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# Cognitive System of Students in Solving Proportion Problems

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**Abstract:** *Cognition and learning mathematics is two things that aren't could separated. Cognitive is related to "thought" domains with how a student obtain process and use knowledge. Cognitive systems are implemented from the domain of memory, manipulate knowledge and use that knowledge. Besides this, system is tasked with processing information or knowledge effectively in completing tasks. This research purpose is to describe students' cognitive system in solving proportion problem based on Marzano's taxonomy. This research is descriptive qualitative research using test about proportion and an interview guide to collect data. subject in this reseach are 2 students at SMPN 3 Sumenep. The results showed that the subject has do system cognitive that is retrieving knowledge, comprehending knowledge, analyzing knowledge, and using Knowledge even if one subject not yet perfect*

**Keywords:** *Cognitive, Proportion, Marzano's Taxonomy.*

## INTRODUCTION

Cognition and learning mathematics is two things that aren't could separated. This is because somebody could said study if cognitive processes occur in himself, included in the study math (Burner in Sutaro , 2017). Piaget argued that cognitive development has a very important role in the learning process ( Sutarto, 2017). Cognitive is an important aspect in child development related to learning or thinking skills (Andarwulan, et al , 2021). Besides that realm Cognitive is also one aspect in achievements learning (Permendikbud , 2013). Because that very urgent for educators for understanding the cognitive processes participants he taught.

Cognitive is related "thought" domains with how a student obtain process and use knowledge and domain is also familiar for educator ( Kasiligam, 2014 ). Cognitive is a thought process to relate, judge, and consider occurrence (Susanto, 2011). Cognitive is also interpreted as a mental activity related to perception, thought, memory, and information processing that allows a person to gain knowledge, solve problems, and plan for the future (Daryanto, 2010 ). Cognitive systems are implemented from the domain in memory, manipulate knowledge and use that knowledge besides this system is tasked with processing information or knowledge effectively in completing tasks (Marzano & Kendall, 2007).

Marzano and Kendall (2007) split the system cognitive into four components namely *retrieving knowledge, comprehending knowledge, knowledge analysis analyzing knowledge, and using Knowledge*. Following this position system cognitive in completion task on Marzano 's taxonomy model.

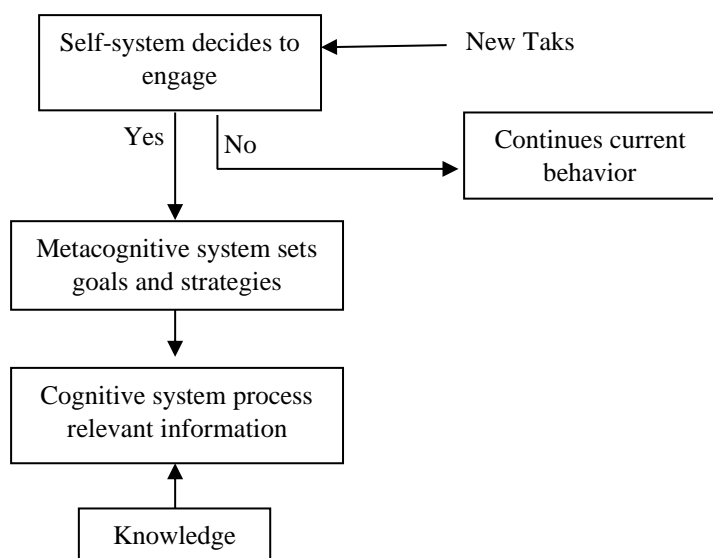


Diagram 1. Marzano's Taksonomy Model.

As in the knowledge component of Bloom's taxonomy, *retrieving knowledge* involves recalling information from memory. At a higher level, *comprehending knowledge* requires identifying what is important to remember and assigning information to appropriate categories. *analyzing knowledge* is more complex than simple understanding, the cognitive processes in knowledge analysis are adjustment, classification, error analysis, and specification. The last process is the *using knowledge* is the process of using the knowledge they have acquired. The following is Marzano's taxonomic knowledge processing (Marzano & Kendall, 2007).

The following tables show the categories of reasoning processes and terms (expressions) used to indicate these reasoning processes in Marzano's taxonomic cognitive system (Marzano & Kendall, 2007).

**Table 1 Retrieving Knowledge**

Reasoning Process	Information
<i>Recalling</i>	Reproducing the required information
<i>Recognizing</i>	Carefully identify the statement to which it relates
<i>Executing</i>	Performing a mental process or physical procedure.

