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The Structure of Students' Metacognition in Problem Solving of Two Physics Contexts

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ABSTRACT

This research aims to describe students' metacognition in problem solving of two physics contexts, i.e. static fluid and heat. The subjects of the research were twenty-five second grade students of a high school in Palu. From the subjects, six students were selected as respondents using selection test. The six respondents represented three categories, i.e., high, medium, and low ability. The data of this research, collection using essay test of physics problems in the two contexts, problem solving activities in setting of thinking-aloud, and it was followed by interview. Based on data analysis it was found that, students of the high category do aspects from three components of metacognition, i.e. *awareness, evaluation dan regulation*. Students of the medium category do aspects from components of metacognition *awareness,* but occasionally do aspects from components of metacognition *evaluation* for considered difficult problems. Students of the low category only do aspects from components of metacognition *evaluation* by being aware for their own limitations in problem solving. *Evaluation* is the components of metacognition that always be there for all students' categories, and this applies in two contexts of physics materials. The ability of understand learning influences problem solving which is closely related to metacognition behaviour.
Keywords: Metacognition, Problem Solving, Static Fluid, Heat

ABSTRAK

Penelitian ini bertujuan untuk mendeskripsikan metakognisi siswa dalam pemecahan masalah pada dua konteks fisika, yaitu fluida statis dan kalor. Subjek penelitian adalah dua puluh lima siswa kelas II sebuah SMA di Palu. Dari subjek, enam siswa dipilih sebagai responden melalui tes seleksi. Keenam responden tersebut mewakili tiga kategori yaitu kemampuan tinggi, sedang, dan rendah. Pengumpulan data dilakukan dengan menggunakan tes esai soal fisika dalam dua konteks, aktivitas pemecahan masalah dalam setting berpikir nyaring, dan dilanjutkan dengan wawancara. Berdasarkan analisis data ditemukan bahwa, siswa dengan kategori tinggi melakukan aspek dari tiga komponen metakognisi, yaitu kesadaran, evaluasi dan regulasi. Siswa kategori sedang mengerjakan aspek dari komponen kesadaran metakognisi, namun sesekali mengerjakan aspek dari komponen evaluasi metakognisi untuk soal-soal yang dianggap sulit. Siswa yang berkategori rendah hanya melakukan aspek dari komponen evaluasi metakognisi dengan menyadari keterbatasan dirinya dalam pemecahan masalah. Evaluasi merupakan komponen metakognisi yang selalu ada pada semua kategori siswa, dan ini berlaku dalam dua konteks materi fisika. Kemampuan memahami pembelajaran mempengaruhi pemecahan masalah yang erat kaitannya dengan perilaku metakognisi.
Kata Kunci: Metakognisi, Pemecahan Masalah, Fluida Statis, Panas

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INTRODUCTION

Problem solving is an integral part and important role in learning, that because most learning is the result of a problems solving process. In physics, problem solving have a close relationship, because topics in physics for the context of everyday life are always based on a problem. Problem solving is to find a way out of a difficulty, to reach a goal that is not immediately achievable. Problem solving is a systematic approach in conceptualizing and understanding the problem, designing a strategy to solve the problem, and evaluating the strategy implemented. Furthermore, ref. Define that problem solving ability is an ability to describe problems, determine the causes of problems, determine and select various solutions to problems and implement solutions to these problems.

To become a good problem solver, students must have a good metacognition, because metacognition is related with the ability to design the strategies, organize the information that is owned, solve the problems, and evaluate the results of thinking. Metacognition and problems solving abilities are two elements which are interconnected with each other, where one of the factors that influence success in solving student problems is metacognition.

The term metacognition was first put forward by John H. Flavell, a psychologist from America in 1970 and is defined to *thinking about thinking* or one's knowledge about their cognitive processes. In addition, Flavell revealed that metacognition is an important element that contributes to the success of problem solving, so can allows someone to identify and work strategically. According to ref there are three components of metacognition in student problem solving, i.e. metacognition *awareness, evaluation, and regulation*. Metacognition Awareness is related to students' awareness in planning, which about their existence in the process of solving problems, specific knowledge about the problems, and knowledge about strategies for solving problems; Metacognition Regulation refers to the implementation by students, which about knowledge of strategies how and when to use them; Metacognitive Evaluation refers to evaluations by students, which about assessments of thinking processes, thinking capacities, and own limitations when working in certain situations.

The research that has been conducted shows that there is a linear relationship between metacognition and student problem solving, including the results of research where metacognition influences students' problems solving abilities. Students who have good metacognition more successful in solving problems than students who have low metacognition. This can be seen from students with good metacognition being able to process the steps of solving the problems. Furthermore, research by found that metacognition and problem solving have a positive relationship, where students who are able to use their metacognition provide appropriate solutions to the problems compared to students who are unable to use their metacognition.

