning and representation abilities of students who were given ill-structured problems was better than those who were given *well-structured problems* (Nurjamil & Kurniawan, 2017; Rofiki & Santia, 2018). Then, it was found that students' mathematical representations, teaching and instructional strategies influenced the problem solving of *well* and ill-structured problems models (Prayitno et al., 2020; Pulgar et al., 2020). Students are better able to solve *well-structured problems* than unstructured problems in physics lessons (Supeno et al., 2020). From the studies that have been described, there has been no analysis of differences in problem-solving abilities of *well-structured problems* and ill-structured problems models in learning mathematics.

In learning mathematics itself, one of the subject matter of mathematics studied in junior high school is the material of opportunity. The concept of opportunity is widely used in scientific fields, such as economics, sociology, health, and so on, so opportunity material is very important to teach (Meliana et al., 2022). Based on Komarudin's analysis (2016), one of the subjects of mathematics that is difficult for students to master is probability, it was found that students only memorized patterns of solving and formula equations without trying to understand them. (Meliana et al., 2022). Therefore, in this study, opportunity material was selected to be tested. The purpose of this study was to describe the differences in the problem-solving abilities of well-structured problems and ill-structured problems related to the concept of opportunity for eighth grade junior high school students. This description can be used as input by teachers in training students' problem solving skills.

Method

The selection of subjects in this study used a purposive sampling technique. In this purposive sampling, samples were selected based on certain criteria according to research needs. Bhardwaj (2019) said that in purposive sampling, based on conformity with the objectives of the study, this type of selection is also called deliberate sampling or judgmental sampling.

By using this technique, the subject of this research was taken by providing research subject criteria

to a mathematics teacher at a school in Ponorogo, then based on these criteria, the mathematics teacher took the 2 subjects we needed. The selection of this subject was chosen because researchers have not been able to go directly into the class and with consideration of the efficiency of the time used. The subjects of this study were considered valid because they were selected based on recommendations from the mathematics teacher at the school who, of course, already knew the mathematical abilities and characteristics of the students. We obtained 2 subjects and we gave them the initials (AA) and (BB).

Data was collected from the subject's work on written tests and interview results related to the subject's answers. In the written test, 2 questions were given in the form of description questions on the types of well-structured problems and *ill-structured problems*. The subject worked on the 2 types of questions for 60 minutes. The first question was prepared by the author taking into account the characteristics of well-structured problems and the second question was prepared by paying attention to the characteristics of *ill-structured problems*. Ill-structured problems cannot be solved simply by applying existing knowledge because solving this type of problem requires students' advanced thinking processes and strategies rather than remembering information (Kim et al., 2018). These ill_structured problems are open-ended problems, not well defined and the solution is not clear at the start. Problems and solutions also evolve as the task progresses (Lazar, 2018). Meanwhile, well-structured problems have one correct answer and one solution path (Dinsmore & Fryer, 2023). Both of these questions use the same context, namely throwing a dice, but are developed into two different types of questions.

Problem development is also based on problem solving indicators. This means that from this question it can be analyzed how students think based on the problem solving indicators. According to Polya (1978) problem solving indicators are divided into 4 stages, namely: (1) understanding the problem, (2) developing a problem solving plan, (3) solving the problem according to plan, and (4) re-examining. The questions were then validated by experts in terms of content, construct, and language. The following are the two questions used as research instruments:

1. An experiment is carried out with the following conditions :
 - The first time a coin is tossed
 - If the side of the coin appears in the coin toss, the experiment continues with the coin toss. Meanwhile, if the number side appears, the experiment is continued with a six-sided die.
 - If up to tossing the coin for the third time an image always appears, the experiment is stopped.
 - If an even number appears in the throw of the dice, the roll is stopped.
 - If in throwing the dice an odd number appears, the throw is repeated once and then the throw is stopped no matter what number appears.

Based on these rules, if an experiment occurs as follows :

1. On the first toss the coin comes up heads
2. When the two coins are tossed, the heads appear
3. On the third toss of a coin comes the number side
4. When the dice is thrown, an odd number appears
5. When the two dice are thrown, an even number appears

Define

- a. What is the probability that an experiment will occur ?
 - b. Is it true that the throw will be stopped at try point 5 ? Explain your reasons !
2. An experiment was carried out with the following conditions :
 - a. The first time a coin is tossed.
 - b. If the side of the coin appears in the coin toss, the experiment continues with the coin toss. Meanwhile, if the number side appears, the experiment is continued with a six-sided die.
 - c. If up to tossing the coin for the third time an image always appears, the experiment is

stopped.

- d. If an even number appears in the throw of the dice, the roll is stopped.
- e. If in throwing the dice an odd number appears, the throw is repeated once and then the throw is stopped no matter what number appears.

Find the probability that the experiment results in exactly one throw of the dice.