**Table 2 Comprehending Knowledge**

reasoning process	Information
Symbolizing	Describing critical aspects of knowledge in pictorial or symbolic form Using models
Integrating	Identify critical or important elements of knowledge

**Table 3 Analyzing Knowledge**

Reasoning Process	Information
Comparing	Identify similarities and differences
Classifying	Identify superordinate and subordinate categories derived from info.
<i>Specifying</i>	Make and maintain predictions about what will happen

<i>Generalizing</i>	Conclude a new formulation / generalization of known knowledge
<i>Analyzing errors</i>	Identify logical or factual errors in knowledge

**Table 4 Using Knowledge**

Reasoning Process	Information
Investigation	Generate a hypothesis and use assertions and opinions from others to test the hypothesis.
<i>Experimenting</i>	Generate and test a hypothesis by conducting experiments and collecting data
<i>Problem solving</i>	Fulfilling goals accompanied by obstacles
<i>Decision making</i>	Conclude a new formulation / generalization of known knowledge.

Proportion is one subject in mathematics taught in grade 7 (seven). According to mathematic dictionary, proportional can be interpreted Describes the relationship between 2 quantities are such that they both change by the same factor. Proportion is something method assessment or investigation with stage compare two or more object study for add and deepen knowledge about object studied (Basah, 1994: 7). Example proportion problem in life daily that is compare speed a student paddle bicycle going to school based on distance and time traveled to school. Another example is compare many workers needed for complete job certain with difference specified time.

Although impressed simple, however fact many students who are still difficulty complete related with proportion problems. Based on results interview with a teacher at SMPN 3 Sumenep who said that still many students who obtain score under 75 on a test on the material proportion. Most student still confused if do different matter from about exercises that have been discussed. However there are also students who have capable apply draft proportion in complete problem. it showed with student answer about the exam with right.

Based on the description above, in research this will study about system cognitive students in solving proportion problems.

**METHOD**

The data obtained in this study are verbal data, therefore this research includes descriptive qualitative research (Arikunto, 2010: 21). The main instrument in this research is the researcher himself, while the supporting instrument is the test and interview guide . cognitive system of subject described based on completion written from about story Theory that comparison given as well as results interview with subject related the resolution .

Subject 1 (S1) and Subject 2 (S2) in study this are 2 students SMP Negeri 3 Sumenep. The subject chosen based on completion results proportion problems and considerations of mathematics teachers about the flexibility of students in communicating and expressing their ideas in finishing about. proportion problems. Following this is proportion problems given to Subject.

**Table 5. Proportion Problem**

Problem 1
A machine in one factory drink capable install Lid bottles for 14 bottles in time 84 seconds. how much many bottles can be closed by machine in 2 minutes?
Purpose
Through this question will be studied:

- 
- The process of thinking and how the thinking process of students in solving material story problems comparison in terms of Marzano's taxonomy

Level 1 ( *retrieving knowledge* ) :

*Recognizing and Executing* , namely recognizing difference unit time and make it to in unit same time.

Level 2 ( *comprehending knowledge* ) :

*Symboling* , namely making lots of comparisons machine capped bottles in 2 minutes by symbolizing as a certain variable.

Level 3 ( *analyzing knowledge* ) :

*Comparison*, namely compares linkages many bottle that can closed and time machine that has is known for know method complete question.

*Specifying*, namely predict what will appen to total bottle that can closed if machine work with a different time.

*Generalizing*, namely making a mathematical model in direct proportion.

Level 4 ( *Using Knowledge* ) :

*Problem solving*, namely completing the direct proportion that has been made to in a mathematical model.

*Decision making* , namely drawing conclusions from what is being asked.

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#### Problem 2

The ratio of money savings Ayu , Bianca and Caca are 8:7:3. Difference in money savings Ayu and Caca are IDR 2,000,000.00. how much total money savings all three?

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#### Purpose

Through this question will be studied:

- The process of thinking and how the thinking process of students in solving material story problems comparison in terms of Marzano's taxonomy

Level 1: *Recalling and Executing*, namely registering and creating ratio total money Ayu , Bianca and Caca as well other known information on the question.

Level 2: *Symboling*, namely making an example of a amount money Ayu , Bianca and Caca by symbolizing as a certain variable.

*Integrating* is making connections between variables, known information and comparative concepts.

