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The Investigation of The Problem-solving Capacity of Primary School Students: A Case Study

Nguyen Phu Loc[1], Duong Huu Tong[2], Nguyen Thi Phương Chi[3]
[1-2] School of Education, Can Tho University, Vietnam.
[3] University Class of Primary Education, School of Education, Can Tho University, Vietnam.

*Corresponding Author:
Nguyen Phu Loc
Email: nploc@ctu.edu.vn

Abstract: There are three main forms of problems in mathematics textbooks in primary schools in Viet Nam: single problems, complex problems and typical problems. Among them, the typical problem is a problem that has a fixed solution. Normally, if students identify typical problems correctly, they will address them correctly. In this study, we only focus on one of typical problems "finding two numbers if their sum and their ratio are known" in Mathematics 4. It is the aim to examine the students' capacity to solve the above form of problem and find out their mistakes made in the process of solving the problem. 92 primary school students participated in the research and they had to address two problems related to "finding two numbers if their sum and their ratio are known". A detailed content analysis was used carefully. The findings showed that most students succeeded in solving the given problems, but they also committed some errors in their solutions.
Keywords: typical problem, finding two numbers if their sum and their ratio are known, problem-solving capacity, error.

INTRODUCTION

In teaching mathematics, there are some important topics such as teaching the concepts, teaching the theorems, and solving problems. Meanwhile, the practical problem is considered as a bridge to connect mathematics and real life. In addition to this important role, it is a good chance to develop students' problem-solving capacity. Towards students' problem solving, we published some findings in [2-4]. In this study, we are especially concerned about the following problem in the textbook "Mathematics 4" (Toán 4) [1] because of its difficult level and complex solutions.

"Problem: The sum of two numbers is 96. Their ratio is $\frac{3}{5}$. Find the two numbers."

Solutions
We have the following diagram:
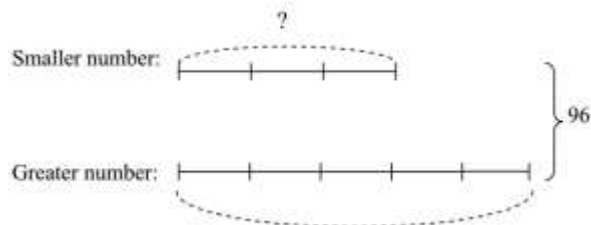
Based on the diagram, the sum of equal parts is: 3 + 5 = 8 (parts).
The smaller number is: $96 : 8 \times 3 = 36$.
The greater number is: $96 - 36 = 60$.

Answer: The smaller number is 36.
The greater number is 60.

Based on these solutions, we have a general strategy for the problem: finding two numbers if their sum and their ratio are known (sum: s; ratio: $\frac{a}{b}$).
- Step 1: Draw a segment diagram to express the data, the relationship between two numbers and the requirement of the problem.
- Step 2: Calculate the sum of equal parts.
- Step 3: Calculate the first number: we divide the sum of two numbers (s) by the sum of equal parts, then multiply quotient and *a* together.
- Step 4: Calculate the second number: we subtract the first number from the sum of two numbers (s) (or we divide the sum of two numbers by the sum of equal parts, then multiply quotient and *b* together).

The above strategy is not very difficult for teachers, but it is not facile for students. Indeed, to address the problem successfully, they have to obey 4 above steps. These steps are rather sophisticated and are not easy to remember. Additionally, the problem will be even more difficult when it is a problem associated with the real life. Because of its long and complex solutions, we believe that students will meet their own difficulties to solve it. Therefore, the aim of our study is to find the answers for the following questions:

- *Do students have enough the problem-solving capacity to address the real life problem related to "finding two numbers if their sum and their ratio are known"?*
- *Are they able to identify the problem and compose a problem if its diagram is given?*

METHODOLOGY
Assignments for students were used to find the answers for the two above questions:
Assignment 1: A rectangular field has a half of the perimeter of 56m. The width is $\frac{3}{4}$ of the length. Find the width and the length of the field.

Assignment 2: Based on the following diagram, write down the problem and solve it.
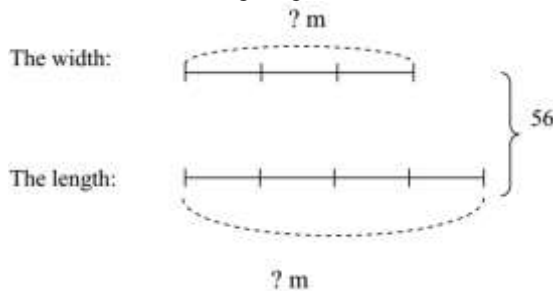

? notebook

Mai:

Lan:

14

? notebook
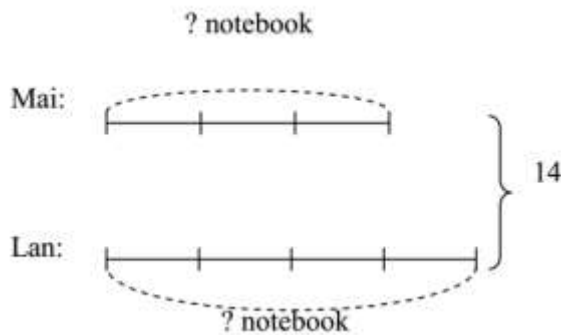
The expected solutions to the above assignments
Assignment 1:
Solutions
We have the following diagram:

? m

The width:

The length:

56

? m

Based on the diagram, the sum of equal parts is: 3 +4 = 7 (parts).
The width is: $56:7\times3=24$ (m)
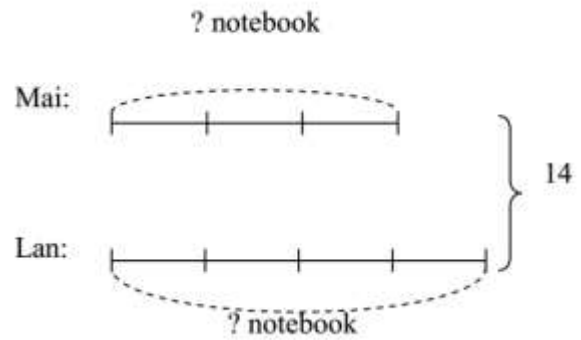The length is: $56-24=32$ (m)
Answer: The width: 24m.
The length: 32m.

Assignment 2: Mai and Lan have 14 notebooks. The number of Mai's notebooks is $\frac{3}{4}$ of the number of Lan's notebooks. How many notebooks does each person have?

Solutions

We have the following diagram:

? notebook

Mai:

Lan:

14

? notebook

Based on the diagram, the sum of equal parts is: 3 +4 = 7 (parts).
The number of Mai's notebooks is: $14:7\times3=6$ (notebooks)
The number of Lan's notebooks is: $14-6=8$ (notebooks)

Answer: Mai has 6 notebooks.
Lan has 8 notebooks.

Participants:
Subjects: 92 4th grade students in the Le Quy Don Primary School in Ninh Kieu district, Can Tho city. (see Table 1).

Data collecting and analyzing: These participants solve the above assignments. After they finish solving, we analyze and evaluate their solutions due to the above strategy.

Table-1: The number of students investigated

School	Class	The number of students
Le Quy Don primary school	4A, 4B, 4C	92
Total		**92**

RESULTS AND DISCUSSION
For assignment 1

Table-2: The numbers of answers to the assignment 1

Answers	% of students
Correct	70/92 (76.1%)
Incorrect	22/92 (23.9%)

Through the survey, the percentage of students drawing a diagram and having a correct answer was relatively high, with 70/92 students (about 76.1%) (see Table 2). This figure shows that participants understood the problem and had practical skills to solve it. In particular, there were 86 students drew a diagram and addressed the problem. Nonetheless, two students solved it without a segment diagram. Also, two other students drew a diagram, but they did not go on solving the problem. In addition to this, some students

committed errors when they drew the segment diagram. For instance, some errors were illustrated as bellow (see Figure 1, 2, 3, 4):

- They did not show or showed facts and requirements of the problem on the diagram incompletely and unclearly.

- The parts on their diagram were not equal.
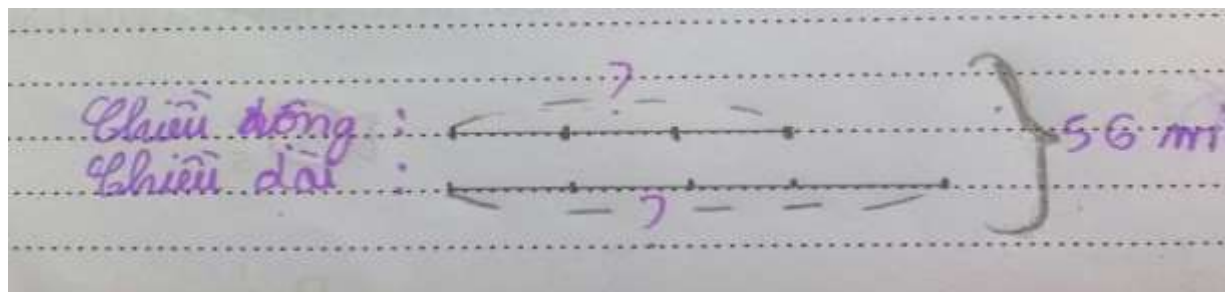- They only drew two segments; however, they did not divide them into equal parts.