After finishing work, we immediately interviewed both subjects. Table 1 describes the interview protocol that guided the interviewers to collect data. However, this protocol does not mean the interviewer guide using all question items is too rigid. Instead it, plays the role of a means of confirming the responses of certain subjects. This is to keep the subject from expressing their thought processes as naturally as possible. Thus, when the subject's responses did not indicate a particular problem-solving process that would occur during the interview, the interviewer did not inquire further about that process.

Table 1. Interview guidelines

Problem Solving Process	Sample interview guide
Understanding the problem	<ul style="list-style-type: none"> • How many times have you read the questions until you understand the problem in the questions presented ? • After understanding the problem, do you immediately know the meaning of the problem from the questions presented ? • In what questions are there terms that you do not know ? • Is the information given in question number 1 sufficient to answer the given problem ? • Retell the problem in question number 1 which is presented using your own language.
Make plans	<ul style="list-style-type: none"> • Have you ever received questions that are similar or that support finding answers to the questions given? • What strategy did you use when planning to solve problem number 1? For example, try - try or reason or something?
Execute the Plan	<ul style="list-style-type: none"> • When solving question number 1, did you do it like what you had planned? • Are you sure about your answer? Give a confidence rating from 1 – 10

	<ul style="list-style-type: none"> • What is the reason or what makes you sure about answer number 1? • Are there difficulties in working on question number 1? What causes it so that you have difficulty solving questions?
Check again	<ul style="list-style-type: none"> • Did you double-check the answers you gave in question number 1? • What kind of check do you do? • After arriving at the answer checking stage, did you realize something was wrong and did you solve the problem again?

Glaser and Strauss (1967) say that the constant comparative method is a method in which you sort and organize the raw data quotes into groups according to attributes, and organize these groups in a structured way to formulate new theories. Thus, in this study the constant comparative method technique was used, which is an analytical technique by sorting and organizing the data in groups so that conclusions can be drawn.

The results of the interviews were conducted interactively. Diagnostic test results data were carried out to determine differences in students' problem-solving abilities in solving well-structured problems and *ill-structured problems*. The constant comparative method technique consists of 3 stages, namely data reduction, data presentation and conclusion.

In data reduction, an analysis is carried out that sharpens, classifies, directs, discards data that is not needed and organizes the data in such a way that conclusions can be drawn and verified. Data reduction in this study focused on students regarding opportunity mathematical problem solving where the results of the answers referred to differences in students' problem solving abilities in solving well-structured problems and *ill-structured problems*. Data reduction was carried out in several steps, namely playing the interview recordings several times so that they could write down exactly according to the results of the recording to find out the reasons for each problem-solving process written by the students, transcribing the interview results according to the subjects who had been given a different code for each subject, and checking return the results of the transcripts by listening to the results of the interviews, so that there are no mistakes made by the researcher in translating the results of the interviews.

Then, in presenting the data, complex information is simplified into a simplified and selective form or configuration that is easy to understand. Furthermore, in the last stage, namely drawing conclusions, it is carried out to provide conclusions on the results of the analysis/interpretation of data on the results of activities which include searching for meaning and providing explanations from the data that has been obtained. The problem-solving process model that guides this research is based on a modification of the Polya problem-solving model, in which there are 4 stages, namely understanding the problem, making a plan, carrying out the plan and checking again.

In the analytical framework in Figure 1, shows the stages that may occur during the completion of a mathematical problem. The direction of the arrow shown in figure 1 indicates that the solver may follow a cyclical process in which the solver moves back and forth, may get stuck and have to take a

step backwards along the way (Mason, 2015).

For example, it is possible that the solver moves back to the understanding stage of the problem when he or she gets stuck making plans. In addition, the process of implementing the plan can occur 2 times longer depending on the level of trust and possible solution strategies obtained/planned. Even though there is a possibility that students, even though they have not encountered similar problems, have been able to plan a solution. Furthermore, the arrows presented at the stages in figure 2 show the logical progression from one stage to the next. Thus, in this study, the polya problem solving stage was adopted to see the problem solving process that occurs which is indicated by the arrows at that stage. The following is an analytical framework for the Problem Solving Process

