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Students' problem solving on mathematical proportion

N Y Sesanti and D Triwahyuningtyas*

Elementary School Teacher Education Study Program, Universitas Kanjuruhan
Malang, Malang, Indonesia

*dyahtriwahyu@unikama.ac.id

Abstract. This study analyzed problem solving abilities of the students on mathematical differential. Descriptive qualitative applied in this study with 26 students of secondary school; 16 males and 11 females. Data analysis reveals the ability of students' problem solving abilities, namely understanding the problem, drawing up a problem solving plan, implementing the solution and re-checking the solution. The instruments used were test and interview. The findings showed that more than 50% mistake happened on drawing up a problem solving plan and re-checking the solution. So that to reduce the mistake we as lecturer should train the students in mathematical problem solving strategies.

1. Introduction

The concept of comparison in Mathematics plays an essential role. This concept allows student to compare and coordinate two or more different numbers [1]. The concept of comparison in Mathematics plays an essential role. This concept allows student to compare and coordinate two or more different numbers [2]. To be able to solve the concept of comparison, students are also required to understand another concept related to comparison [3]. Therefore, the students need to acquire good understanding to be able to solve mathematical problems [4].

Some major situations that lead to the low ability of student's mathematical problem solving related to the concept of comparison are when students remain using a memorization of mathematical concept instead of comprehensively understanding the concept of comparison in solving the problem [5], the low reasoning ability of students on the concept of comparison contributes to the major factor of difficulty encountered by students in solving comparison problems [6], the student's pseudo-thinking process remains incomplete and incompatible [7], the low arithmetic ability used to solve the comparison problem [8], lack of understanding of the concept of comparison and cannot solve a variety of problem contexts [9], students do not understand the problem keywords given and the relationship of variables in the concept of comparison [10].

According to Neng Fia Niswanti et al, states that the students' problem solving on mathematics still low, especially on understanding the problem and re-checking the solution which given by the teacher [11]. This finding is in line with the study was done by Tagrul Kar et al, they stated that the students' ability in solving mathematical problems was low, most of the students having difficulties in solving the problem given by the teacher [12]. There are many factors that influence students' difficulties in solving mathematical problem. According to Tarzimah dan Subahan, the difficulties in solving mathematical problem is influenced by less skill in solving mathematical problem skill and students' low cognitive skill [13]. Furthermore, some aspects that influence the students ability in doing problem solving are: students having difficulties in understanding the keyword that appear in the problem given so they



cannot interpret the mathematical statement, students having difficulties in determining what should be interpreted or the assumption of the problem and what kind of information from the problem that needed to be solved; students ever do guessing when they don't understand the question, they do not like thinking; students are not patient in reading the question and; students dislike to read long question type [14]. The students' difficulties can be as their own problem that should be solved.

Problem solving is one of the core concepts for learning mathematics [15,16]. Learning is an activity or process of discovering, creating, self-actualizing, thinking and applying innovative ways to solve problems [17]. Solving mathematical problems is a common task for all students at all levels of Education [18]. National Council of Teacher of Mathematics [17] states there are five standard competences of mathematical thinking in learning mathematics, they are problem solving ability, reasoning ability, connection ability, communication ability and representation ability [19]. While the problem solving ability of students in mathematics is still low. Mathematical problem is a question that need challenge in solving it, it is difficult to solve, and it needs good planning to solve. Problem solving is an effort to solve that kind of question, to solve systematically and structured [20]. Problem solving is needed to make decisions on individual understanding [21]. Mathematical problem solving, starting with open problems and giving students to solve problems themselves, encourages students to create their own problems and problem solving strategies [22].

According to Polya, there are four important stages in problem solving that must be taken to solve the problem, namely: understand the problem, devise a plan, implement the plan, and re-check the solution [20]. Teaching learning process in mathematic problem solving can train the students to find various alternative problem solving and developing students critical thinking [22, 23]. In solving complex problems, students must relate prior learning concepts [24]. So to improve the ability to solve complex problems, the role of the teacher is very important. Through collaborative activities between students can also have a positive effect in solving problems [25].

