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Research Article

The Analysis of Mathematical Problem-solving Ability of Elementary School Teacher Candidate: Fraction Case

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Abstract.
It is important for school students as well as elementary school teacher candidates to master mathematical problem-solving abilities. This study aims to analyze the mathematical problem-solving ability of elementary school teacher candidates on the concept of fractions based on Polya's steps. This research uses a descriptive qualitative approach. The research participants were 12 students of elementary school teacher education program whose problem-solving abilities were assessed based on the topic of fractions for 60 minutes. The results of this study indicated that students were able to understand information related to the questions; (1) determine what had already been known and what was being asked completely. In addition, students were also able to understand the relationship between the information provided. It can therefore be said that students were able to understand the problem. (2) Most students were less able to develop a correct problem-solving plan. (3) Most students completed solutions based on incorrect strategies. (4) Students rarely re-checked the problem-solving. Based on the results of the interviews, they rarely solved the problem-solving questions. Thus, it can be concluded that the level of their mathematical problem-solving ability was still low.

Keywords: elementary school teacher candidate, fraction case, mathematical problem-solving ability.

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1. INTRODUCTION

Mathematics is a subject taught at all levels of education and plays an important role in the development of science and technology [1]. One of the goals of teaching mathematics is that students can possess problem-solving ability [2] [3]. According to [4] problem-solving is a process that starts from the time an individual faces a problem until the end when the problem is solved. Problem-solving ability become an inseparable

part of everyday life because they are used to solve problems and make decisions [5, 6].

In recent years, the topic of mathematical problem solving has become an important focus in many studies as an effort to improve the teaching of basic mathematics programs around the world because it belongs to the category of fundamental life ability [7]. Mathematical problem solving is a structured learning process so that the ability cannot be simply transferred but, instead, need to be taught [2]. There are four basic steps of solving mathematical problems based on [8], namely: (1) understanding the problem; (2) devising a plan; (3) carrying out the plan; and (4) looking back. The stage of understanding the problem, individuals identify questions or challenges to be solved while gathering the available facts [5]. Furthermore, at the stage of devising a plan, individuals find the relationship between known and unknown data, so that they can develop a settlement strategy. Carrying out the plan is an action made based on the strategy that has been created and looking back at the solution is carried out to ensure the correctness of the chosen solution.

Mathematical problem-solving ability must be taught to students since elementary school level [9, 10]. It is because mathematical problem ability will continue to be used in real life; thus, its learning process must be carried out effectively and optimally [6]. In learning, the quality of teachers plays a major role in ensuring that students enjoy mathematics, understand mathematical concepts, and have mathematical problem-solving ability [11, 12].

Fractions are one of the topics taught by teachers in elementary school. Fractions are also one of the topics that are difficult for elementary school students to learn and difficult for teachers to teach. The results of studies summarized by Lee show that there are still difficulties for teachers in understanding fractions, explaining the rules of the concept of fractions, and making representations of fractions. Therefore, by having problem-solving ability, elementary school teacher candidates are expected to be able to solve fraction problems correctly as a preparation for teaching fraction concepts to elementary school students later.

Elementary school teacher candidates should get enough opportunities to develop their problem-solving ability because one of their responsibilities, when they have become teachers, is to guide students in learning about how to solve mathematical problems. Teaching how to solve problems is the teacher's activity to provide challenges or motivation to students so that they are able to understand the problem, interested in solving it, able to use their knowledge to formulate strategies for solving the problem, able to implement the strategy, and able to assess whether the answer is correct.

Teacher education institutions have an essential role in the achievement of elementary school students by preparing teacher candidates to have the necessary competencies. The analysis of the mathematical ability of the teacher candidates can act as an evaluation tool for determining whether the teacher candidates are qualified to become teachers and mentors of students in schools, whether their concepts are correct, and whether they are able to build the competencies needed in student life?

Several previous researchers have done a lot of analysis of problem-solving ability, Dina Pratiwi Dwisanti found the fact that there were students who were still stating the meaning of fractions incorrectly. As an example,

> Write down the fractions that represent the shaded areas!"

Figure 1: Examination question on fraction numbers.

The university students' answers to questions (b) and (c) were 5/8 and 2/5, respectively. Conceptually, the answers were incorrect. These findings are in line with the research results of [13] that in studying fractions there are still difficulties in stating the meaning/definition of fractional numbers. This condition makes it difficult for students to complete academic tasks given by lecturers. Previous research only revealed students' problem-solving ability on the concept of fractions but not yet based on Polya-based problem-solving steps. Therefore, this study aims to analyze the mathematical problem-solving ability of elementary school teacher candidates on the concept of fractions based on Polya's steps. This research is important because the elementary school teacher candidates' problem-solving ability will have an impact on the development of elementary school students' mathematical problem-solving ability.