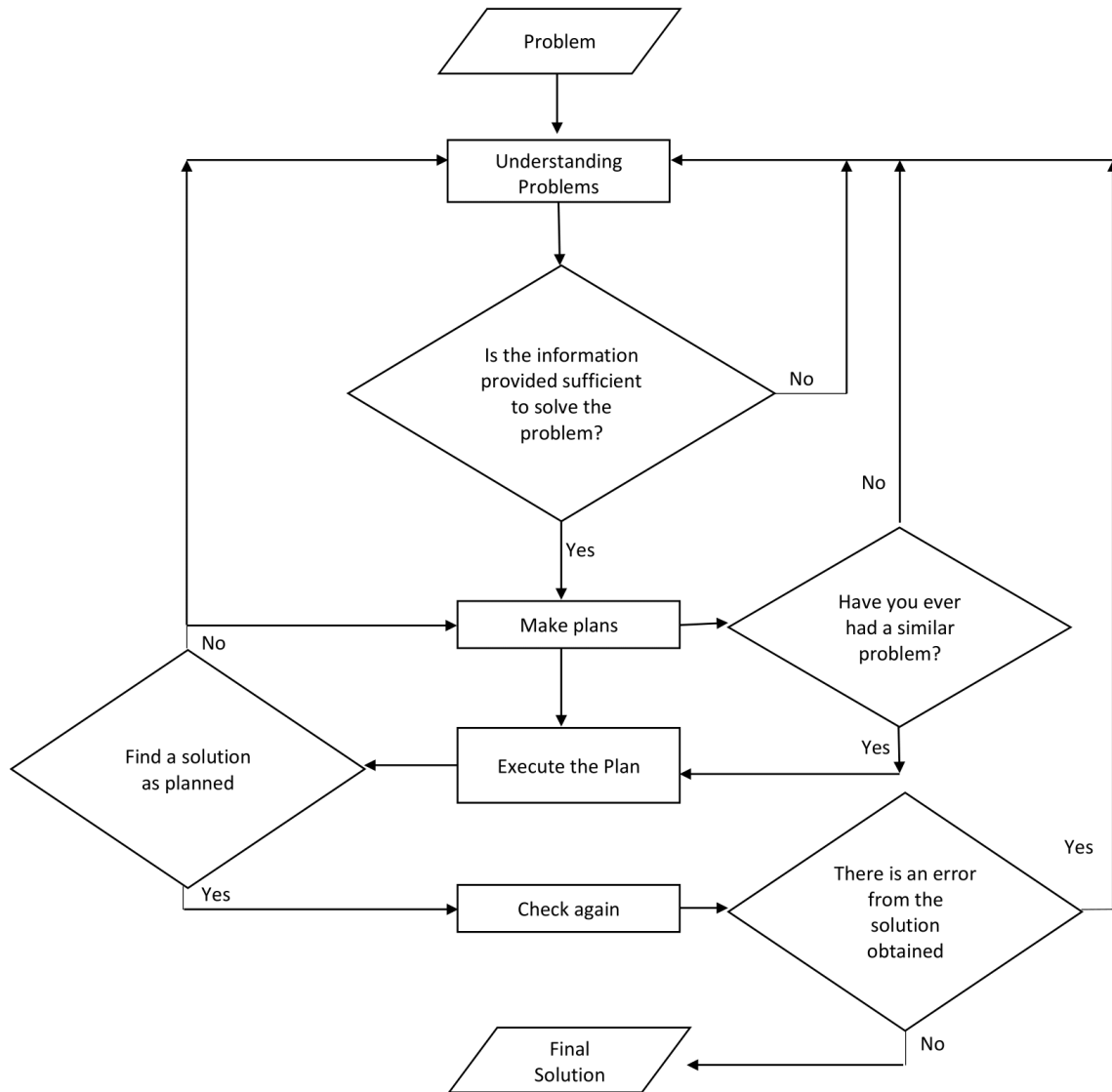


Figure 1. Analysis Framework of Student Problem Solving Process

Result and Discussion

Table 2. Student Answer Results
Well-structured problems

Results Answer AA	Results Answer BB
<p>Diketahui : • 2 kali percobaan awal muncul sisi gambar. • 1 kali percobaan setelahnya muncul sisi Angka. • Pelemparan dadu pertama muncul angka ganjil, dan selanjutnya muncul angka genap.</p> <p>Di tanya : a. Peluang yg terjadi? b. Apa yang terjadi setelah sampai pada percobaan poin 5?</p> <p>Jawab : . . .</p> <p>a. Peluang muncul ^{sisi} mata uang gambar adalah $\frac{2}{3}$. Dikarenakan dipercobaan ke-3 muncul sisi angka, maka dilakukan pelemparan seperti aturan yang sudah ditentukan.</p> <p>b. Maka pelemparan dihentikan, karena sesuai aturan yg sudah ditentukan. Jika pelemparan dadu muncul angka ganjil, maka pelemparan diulang sekali dan dihentikan selanjutnya dihentikan apapun angka yang muncul.</p>	<p>Diket : Pelemparan pertama dan kedua muncul sisi gambar, percobaan ketiga muncul sisi angka, dilanjutkan dengan pelemparan dadu muncul angka ganjil dan berakhir dengan pelemparan dadu muncul angka genap.</p> <p>Ditanya: a. Peluang percobaan tersebut b. Apa yang terjadi setelah sampai pada percobaan poin 5</p> <p>Jawab A. Peluang muncul sisi gambar pada percobaan pelemparan mata uang pertama = $P(A) = 1/2$ B. Peluang muncul sisi gambar pada pelemparan mata uang kedua $P(B) = 1/2$ C. Peluang muncul sisi gambar pada percobaan pelemparan mata uang ketiga $P(C) = 1/2$ D. Peluang muncul angka ganjil pada percobaan pelemparan dadu pertama $P(D) = 3/6$ ($1/2$) E. Peluang muncul angka genap pada percobaan pelemparan dadu kedua $P(E) = 3/6$ ($1/2$)</p> <p>a. Peluang dari percobaan tersebut adalah $P(A) \times P(B) \times P(C) \times P(D) \times P(E) = 1/2 \times 1/2 \times 1/2 \times 1/2 \times 1/2 = 1/32$ b. Yang terjadi adalah pelemparan dihentikan, sesuai aturan yaitu pelemparan dihentikan apapun angka yang muncul.</p>