The researchers considered that there are still many high school students who have difficulty in solving mathematical problems, particularly problems related to the concept of comparison. This is because the character of mathematical problems invokes challenges and situations that encourage students solve but cannot immediately obtain the solution [26]. It is important for the researchers to examine students' mathematical problem-solving abilities on the concept of comparison. The purpose of this study was to analyze the students' mathematical problem-solving ability on the concept of comparison. This research was expected to be a reflection material for educators/teachers to prepare their students with a deeper understanding particularly the concept of comparison. Consequently, in the near future, students problem-solving abilities increase. The scope of the study was the ability of problem solving on the concept of comparison that is seen from understanding the problem, compiling a plan for solving, implementing a problem-solving plan, re-checking the results of problem-solving.

2. Methods

Descriptive qualitative procedure was applied in this study. The researcher took a role as the key instrument. The instruments used were tests and interviews. The subject of the study was the students of one senior high school in Malang, East Java which consisted of 26 students. This descriptive qualitative study was carried out using the following procedure: students have learned the concept of comparison before conducting tests and interviews. Each student was given three problems related to the concept of comparison made by the researcher and has been validated by experts. During the implementation of the test, the student required to solve the problem given. Then, the interview was conducted before drawing the final conclusions.

3. Results and discussion

From the test result, the researcher decided to take 2 students in each category to be interviewed. The subject from high category were S_{25} dan S_{26} , students from medium category were S_6 dan S_{27} , and low ability were S_3 dan S_{28} . Subjects were derived from the highest score of each category.

S₂₆ understand the problem given, but he cannot write well based on his understanding. He missed one information, age ratio. Strategy planning was good as well as the solution given and re-checking solution. Based on interview session, S₂₆ can answer researcher question confidently and the interview result is the same as his answer in written test. S₂₆ also have a right problem solving, he can do Polya's four stages and he knows his weaknesses in giving solution. It means that S₂₆ understand the problem, give a right solution but in communicative aspect, he cannot give a good/clear mathematical communication. S₂₆ will has a good ability in mathematical communication if he is well trained and well directed in problem solving. Because of the problem given mathematical communication of S₂₆ increases. Stages in problem solving that starting from serving the problem, identification of the problem, finding an alternative solution, and giving value to each problem can increase students mathematical communication [18,28].

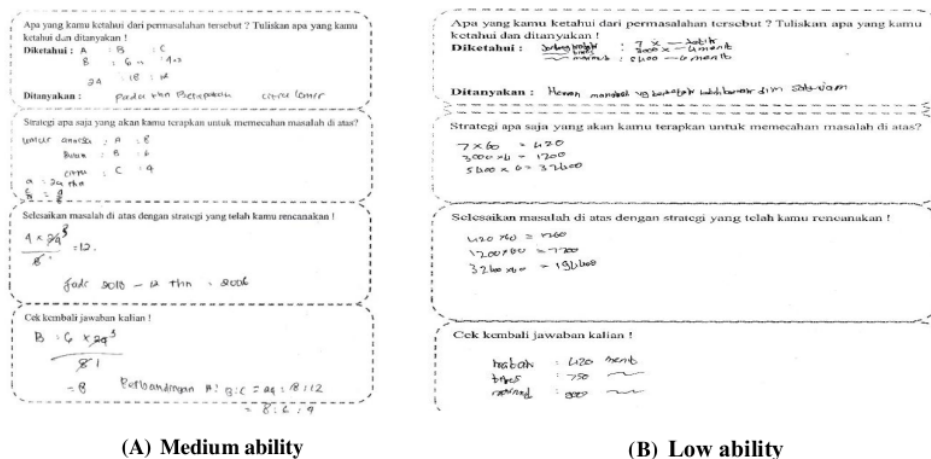


Figure 1. Question 1 and 2.