2. RESEARCH METHOD

This research is qualitative research with a case study design. The research subjects were 12 elementary school teacher candidates consisting of ten 4th semester students and two 6th semester students. They were given four questions related to mathematical problem-solving skills on the concept of fractions. The time to solve these problems is 90 minutes. To get clear data, the researchers interviewed 5 students as the research sample for 20 minutes per student. This research was carried out synchronously through the zoom platform.

3. RESULT AND DISCUSSION

The results of the data obtained by giving a score on each indicator of problem-solving abilities that have been achieved by students. The comparison between the number of students who fulfill the problem-solving steps according to Polya and the number of students is shown in the form of proportions. This percentage will describe the problem-solving ability of prospective elementary school teacher students on material based on Polya's steps.

Table 1: Data on problem solving ability of pre-service elementary school teachers.

Problem Solving Phase based on Polya's Steps	Sum of students	Percentage
Understand the problem	12	100%
Devise a problem-solving plan	5	41,66%
Carry out the settlement plan	5	41,66%
rechecked the stages of problem-solving	6	50%

Table 1 shows that all students had already understood the contents of the questions given. All of the students (100%) were able to understand the information that had already known and were being asked correctly. In the second step of Polya's method, which is to devise a problem-solving plan, there were 41.66% of the students that were able to determine the settlement plan correctly, while the rest of the students were confused and only did trial and error. Then 41.66% of the students were able to carry out the settlement plan correctly and as many as 50% of the students rechecked the stages of problem-solving based on Polya's steps. The following are examples of student's answers for each type of question given.

3.1. Analysis of Question Number 1

The following is an example of the answer to number 1 that appears:

> Write down the fractions that represent the shaded areas!"

Figure 2: Examples of answers from student a number 1.

Based on student A's answer, we can see that the student is able to read the questions well, this is shown by the accuracy of the students in writing what they know from the

questions. The answer shows that the student understands what must be done to solve the mathematical story problem, namely solving the fraction division problem. When students solve the problem by dividing the numerator by numerator and denominator by denominator, the results are the same so that the student concludes that the second method he did is also correct. When interviewed regarding whether the rule can apply generally to other fractions, the student seemed confused and said it could be just a coincidence for the fraction that he needed to check the division of the fraction using a different fraction.

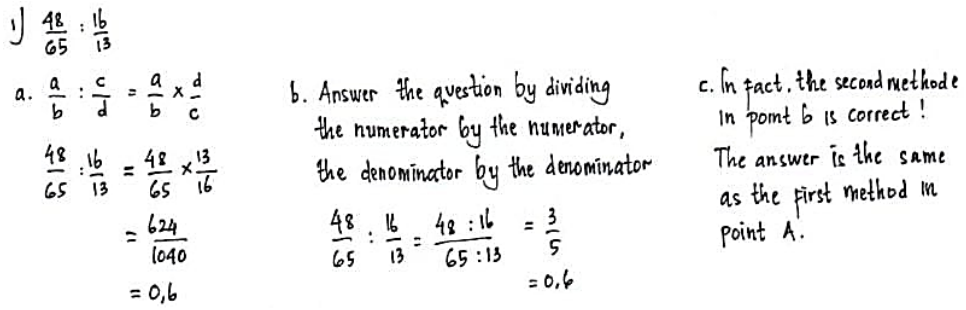


Figure 3: Examples of answers from student b number 1.

When interviewed, student B was able to understand the questions and do fraction division well, but when working on question 1b he stated that the results were not the same, namely 48/65 : 16/13 = 624/1040 = 1.66. When the researcher asks you try divide by 624: 1040. Student B also answered the result was 0.6. Then the researcher asked again, “Try now to divide 3: 5!” The student again answered “The result is 0.6 ma’am”. In the end the students concluded that they both had the same result. The researcher also asked about the process of checking the completion of the questions and the student admitted that he did not double-check the answer.

3.2. Analysis of Question Number 2

The following is an example of a student’s answer.

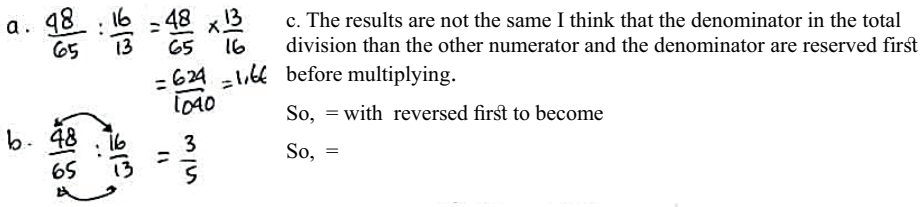
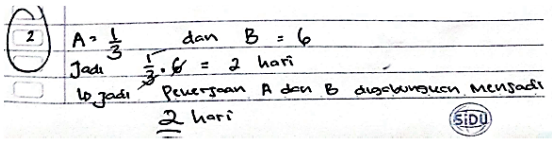


Figure 4: Examples of answers to student c number 2.