Ill-structured Problems

Results Answer AA	Results Answer BB
<p>Diketahui : • penjelasan sama pada soal nomer 1. Ditanya : • Tentukan peluang yang mungkin dari percobaan tsb sehingga terjadi satu kali pelemparan dadu!</p> <p>Dijawab :</p> <p>a. Peluang muncul mata uang sisi angka = $\frac{1}{3}$</p> <p>b. Peluang muncul angka genap dalam pelemparan dadu sebanyak 1 kali. $P(A) = \frac{n(A)}{n(S)}$ Angka genap = {2, 4, 6} $= \frac{3}{6} = \frac{1}{2}$</p> <p>agar terjadi 1 kali pelemparan dadu, maka dadu harus menunjukkan angka genap.</p>	<p>Diketahui : Pelemparan dadu akan dilakukan bila mata uang memunculkan sisi angka • 1 x pelemparan dadu muncul angka genap.</p> <p>Ditanya : Peluang yang mungkin sehingga terjadi tepat satu kali pelemparan dadu</p> <p>Jawab Peluang munculnya sisi angka selama 3 kali pelemparan = $1/2 \times 1/2 \times 1/2 = 1/8$ Peluang munculnya angka genap dadu = $3/6$ Maka peluangnya adalah $1/8 \times 3/6 = 3/48 = 1/16$</p>

Table 3. Analysis of Student Answers

Problem Type	Activity Indicator	S1 Answer Analysis	Analysis of S2 Answers
<i>Well Structured Problem</i>	Understanding the problem	Read the questions repeatedly (as much as 6 times) Able to identify information that is known, which is asked, but is not precise in stating the conditions needed to solve the problem.	Read the questions repeatedly (as many as 8 times) Able to identify known information, precise in stating the conditions needed to solve the problem, but does not mention what is being asked.
	Making Plans	Never got a question that is relevant to the problem at hand Logical reasoning strategies in planning problem solving by carefully re-reading the questions for question number 1, then using logic to be able to find the answer	Never got a question that is relevant to the problem at hand Trial strategy - try with logical reasoning in planning problem solving.
	Execute the Plan	Doing as planned but the resulting answers are wrong for question 1a and correct for question 1b	Doing as planned, but the resulting answers are wrong for question 1a and correct for question 1b
	Check again	Check again by reading and understanding the answers that have been written again Linear problem solving	Check again by reworking the question 3 times until you find the right answer Iterative (non-linear) problem solving

<i>Ill Structured Problem</i>	Understanding the problem	Read the questions repeatedly (3 times) Able to identify information that is known, which is asked, but is not precise in stating the conditions needed to solve the problem.	Read the questions repeatedly (3 times) Able to identify the information provided, but it is not precise in writing what is known and writes what is asked correctly and knows the conditions for solving problems.
	Making Plans	Never got a question that is relevant to the problem at hand Logical reasoning strategies in planning problem solving by calculating the probability of appearing on the coin side of the number and calculating the probability of appearing an even number on the throw of the dice	Never got a question that is relevant to the problem at hand Trial strategy - try with logical reasoning in planning problem solving.
	Execute the Plan	Doing as planned, but the resulting answer is wrong	Doing as planned, but the resulting answer is wrong
	Check again	Check again by recalculating the answers that have been written.	Check again by reworking the question 2 times until you find the right answer
		Linear problem solving	Linear problem solving

AA Problem Solving Process

In the well-structured problems question AA answered question (b) correctly but was wrong in question (a). At the stage of understanding the problem AA begins the process of solving the problem by reading the questions four times. After reading AA questions 4 times, I still don't know the meaning of the problems in the questions presented. So that AA does the step of re-reading the questions in the questions 2 times until finally knowing the meaning of the questions given. AA said that there were no unknown terms and the information provided in the problem was sufficient to answer the question.

When AA was asked to retell the problem presented, he stated that the information given was

that he made 2 attempts with the image side appearing, and 1 trial appearing the number side. Then, AA added that because at point 3 a number appeared, the dice was rolled so an odd number appeared on the fourth attempt (the first roll of the dice) and then an even number appeared on the fifth attempt (the second roll of the dice). AA did not understand the point of the question that throwing attempts from 1 – 5 had been carried out, this can be seen when AA stated that the information provided only had 3 attempts and mentioned that in experiment point 4 this could happen because of the rules presented. Rule information and experimental information should be different things.