Level 3 : *Comparing* that is compare linkages total money Ayu , Bianca and Caca as well as difference total money savings Ayu and Caca for know method complete question .

*Generalizing*, namely making a mathematical model in direct proportion .

Level 4: *Problem solving*, that is completing direct proportion that already made .

*Decision making*, namely drawing conclusions from what is being asked.

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In research also conducted check data validity, this is done in order to obtain valid findings. Checking technique the validity of the data used in research this is data triangulation. Triangulation is a data validity checking technique that utilizes something from outside the data for checking purposes or as a comparison to that data (Moleong , 2010 ). This research use triangulation source made to compare results completion proportion problem , interview with subject, and discussion with a mathematics teacher at SMP Negeri 3 Sumenep .

## RESULT AND DISCUSSION

Based on Marzano's taxonomy that has put forward first, cognitive system own four component that is retrieving knowledge, comprehending knowledge, analyzing knowledge, and using knowledge. The following will be described system cognitive S1 and S2 in solving proportion Problem base on Marzano's taxonomy.

### S1 cognitive system in solving the first problem

S1 cognitive system, namely processing knowledge in solving problems in the first problem. At level 1, namely *retrieving knowledge*, S1 did "recognizing and executing", namely S1 recognizes unit different times on the problem and then make it to in same unit with change 2 minutes to 120 seconds.

At level 2, namely *comprehending knowledge*, S1 did "symboling". S1 did "symboling" which is marked with S1 makes an example by symbolizing with the variable  $x$  to exemplify the number of bottles that can be closed by machine in time 120 seconds. This is known based on the completion sheet S1 and the results of interviews with S1.

At level 3, namely *analyzing knowledge*, S1 did "comparison" that is compare linkages many bottle that can be closed and the time that machine need. it seen from table that has made by S1. Based on results S1 interview also conducted "specifying" ie predict what will happen to total bottle that can be closed if machine work with different time. S1 said if machine work longer so bottles that can be closed are also more many. Based on Thing the S1 can conclude that about could done with use direct proportion. With thus S1 did "generalizing", namely making a mathematical model in direct proportion with write  $\frac{14}{x} = \frac{84}{120}$ .

At level 4, *using knowledge*, S1 did "problem solving and decision making". S1 did "problem solving", namely completing the mathematical model that has been made. S1 made direct proportion mathematical models. S1 did trick multiplication cross for know score of variables  $x$ , ie  $x = \frac{14 \cdot 120}{84} = 20$ . S1 also did "decision making" at level 4, this is shown from S1 drawing conclusions from what was asked in the problem. This is shown by S1 writing "so, the number bottle that can closed by machine is 20 bottles " on the completion sheet. The above is as shown in the following image

**Soal :**

Sebuah mesin di suatu pabrik minuman mampu memasang tutup botol untuk 14 botol dalam waktu 84 detik. Berapakah banayah botol yang dapat ditutup oleh mesin dalam waktu 2 menit?

**Penyelesaian:**

= 2 menit =  $2 \times 60 = 120$  detik

Botol (buah)	Waktu (detik)
14	84
$\times$	120

Karena perbandingan senilai maka

$$\frac{14}{x} = \frac{84}{120}$$

$$x = \frac{14 \cdot 120}{84} = \frac{2120}{12} = 2 \cdot 10 = 20$$

Jadi banyaknya botol yang dapat ditutup oleh mesin adalah 20 buah

Figure 1. S1 Completion Sheet in solving the first problem.

S1 thinking in completing about proportion, the researcher interviewed S1 as follows.

Q : "Please explain the completion you wrote down to solve this problem!"

S1 : " In the matter it says if something the factory is able to install bottle caps for 14 bottles in 84 seconds. then asked a lot of bottle caps that can be closed within 2 minutes. Means we can use a direct proportion method."

Q : "Where are you know if that direct proportion?"

S1 : "From what is known in the Problem Ma'am."

Q : "What does it mean from the known?"



- S1 : " So if the machine closes the bottle, the longer the time he works with means the more the bottle is too closed."
- Q : " Ooo so it is. Continue to try the next explanation just now about the method of solving it."
- S1 : " Here first I convert 2 minutes To seconds , 2 minutes is equal to 2 times 60 seconds, so we have 120 seconds . after the same unit of time, I solved it by way of a comparison of worth."
- Q : "So what does this mean?" (*pointing to the word "botol (buah) dan waktu (detik)" on the completion sheet* ).
- S1 : " "I made the data first ma'am, like a table to avoid placing the wrong value in the proportion."
- Q : "So this means a kind of table huh?"
- S1 : "Yes ma'am."
- Q : "Yes next?"
- S1 : "Then I finished the proportion, and the result is 20. So the number of bottles that the machine can close in 2 minutes is 20 bottles."