Researched about the effectiveness of learning with metacognition, and found that there were differences in students' assumptions in understanding combinatoric problems based on the results of questionnaires with their practice when they solve

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the combinatoric problems. Those researches not explained with descriptively about how students' metacognitive behavior if they faced with the different learning contexts in solving problems. How metacognition works on a person when they implementing the strategies and their performance in solving problems and understanding learning still unclear.

On the other hand, the students' problem-solving abilities not only depend on the understand of learning material, but also on the students' own metacognition, the awareness of how they organize strategies, the planning, the implementation and evaluating. Metacognition is a strong predictor of the ability to understand learning and problems solving. Between metacognition, problem solving abilities, and the ability to understand learning material are interconnected. The purpose of this research is to describe students' metacognition processes in problem solving of two physics learning contexts, i.e. static fluid and heat.

RESEARCH METHOD

This research is the qualitative research with a descriptive approach, where the qualitative data that obtained based on field facts and explained with descriptively. This research was conducted on second grade students at a high school in Palu city who had finished physics subjects for static fluid and heat materials. The subjects of this research were all students of class MIPA 3 with a total of twenty-five students, were six students selected as the respondents.

The data collection technique in this research was conducted in stages. First using multiple choice test instruments for all students of class XI MIPA 3. Furthermore, selected respondents with a *purposive sampling* technique or taking respondents on certain based. The certain based in this research i.e. high, medium, dan low categories of ability. Determination of these categories using the average value and standard deviation from the results of the students' multiples choice tests. Second, using essay test with a total of 4 questions about physics problems in the two contexts i.e. static fluid and heat. Third, the problems solving activities in setting of *thinking aloud*, and it was followed by interview to obtain more accurate data.

RESULT AND DISCUSSION

Based on the results from essay test of two physics context i.e. static fluid and heat by the respondents, as an example, there are *thinking aloud* transcript, quotations of answers, and interviews transcript from high, medium and low ability categories are as follows:

High Ability Categories (HC-1) Question of Determining the Weight of an Object in Water

It is known that an object has a weight of 30 N when weighed in air, if the object's volume = 9×10^{-4} m^3, the density of water = 1000 kg/m^3, and the acceleration of gravity is 10 m/s^2. Determine the weight of the object when it's weighed in water!

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Thinking aloud transcript:

(Read the questions) *I think, from this questions I may be able to understand a little, where it is known that the weight of the object is 30 N, the volume is 9×10-4 m3 with the density of water being 1000 kg/m3 and the gravity is 10 m/s2, then what is being asked is the weight of the object when it is weighed in water, then here using F = ρ times g times V.*

(Pay attention to the questions) *It seems that from this question I don't understand a bit about the weight of the 30 N object, how about that? I don't understand when it operates, hmm.. I think the weight of this is not discussed in the formula so I don't understand.*

(See the answer) *"For this questions I have adjusted with the formula, so I just multiply all the quantities, i.e density times with the gravity, then times the volume, it's just that I don't understand about the weight of this object, maybe there is a long solution for this, because I've never had seen a model of questions like this before, so it looks like I'm just do just in here"*

Based on the *thinking aloud* transcript, it can be seen that respondent HC-1 is aware for the planning process when solving the problems by do the aspects from metacognition component of *awareness* as 2 times. First, respondent can consciously monitor the ability to understand the problem, by expressing "*I may be able to understand a little*". Second, the respondent consciously understands and knows that there a relationship between what is known and what is asked in the problem, then based on this respondent chose to determines the strategy which will be used to solve the problem by decided to use the Archimedes force formula $F = \rho . g. V$"

Furthermore, the respondents do the aspects from metacognition component of *regulation* as 3 times. Respondents can consciously carry out and manage the strategies according to the planned method by expressing that obtaining the results of answers with multiplying the $F = \rho . g. V$. Respondents consciously know that they need to adjust their steps when they found difficulties in the implementation process of problem solving by expressing *"I don't understand a bit about the weight of the 30 N object, how about that? I don't understand when it operates, hmm.. I think the weight of this is not discussed in the formula so I don't understand"*. Respondent aware and know their abilities when carrying out problem solving. Respondent chose not to subtract the weight of the object with the result of Buoyant force because previously respondent HC-1 expressed for confused about the part of the object's weight which is known 30 N in the questions.