In the planning step, AA has never received questions that are similar or that support solving the problems given in the questions. In this step, AA chooses a logical reasoning strategy in planning problem solving by carefully re-reading the question, after re-reading AA decides to then also use logic in order to be able to find the answer. This is done for questions (a) and (b).

In the step of carrying out the plan, AA completed the questions according to the strategy he had planned, but with confidence in the answers from 1-10, AA only gave them a value of 4. This happened because according to AA, this question was difficult to understand.

When AA was asked to explain why he produced a $\frac{2}{3}$ answer in question (a), AA explained that the $n(a)$ of 2 was obtained from 2 times the side of the coin appeared on the coin toss and the $n(s)$ was 3 obtained from the number of attempts of throwing eyes. money that is as much as 3 times. So, AA assumes that $n(a)$ and $n(s)$ from the 3 experiments carried out can be combined in one calculation without applying the concept of multiplication of probabilities.

Furthermore, when asked that the experiments carried out from points 1 to 5 in the question were a sequence of activities, that is, after point 1 was completed, then proceed to point 2 and so on up to point 5, "In your opinion, are the opportunities from activities 1 to 5 can be combined so as to produce 1 value odds on the final result? For example, the probability of tossing a coin compares to the probability of throwing the dice?" AA answered "can be combined" so that it produces 1 probability value in the end result, but when asked "why is the answer presented only the opportunity to toss a coin? Not followed by the chance of throwing the dice?", AA could not explain and said that "number 1(a) is really difficult, so answer as best you can first." AA also revealed that he did not understand the correct solution for number 1(a).

In addition, AA also said that there were difficulties in working on the questions given, then said the cause of these difficulties was his lack of knowledge to answer the questions given. AA carries out the re-examination stage by reading and re-understanding the answers that have been written in both questions 1(a) and 1(b). At this stage AA is not aware that the answer in question 1(a) is wrong and does not rework even though he is unsure of the answer.

On ill-structured problems AA produces wrong answers. At the stage of understanding the problem AA begins the process of solving the problem by reading the questions three times. After reading AA questions 3 times, I immediately knew the meaning of the problem in the questions presented. AA said that there were no unknown terms and the information provided in the problem was sufficient to answer the question.

Based on the results of the interview, when asked to retell the problems presented. AA stated that the information provided was that the tossing of coins would stop if 3 sides of the image appeared. If a number appears, then the dice will be continued, if an even number appears, the throw will be stopped, if an odd number appears, the throw will be carried out once again and will be stopped regardless of the number that appears. AA also mentioned what was asked in the question, namely the possible probability of the experiment that the dice was thrown 1 time.

In the planning step, AA has never received questions that are similar or that support solving the problems given in the questions. In this step, AA chooses a logical reasoning strategy in planning problem solving by calculating the probability of appearing on the coin side of the number and calculating the probability of appearing an even number on the throw of the dice.

In the step of implementing the plan, AA uses the strategy as planned, namely the logical reasoning strategy. AA gives a value of 7 for confidence in the answer from the range of values 1-10 and says that he is confident in his answer. AA also said that he could provide a confidence level of 7, based on the reasoning he had done.

When AA was asked why he presented his answer in 2 points, then AA answered the reason he presented his answer in two points, namely to make it clearer and said that the original answer, namely point b and point a, was optional. Furthermore, when asked "can the chance of throwing currency and throwing dice be combined?" AA replied "can sis". Then asked again. "So, based on your answer, what is this? Still can be merged or not?" AA couldn't explain and said "I don't know sis, number 2 is really hard". Even though AA said that the question was difficult, AA felt that there was no difficulty in working on the questions given. So this AA feels that when working on it he does not encounter difficulties but when directed to rethink his answer by being asked questions about the answers he gave this AA finds it difficult. AA carries out the re-checking stage by recalculating the answers that have been written. At this stage AA is not aware that the answer is wrong and does not rework