From figure 1.a, S₂₇ does not understand the problem well. It can be seen from his answer, he cannot rewrite or interpret the question. In strategy planning, S₂₇ uses comparative concept but it is not clear and not complete. It doesn't appear the process of problem solving, straightly to the last answer. In interview session, S₂₇ told the researcher that he didn't understand with the problem of the fourth and the fifth question. S₂₇ seems having difficulties in answering the researcher's question because he is confused with his own answer. He thinks that question number 4 and 5 are the most difficult question. long question types are not liked by students. S₂₇ cannot do Polya's stages well especially in composing the problem solving strategy. The most frequent of S₂₇ made was in the third step because he doesn't accustom to use definition so that he directly writes the result without writing the process. This case is in line with [14,29], states that students pay less attention to the prerequisites in using formulas, theorems, or definitions so that they make a mistake in principle in solving mathematical problems. Sometimes students with medium problem solving ability reach the indicator of checking answer, they can fulfill Polya's stages but they have difficulties in making mathematical models [18,30].

From figure 1.b, S₂₈ cannot solve overall the problem given by the researcher. It can be seen from figure 3. In answering question number 2, she cannot fulfill the four stages. It can be inferred from the answer from question number 1 and 2 that S₂₈ was still confused with her own answer. It is also clarified in the interview session; she cannot explain of her own answer. S₂₈ told that the question given is too difficult for her, therefore she cannot answer based on the instruction. S₂₈ needs longer time to do the questions than others. She cannot apply the indicator of mathematic problem solving ability based on Polya's criteria. From the first stage, device a plan, S₂₈ thinks that using sketch or picture is not useful furthermore she thinks that device a plan stage cannot be used as logic reasoning in re-checking solution

in the last stage, she believes that her answer is right, but the answer is wrong. In the fourth step is also indicated that S_{28} doesn't understand what should be written in the answer sheet. Similar to the opinion [29], students do not fulfill the last answer sheet (re-checking solution) is because the students do not know what should do and what should be written in the sheet.

The result of students' mistake in each indicator can be seen on the figure 2.

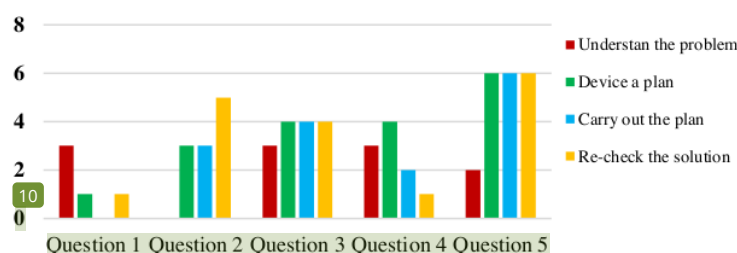


Figure 2. Graphic of students mistake in problem solving.

Based on figure 3, the mistake of the students in solving the problem served. The graphic is from the sixth test. Every student's work is analyzed based on Polya's stages in solving mathematic problem. The average of the students' mistake can be drawn as: mistake in understanding problem as marked in red color was 36.7%; mistake in device a plan as marked in green color was 60%; mistake in carrying out the plan marked as blue color was 50%; mistake in re-checking the solution marked as yellow color was 56%.

Less students have mistaken in doing question number 1 even in the first step there is no mistake found in carrying out the plan stage. Contrary to question 1, question 5 is the most found the mistake, all students have mistaken in composing plan, carrying out the plan and re-checking the solution. Not all mistaken done by the students in answering the problem is equal, some have mistaken but some haven't, such as one student have mistaken in first step but not for the second or third step and the other way round. Sometimes student has high score in understanding and devising the plan but having low score in re-checking the solution [31,32]. In general, it can be stated that student mistake is vary from each level starting from student understanding to the last step, because of student cognitive skill [33,34]. Students mistake should be noticed by lecturer since the problem solving is important for student real life in the future. Likewise, the ability to understand a problem, solve a problem and re-check its solution is needed in mathematical literacy [35,36].

4. Conclusion

Based on the discussion above students Problem solving in mathematic differential have not be able to apply all stages of Polya's theory. Learners solve the problems given direct calculate answers without interpreting the problem. Teachers are expected to often provide problems in the form of mathematical problem solving. It is aimed at practicing the students' mathematical problem solving skills so that there are no difficulties and confusion in solving on similar categories.

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