### **S2 cognitive system in solving the first problem**

S2 cognitive system, namely processing knowledge in solving problems in the first problem. At level 1, namely *retrieving knowledge*, S2 did "recognizing" but didn't "executing", that is S2 recognize unit at different times on the problem this thing seen from the chart that S2 wrote on the completion sheet, but the S2 doesn't change it to in-unit same time. Based on the results of the interview, S2 admitted that he did not know if the time units had to be equated

At level 2, namely *comprehending knowledge* , S2 did "symbolizing" which is marked with S2 makes an example by symbolizing with variable  $a$  for example many bottles that can be closed by machine in 2 minutes time. This is known based on the completion sheet S2 and the results of interviews with S2 .

At level 3, namely *analyzing knowledge* , S2 did "comparason" that is compare linkages many bottle that can closed and time that machine need. it seen from visualization that has made by S2 with sign arrow . S2 also "generalizing", namely making a mathematical model in direct proportion. Based on results of interview, S2 didn't "specifying" ie predict what will happen to total bottle that can closed if machine work with different t e that is if machine work longer so bottles that can be closed are also more many. S2 only focuses on the numbers written down and immediately finish it for find solution .

At level 4, using *knowledge* , S2 did "problem solving" and didn't "decision making". S2 did "problem solving", namely completing the mathematical model that has been made. The mathematical model in question is direct proportion . The S2 didn't " decision making" at level 4, this is shown from S2 didn't made conclusions from what is asked in the problem. The above is as shown in the following image .

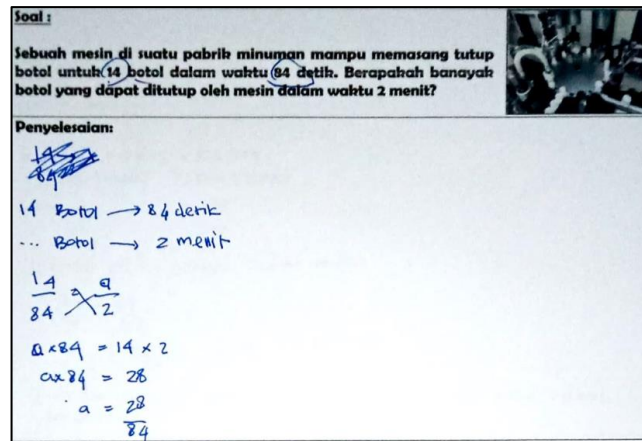


Figure 2. S2 Completion Sheet in solving the first problem.

S2 thinking in completing about proportion, the researcher interviewed S2 as follows.

Q : "Please explain the completion you wrote down to solve this problem!"

S2 : ( read the problem). Machine could installed 14 caps bottle in 84 seconds ( while show the solution ), then what is asked how many bottle that can closed in time 2 minutes, because we don't know how many bottles are installed within two minutes I wrote down with dots. So these points are what we're looking for. We work on it by making equations"

Q : "This means how come you can find equations like this using what model/concept?"

S2 : " This use proportion ma'am."

Q : "What proportion?"

S2 : " Eeeee proportion"

Q : " Direct proportion or inverse Proportion?"

S2 : " Direct proportion Ma'am"

Q : "Yes , try next the explanation!"

S2 : "The equation is 14 per 84 equals a per 2."

Q : " a here as what?"

S2 : " a is a lot of bottles that we want to look for Ma'am, those dots."

Q : "Many bottles how?"

S2 : "Many bottles are machine-sealed within 2 minutes Ma'am"

Q : "Okay."

S2 : "Then cross-multiplied, it is found that the value of a is 28 per 24."

Q : "Are you sure the answer is 28 per 24?"

S2 : " Actually, no Ma'am because I found a fractions, it seems impossible."

Q : " you know where it is not very thorough?"

S2 : " Where's Mom?"

Q : "This is a different unit of time, it should be equated first into all minutes or seconds."

S2 : "Oo so it should be equalized first, ma'am.."

Q : "Yes."