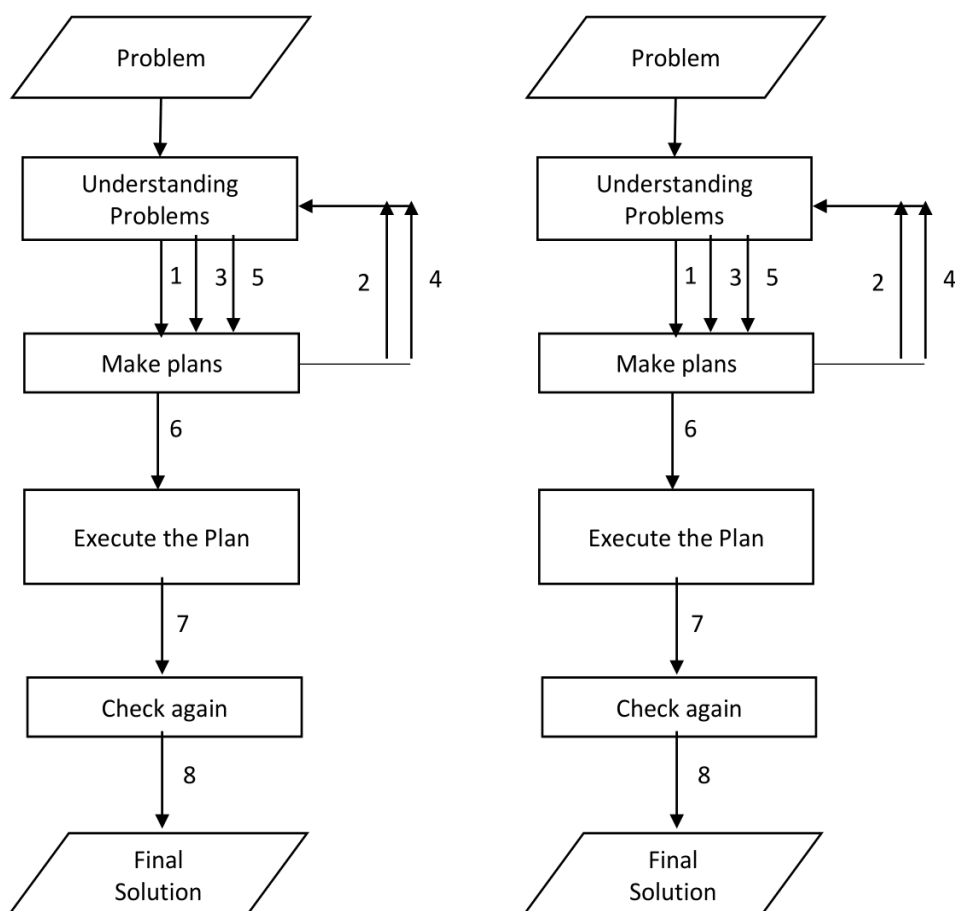


Figure 2 (problem 1a) and 3 (task 1b). Problem Solving Process Well-Structured Problems AA

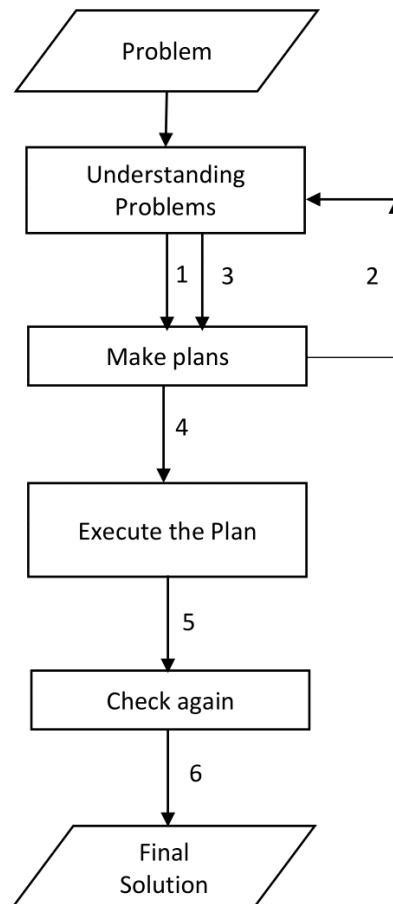


Figure 3. Problem Solving Process of ill-Structured Problems AA

BB Problem Solving Process

In the questions of well-structured problems BB produces wrong answers in (a) and correct in (b). At the stage of understanding the problem BB starts the process of solving the problem by reading the questions eight times. After 8 times reading the subject matter, you immediately know the meaning of the problem in the problem presented. BB said that there were no unknown terms and the information provided in the problem was sufficient to answer the question. BB also said that one only needed to understand the problem more to answer the problem.

Based on the results of the interview when asked to retell the problems presented, BB stated that the information given was “The first and second tosses appear as the sides of the image so continue tossing coins. The third throw shows the number side, then the dice is continued. The fourth attempt (the first roll of the dice) turned up an odd number, according to the rules, continued tossing the dice again and an even number appeared. Regardless of the number, the throwing is stopped according to the provisions”

BB can mention information that is known in the problem, but does not know the meaning of the problem that the throwing attempt has been carried out, this can be seen when BB mentions that in the experiment points 3 and 5 can occur because of the rules presented. Rule information and experimental information should be different things.

BB was not careful in writing down what was known, but was able to write down what was asked well.

In the planning step, BB never got questions that were similar or that supported solving the problems given in the questions. In this step, BB chooses a trial and error strategy with logical reasoning in planning the completion of problem (a) and uses logical reasoning for problem (b).