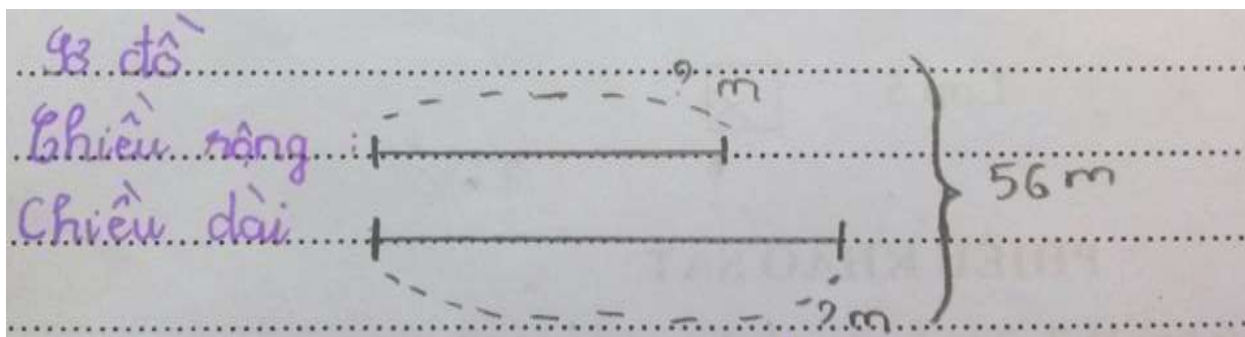**Fig-1: Diagram of a student for assignment 1**

Fig-2: Deficient diagram of a student for assignment 1

Moreover, some mistakes were recorded from their solutions. Some students did not master this problem, so they were confused into another problem. For example, they gave a solution to the problem "finding two numbers if their difference and their ratio are known" (see Figure 3)

Fig-3: The solution of a student

Additionally, they combined the steps to make the problem more succinctly, but this more easily
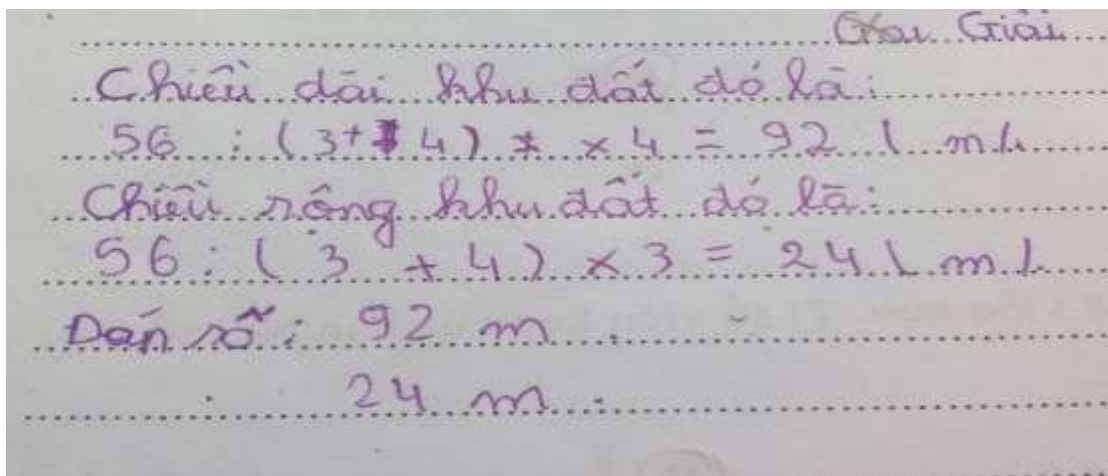
resulted in errors in calculation.

Fig-4: The another wrong solution of a student

In this solution, the student's calculation of the length was completely wrong. Instead, the length was $56 : 7 \times 4 = 32$ (m), but his answer was 92 m (see Figure 4)

Furthermore, some students had solutions whose keys were not clear and specific. Because the requirement of the problem was "Find the width and the length of the field", so the correct keys had to be "The width of the field is" and "The length of the field is". Nonetheless, some unacceptable students' keys were "The width of the rectangle is" and "The length of the rectangle is".

For assignment 2

Table-3: The numbers of answers to the assignment 2

Answers	% of students
Correct	66/92 (71.7%)
Incorrect	26/92 (28.3%)

The requirement of the assignment was to compose a problem if its diagram was known. From Table 3, the percentage of students succeeding in creating a reasonable problem was rather high (accounted for 71.7%). This percentage revealed that most students understood the problem deeply, had practical skills as well as skills to analyze data shown on the diagram, and knew how to use everyday language to mathematics, then they expressed their thinking ability. However, 26 students produced problems, but they were not suitable for our requirement. This indicated that they still depended on the sample problems, had no more creativity and did not adapt to the higher levels in solving the problems.

CONCLUSION

It was evident from the study results that most students had enough the problem-solving capacity to address the problem "finding two numbers if their sum and their ratio are known" and they mastered it, then they were capable of composing a practical problem similar to the learnt ones. Nevertheless, some of them made errors such as drawing a diagram with unequal parts, calculating incorrectly, and identifying the form of the problem wrongly. In addition to these mistakes, they did not understand the requirement of the problem or they did not obey the steps to solve the problem "finding two numbers if their sum and their ratio are known". For this reason, teachers should encourage students to draw diagrams, have a right solution with full steps, give a reasonable and appropriate explanation and calculate correctly. Besides, teachers need to spend time guiding for students to draw diagrams, finding out the causes of failure of students, then helping them to correct errors timely.

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