### S1 cognitive system in solving the second problem

S1 cognitive system, namely processing knowledge in solving problems in the second problem . At level 1, namely *retrieving knowledge* , S1 did "*recalling and executing*", namely S1 register and create ratio amount of Ayu, Bianca and Caca's money, the difference between Ayu and Caca's money into a table form as it is on the completion sheet.

At level 2, namely *comprehending knowledge* , S1 did "*symboling and integrating*". S1 did "*symboling*" which is indicated by S1 making an analogy by symbolizing with variables A, B, C and x to exemplify for the amount of Ayu's money, Bianca's amount of money,



Caca's amount of money and the amount of money of the three. S1 is also "integrating", namely making connections between variables, with subtract ratio of amount of Ayu's money and the amount of Caca's money that is  $A - C = 8 - 3 = 5$  as a ratio for difference money both of them that is IDR 2,000,000.00. Besides it, s1 also adds ratio of total money all three that is  $A + B + C = 8 + 7 + 3 = 18$  which will then be used to determine the amount of money for the three. This is known based on the completion sheet S1 and the results of interviews with S1.

At level 3, namely *analyzing knowledge*, S1 did "comparison" that is compare linkages between amount of money Ayu, Bianca and Caca as well as difference in amount of money Ayu and Caca. it seen from table that has made by S1. S1 also did "generalizing", namely making a mathematical model in direct proportion, ie  $\frac{5}{2.000.000} = \frac{18}{x}$ .

At level 4, *using knowledge*, S1 "problem solving and decision making". S1 did "problem solving", namely completing the mathematical model that has been made that is direct proportion. S1 complete the proportion that have been she made for find x ie  $x = \frac{18 \cdot 2000000}{5}$  so found x is 7,200,000. S1 also did "decision making" at level 4, this is shown from S1 made conclusions from what was asked in the problem. This is shown by S1 writing "jadi jumlah tabungan ketiganya adalah Rp 7.200.000" on the completion sheet. The above is as shown in the following image .

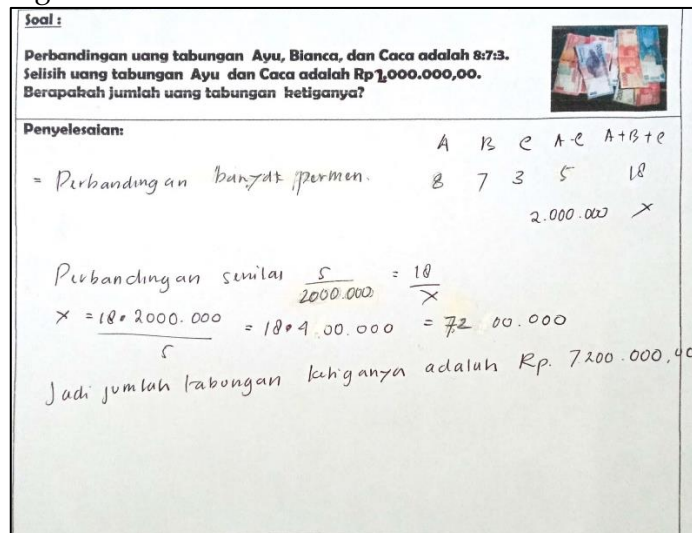


Figure 3. S1 Completion Sheet in solving the second problem.

S1 thinking in completing about proportion, the researcher interviewed S1 as follows.

Q : " Try to explain the solution that you wrote to solve this problem!"

S1 : " So from the problem We know ratio money savings Ayu , Bianca and Caca are 8:7:3, here I write down as table, this is ma'am (*pointing completion sheet* ). This is also A-C difference ratio money savings Ayu and Bianca are the same with 5 and A+B+C is total ratio money savings Ayu, Bianca and Caca"

Q : " This is what the words "comparison of many candies"?"

S1 : "Oh this is i mean savings not candy Ma'am, when i write, i don't focus on Mom maybe".

Q : "So this is just a miswriting, huh?"

S1 : " Yes ma'am."

Q : " Try next explanation in the completion?"

S1 : " Then I write direct proportion, because that is known is difference money savings Ayu and Caca, that is of 2,000,000 then what I am comparing is that difference ratio money savings Ayu and Bianca are the same with 5 compared difference money

savings Ayu and Caca, that is equal to 2,000,000 with total ratio money savings Ayu, Bianca and Caca Uang compared total money savings Ayu, Bianca, and Caca are mine symbolize with  $x$ . Because of that, I write down 5 per 2,000,000 equals with 18 per  $x$ ."