At the stage of implementing the BB plan, use the strategy as planned, namely the trial and error

strategy with logical reasoning to solve the problem in the problem. BB gave a value of 7 for the confidence range of values from 1-10 and said that he was quite sure of his answer because it was based on the reasoning he did. BB said that there were difficulties in working on question 1(a) given and was rather slow in understanding the problem and the cause of this difficulty was that it was rather difficult for him to determine his chances.

When asked the reason he answered that the odds for P(B) and P(C) were the same, namely because he was confused about applying the knowledge he had previously obtained. He explained that in this problem the image appeared 2 times so he got a $\frac{1}{2}$ chance. When explained that points 1 to 5 are sequential events, that is, after the experiment at point 1 has been completed, then the experiment at point 2 continues and so on until point 5. He remains convinced that P(B) and P(C) are still $\frac{1}{2}$.

BB carried out the re-examining stage by reworking the question 3 times until he found the right answer. BB performs problem solving iteratively. BB revealed that initially he made a mistake when calculating the probability value, but when he checked again, BB realized that the opportunity value written there was not in accordance with what was in the question, so BB returned to the step of carrying out the plan to do it again for question (a). However, BB felt that he was right about (b) and did not rework.

In terms of ill-structured problems BB produces wrong answers. At the stage of understanding the problem BB starts the process of solving the problem by reading the questions three times. After reading the BB questions 3 times, I immediately knew the meaning of the problems in the questions presented. BB said that there were no unknown terms and the information provided in the problem was sufficient to answer the question.

Based on the results of the interview when asked to retell the problem presented by BB, the information provided was "The dice will be rolled if the currency shows the number side. For 1 throw of the dice if an even number appears."

From the results of the answers and interviews, it can be said that BB can determine what is being asked and understand the intent of the question, but cannot determine which information is known. It can be seen from BB's answer that he wrote what is known "The dice will be rolled if the coin shows the number side. If the dice is thrown 1 time, if an even number appears, this sentence should enter the stage of making plans and carrying out plans, because all that is known in the problem is the conditions for the attempted throw.

In the planning step, BB never got questions that were similar or that supported solving the problems given in the questions. In this step, BB chooses a trial and error strategy with logical reasoning in planning problem solving.

In the step of implementing the plan, BB uses the strategy as planned, namely the trial and error strategy with logical reasoning to solve the problem in the problem. BB gave a value of 8 from the confidence range of 1-10 answers and said that he was sure of his answer because he understood what the question meant. BB also said that there were no difficulties in working on the questions given.

In the answers written in the numbers, the reason BB wrote down the answers was that he did not know when the numbers would appear from the three tosses. When asked "can it be tossed coins again when it produces a number?", because if a number appears it continues to throwing the dice, BB said that it was impossible to toss coins again and realized that the answer he gave was not quite right. BB carried out the re-checking stage by reworking the question 2 times until he found an answer that he thought was right, but still BB did not realize that the answer was wrong

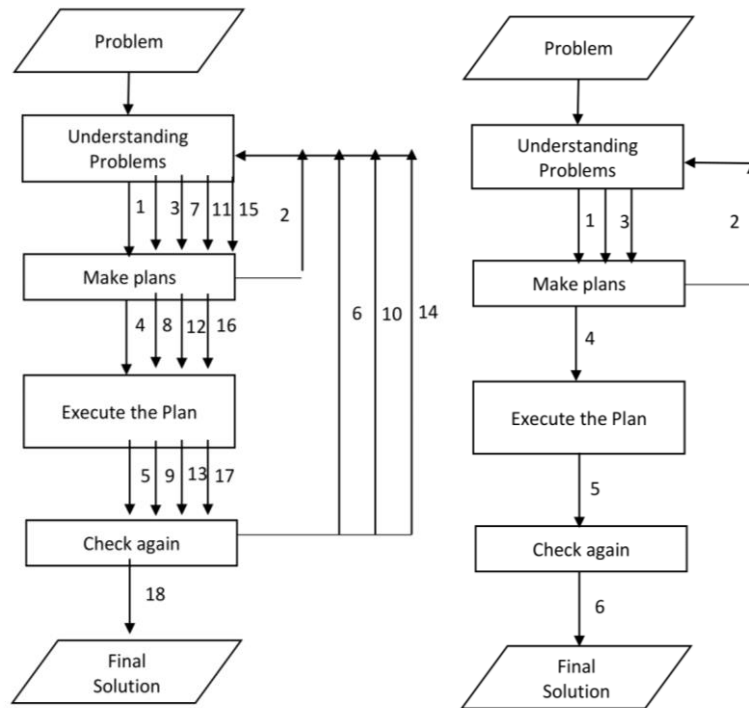


Figure 4 (problem 1a) and 6 (task 1b). Problem Solving Process Well-Structured Problems BB