Based on the student's answers, students are able to understand what is known and asked, but when completing the problem-solving process, student C multiplies by 1/3. 6 = 2 days. When the researcher asked the students to explain the answer, the student replied that "This is not it, Madam, A can finish a third of the work in one day. B can finish the job in six days. So, I just multiplied the numbers in the problem because usually when doing math problems it is not far from addition, subtraction, multiplication, and division ". The researcher also asked "Did you double-check the completion steps?". Students also answered "No ma'am!". In addition to the student's answers, the researchers even found answers like the following:



A = and B = 6
So, x 6 = 2 days
So, jobs A and B are combined into 2 days.

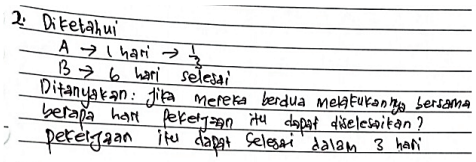
Figure 5: Examples of answers from student d number 2.

Figure 6.

Student D is only able to understand the problem and he is confused about the process of solving the problem. After being interviewed "Have you ever come across a problem like this?". Student D answered "Once in high school ma'am". Have you ever completed these questions during the previous lecture?". "Not yet ma'am", answered the student. Researchers found that when students answered questions by multiplying without clear reasons, it indicated that students had not yet understood the concept that underlies the problem. Even though a good understanding of the concept is the basis of problem solving [14].

3.3. Analysis of Question Number 3

Here's an example of answer number 3 that appears:



Number 2
A 1 day
B 6 days to finish
Question: If they both do it together, in how many days the work can be completed?
Answer: in 3 days

Figure 6: Examples of answers from student a number 3.

Problem number 3 is a very challenging question for students. Of the 12 students, only 1 student answered correctly. Based on written data and interviews, it can be concluded that most students are only able to understand problems well. Student A's answer explained that he was able to make a connection between what was known and

what was asked to solve the problem. And so on, the analysis is carried out to make a problem-solving plan, carry out the problem-solving plan and check again. Students are able to assume the denominator = x and numerator = y and substitute the problem. After finding the answers, it turned out that the students tried to check the answers they got and the results were correct. The researcher also asked “Have you ever solved a problem like this?” He replied, “Once, Mom in high school and during college I have not found any more.” “How can you do this problem?” asked the researcher. “I still understood the concept of algebra when I was in high school and tried to do it according to my understanding. Then at the end of the completion process, I tried to substitute the answers obtained with the questions and it turned out that the answers met the requirements provided in the questions. So, the fraction in question is 3/7”.

3.4. Analysis of Question Number 4

Here’s an example of answer number 4 that appears:

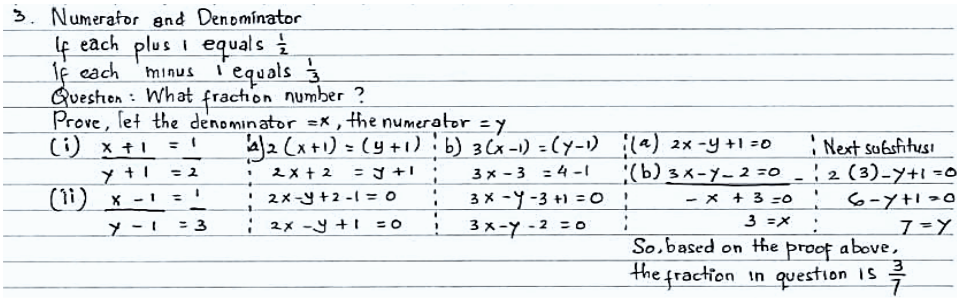


Figure 7: Examples of answers to student f number 4.

From the completion, student F revealed that he understood the information on the questions, understood what was known and what was asked. Student F performs the addition operation from known data. Based on the results of the interview, he stated that student F was confused about solving questions like this because he had just found the questions and found it difficult. So student F tried to answer by adding up. This fact explains that some students directly use the formula without doing prior analysis, resulting in inaccurate problem-solving planning. The use of formulas directly without doing analysis for problem solving is one of the factors that causes low problem-solving abilities [15].

4. CONCLUSION

The level of problem-solving skills of elementary school teacher candidates was still low because in solving the problems given, students directly used the formula and the numbers that had been provided in the questions. The students did not write down their understanding of the problem and plan solutions based on mathematical concepts as should be done in the procedure of solving mathematical problem. Most students were less able to devise an appropriate solution plan and rarely re-check the problem-solving process that had been implemented. The limitations in this study are the subjects involving in this research were only 12 students and were limited to the concept of fractions. Based on the results of the interview, it was revealed that they rarely solved problem-solving questions.

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