Q : " Yes. "

S1 : " Then I count and complete, finally  $x$  found 7,200,000. So total money savings Ayu, Bianca, and Caca are 7,200,000."

Q : " Okay, thank you love on explanation."

## S2 cognitive system in solving the second problem

S2 cognitive system is knowledge processing in solving problems in the second problem. At level 1, namely *retrieving knowledge*, S2 did "*recalling and executing*", that is S2 writing ratio total money Ayu , Bianca and Caca. S2 is also a difference money between Ayu and Caca on completion sheets.

At level 2, namely *comprehending knowledge* , S2 performs "*symbolizing and integrating*". S2 performs "*symboling*" which is indicated by S2 making analogy by symbolizing with variables  $A$ ,  $B$ , and  $C$  to exemplify the amount of money Ayu, amount of money Bianca, amount of money Caca. S2 is also "*integrating*", namely making connections between variables, with subtract ratio the amount of money Ayu and amount of money Caca that is  $A - C = 8 - 3 = 5$  as a comparison for the difference in money between the two, which is IDR 2,000,000.00 .

At level 3, namely *analyzing knowledge*, S 2 did "*comparison*" that is compare linkages subtraction of ratio the amount of money Ayu and amount of money Caca as well as difference total money savings Ayu and Caca. it seen from sheet S2 solution that writes  $A - C = 2,000,000$  and then substitute  $A - C$  with  $8 - 3 = 5$ . But the S2 didn't "*generalizing*", this is because S2 didn't create a mathematical model in direct proportion, but only equality  $A - C = 2,000,000$  .

At level 4, *using knowledge* , S2 did "*problem solving*", but didn't "*decision making*". S2 did "*problem solving*", namely completing the mathematical model that has been made. S2 finish equations that have she made from sheet current S2 completion complete equality and write down results end from equality is  $5 = 2.000.000$  and then assuming that equation the comparable with  $1 = 400,000$ . kindly logic assumption from S2 is not wrong, however in a manner writing S2 is not justified. S2 determines total money savings Ayu , Bianca and Caca with method look for money savings each . First, S2 determines money savings Ayu with multiplying 8 by 400,000 because S2 has assume bring value 1 in ratio equivalent with 400,000 rupiah. Next S2 determines money saving Bianca and Caca with method multiply each ratio with 400,000. S2 then sum up money savings Ayu, Bianca and Caca, so found total money all three is 7,200,000 rupiah. The S2 didn't "*decision making*" at level 4, this is shown from S2 didn't made conclusions from what is asked in the problem. The above is as shown in the following image .

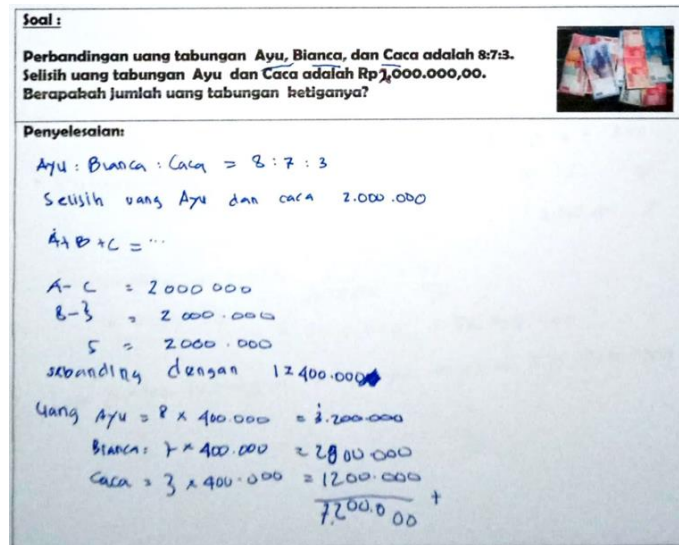


Figure 4. S2 Completion Sheet in solving the second problem.