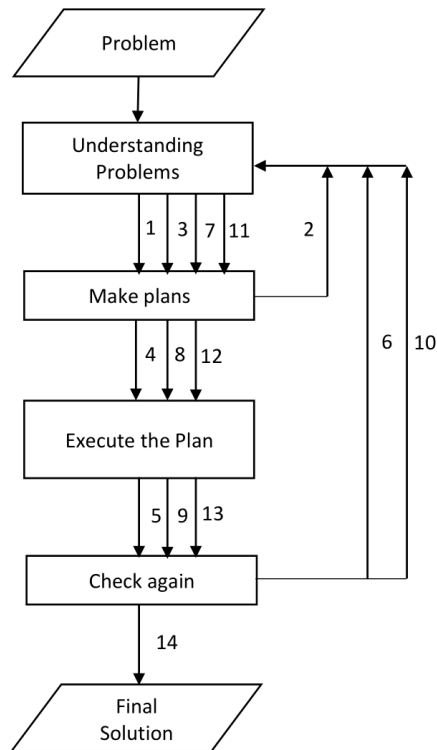


Figure 5 Problem Solving Process III-Structured Problems BB

In relation to the polya problem solving process, the two students succeeded in obtaining a mathematical solution in question 1(b) and describing the process but failed to obtain a mathematical solution in questions 1(a) and 2. Where questions 1(a) and 2 are questions that must be solved by utilizing the different probability theorem with question 1(b) not being calculated to get the correct answer, meaning that students' math skills in these two types of questions are still low.

On well structured problem questions, AA students were able to identify known information that was asked, but did not correctly state the conditions needed to solve the problem. The strategy used is

a logical reasoning strategy by carefully re-reading the question, then using logic to be able to find the answer. AA did as planned but the answers that were generated were wrong for question 1a and correct for question 1b. AA checked again by reading and understanding the answers that had been written, but did not know that there were still mistakes in the answers. Then BB is able to identify known information, is precise in stating the conditions needed to solve the problem, but does not mention what is being asked. The strategy used is a trial and error strategy with logical reasoning in planning problem solving. BB did as planned but the answers produced were wrong for question 1a and correct for question 1b. BB carried out the re-examination stage by reworking the question 3 times until he found an answer that he thought was correct, even though the answer that BB produced for question 1a was still not correct.

On *ill-structured problems*, AA students were able to identify known information that was asked, but it was not correct to state the conditions needed to solve the problem. The strategy used is a logical reasoning strategy in planning problem solving by calculating the probability of appearing on the coin side of the number and calculating the probability of appearing an even number on the throw of the dice. AA did as planned but the resulting answer was wrong. AA checked again by recalculating the answers that had been written even though he was still not aware that the answers produced were wrong. Then BB is able to identify the information provided, but is not precise in writing what is known and writes down what is asked correctly and knows the conditions for solving problems. The strategy used is a trial and error strategy with logical reasoning in planning problem solving. BB did as planned but the resulting answer was wrong. BB checked again by reworking the question 2 times until he found the answer that he thought was right even though he was still not aware that the resulting answer was wrong.

In analyzing students' problem-solving abilities in the two types of well-structured problems and ill-structured problems with opportunity content, several new findings were obtained that need attention. When facing these two questions, students find it more difficult when solving well structured problems, this is contrary to the findings of previous studies which say that systematic problem solving is the process of changing ill-structured problems into well-structured problems so that they are easier to solve (Mohaghegh & Furlan, 2020). Then it also contradicts the characteristics of well-structured problems which have clear and well-defined steps, while ill-structured problems have undefined steps and goals, making it more difficult to solve ill-structured problems (Reed, 2016). Opportunity material is material that it is difficult for students as evidenced by the results of the research the two students answered incorrectly on both types of questions. This is in line with previous research which said that students often make mistakes, namely misunderstanding questions, transformation errors and process skills errors (Klorina & Juandi, 2022; Rahmawati, n.d.). In addition, previous research also found that the obstacles experienced by students were the many misconceptions in problem solving, lack of interest in solving problems related to the concept of opportunity (Maharani et al., 2022). Both students used logical reasoning and trial and error problem solving strategies, this was in accordance with the various logical reasoning strategies in general.

Conclusion

Based on the research that has been done, it can be concluded that students' ability to solve well-structured problems and ill-structured problems is still relatively low. When at the stage of understanding the problem which is the first stage of the problem solving process students are already experiencing difficulties here, it is evidenced by the understanding stage of the problem, students need to read the questions repeatedly and when asked to retell students cannot do it well. So, students' problem-solving abilities in opportunity content with the two types of questions presented are still relatively low and tend to find it more difficult to work on well-structured problems than ill-structured problems but still find no solutions to math problems in both types of questions. From the results of this

study, learning mathematics should be designed so that it can train students' problem-solving abilities. This can be done by providing problem solving questions with both types of questions, namely well-structured problems and ill-structured problems. By frequently giving these questions students will get used to facing problem solving questions with various contexts and other materials, besides that students' creativity in solving problems will also increase so that they can improve students' problem solving abilities.

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