- Q : " Try to explain the solution tha you wrote to solve this problem!"
- S2 : " ( reading First I wrote down the ratio money savings Ayu to Bianca to Caca with 8:7:3. After that, i write down difference money Ayu , Bianca and Caca 2,000,000. After that, i write down what is asked total money all three , because We still don't know, so i write down  $A + B + C = \dots$  Ma'am. "
- P : " Means A means is money savings Ayu , B is money Bianca and C is savings money Caca?"
- S2 : " Yes ma'am."
- Q : " Okay, try to continue the explanation on the completion sheet!"
- S2 : " Yes ma'am. Then I write it down  $A - C = 2.000.000$  because it is known that the difference between Ayu and Caca's savings is two million rupiah. Then I substitute value  $A - C$  with  $8 - 3$  because ratio saving mone Ayu is 8 and Caca is 3. Finally got equality  $5 = 2.000.000$ . so if we have the 5 equal 2,000,000 then 1 it is same with 400,000 ma'am."
- Q : " What do you think writing equation  $5 = 2,000,000$  is? Is it true that 5 can be assumed with 2,000,000?"
- S2 : " No ma'am, there I mean comparable not the same."
- Q : " Yes , if comparable, writing it should not be the same as, what value will be compared, write the comparison."
- S2 : " Yes ma'am, I am confused how to wrote it, what should be compared".
- Q : " For examplif you want to looking saving money each, for Ayu, you can compare ayu money and difference Ayu and Caca's money equal to ratio each, swe can write down  $A : A - C = 8 : (8 - 3)$  or  $\frac{A}{A - C} = \frac{8}{3}$ . Then substitute A-C with 2,000,000, that is  $\frac{A}{2.000.000} = \frac{8}{3}$ . From this equation you will find Ayu's savings. For money Bianca and Caca's savings get use the same way."
- S2 : " Yes ma'am."
- Q : " Yes, no problem, next time you can repaired if find similar problem. Now try explained next completion."
- S2 : " Next I looking for money each from Ayu , Bianca and Caca. Because of me just now assume the ratio 1 it is same with 400,000 so for looking for money each I multiply 400,000 by the score ratio each . So that found results for money Ayu is 3,200.00 rupiah, Bianca 's money is 2,800,000 rupiah, and Caca 's money is 1,200,000 rupiah. Then I add up and we could total money all three ."
- Q : " Yes , thank you for the explanation ."

## CONCLUSION

S1 Cognitive system in complete first problem, at level 1, namely *retrieving knowledge*, S1 did *recognizing and executing*. At level 2, namely *comprehending knowledge*, S1 did *symboling*. At level 3, namely *analyzing knowledge*, S1 did *comparing, specifying and generalizing*. At level 4, *using knowledge*, S1 did *problem solving and decision making*.

S2 cognitive system in complete first problem, at level 1, namely *retrieving knowledge*, S2 did *recognizing* but didn't *executing*. At level 2, namely *comprehending knowledge*, S2 did *symboling*. At level 3, namely *analyzing knowledge*, S2 did *comparison and generalizing* but didn't *specifying*. At level 4, *using knowledge*, S2 did *problem solving* and didn't *decision making*.

S1 cognitive system in complete second problem. At level 1, namely *retrieving knowledge*, S1 did *recalling and executing*. At level 2, namely *comprehending knowledge*, S1 did *symboling and integrating*. At level 3, namely *analyzing knowledge*, S1 did *comparison and generalizing*. At level 4, *using knowledge*, S1 did *problem solving and decision making*.

S2 cognitive system in complete second ratio, at level 1, namely *retrieving knowledge*, S2 did *recalling and executing*. At level 2, namely *comprehending knowledge*, S2 did *symbolizing and integrating*. At level 3, namely *analyzing knowledge*, S2 did *comparison* but the S2 didn't *Generalizing*. At level 4, *using knowledge*, S2 did *problem solving*, but didn't *decision making*.

## ACKNOWLEDGMENTS

Study This provides an overview to researchers, prospective teachers and teachers about system cognitive student in complete about comparison. There is some interesting on the results cognitive system research in research this. If usually We used to only could say completion students correct or completion students wrong, on research this We could look more in what to think student when do questions and explanations they about method do about proportion. By knowing system cognitive students, expected researchers, prospective teachers and teachers can study system cognitive student more in more on other material and can design more learning innovative.

This research provides researchers, prospective teachers and teachers with an overview of students' cognitive systems in solving proportion problems. There are some interesting things in the results of cognitive system research in this reseach. If we are usually used to only being able to say a student's solution is right or wrong, in this study we can take a deeper look at what students think when solving problems and their explanations of how to solve proportion problems. By knowing the cognitive system of students, it is hoped that researchers, prospective teachers and teachers can examine students' cognitive systems more deeply on other materials and can design more innovative learning.

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