Then, respondent HC-1 do the aspects from metacognition component of *evaluation* as 2 times, by being aware of their own limitations when solving problems. Respondents can consciously evaluate the results of their work which are not quite right because did't understand before about the weight of the object from the question. Respondent express *"I've never had seen a model of questions like this before"* and *"maybe there is a long solution for this, so it looks like I'm just do just in here".*

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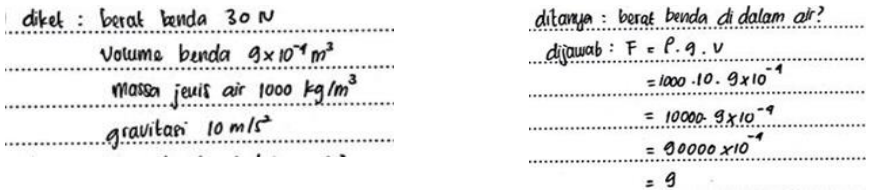
The results obtained above are supported again by the quote of respondents' answers as follows:



(a) (b)

FIGURE 1. The quote of respondent HC-1's answers about question of determining the weight of an object in water

Furthermore, to get more accurate data the respondent reconfirms some statement in the interview transcript as follows:

Interview transcript:
Researcher : Is there another way to solve this problem besides the way you did?
HC-1 : *"In my opinion, maybe there is still a long way, but I don't know, I choose to use the buoyancy formula because what is being asked is related about the weight of an object in water"*
Researcher : Based on this answer, did you do a good overall calculation?
HC-1 : "*Yes, I have counted, but only the 30N part, because I was confused for that"*
Researcher : Did you sure or not with this answer?
HC-1 : *"For this one, I'm not sure, because I don't understand about the weight of this object, hmm.. maybe there is still a long way for the solution"*

Based on the interview transcript, respondent HC-1 confirm the statement which showed that HC-1 was aware of the strategy that will be used. Respondents revealed, choose to use a strategy who related with what was asked in the question. Respondent HC-1 confirm again the statement to indicating that he was aware of the implementation process when solving the problem. Respondent said *"I don't understand about the weight of this object, hmm.. maybe there is still a long way for the solution".* Then, respondents stated that have make sure that the calculation process was correct, but was not sure about the results of the calculation. Respondents can consciously evaluate the results of their work that are not quite right.

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High Ability Categories (HC-1) Question of Determining Heat Absorbed

Mr. Tono heats two liters of water from temperature 25 °C until 95 °C. How much heat is absorbed by the water ? (c_{water} = 4200 $\frac{J}{Kg\ °C}$)

Thinking aloud transcript:

(Read the questions) "*In this question, for me it's clear, what is known and what is asked also clear, hmm... from what is known that two liters of water were heated, these two liters might be converted into kilograms because they have a mass, this water then be heated from its initial temperature i.e. 25 °C until 95 °C, this* c_{water} *for the specific heat of water = 4200* $\frac{J}{Kg\ °C}$ *, what was asked about the heat absorbed by the water or its the Q, so I solved this problem using the heat formula, or Q = m. c. ΔT*"

(See the answer) *"So to get the heat absorbed, the result is the product from m . c. ΔT , hmm then first, the final temperature or T2 is reduced by the initial temperature or T1, so 95 - 25 the result is 70, then 2 is multiplied by 4,200 which the results 8,400, then 8,400 is multiplied by the 70 earlier, so that i found the result is 588,000"*

Based on the *thinking aloud* transcript, it can be seen that respondent HC-1 is aware for the planning process when solving the problems by do the aspects from metacognition component of *awareness* as 3 times. First, the respondent can consciously monitor the ability to understand the problem, which the respondent expresses "*In this question, for me it's clear*". Second, Respondents revealed that there were 2 liters of water where the unit needed to be changed to kilograms to determine the mass. In this case the respondent can consciously understand that there is a relationship between what is known and the strategy that be used. Third, the respondent HC-1 can consciously know and determine what strategy to solve the problem, by deciding to use the heat formula, according to what is asked in the questions.

Furthermore, the respondents do the aspects from metacognition component of *regulation* about 2 times. Respondents can consciously carry out and manage strategies according to the planned method by expressing obtaining the results of answers with multiplying the *m . c . ΔT*. Respondents consciously know the information which needed, and organize it in the process of problem solving. Respondents consciously know need to subtract the final temperature with the initial temperature to get the result of the *ΔT* before multiplying it by mass and specific heat.

The results obtained above are supported again by the quote of respondents' answers as follows:

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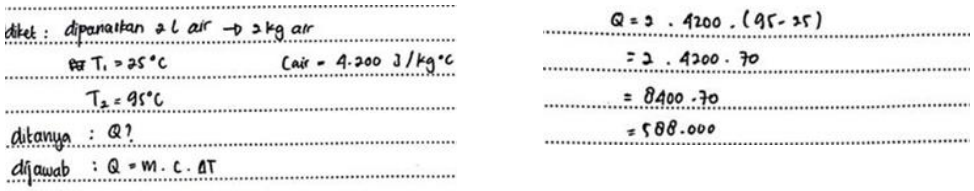

(a) (b)

FIGURE 2. The quote of respondent HC-1's answers about question of determining heat absorbed by the water

Furthermore, to get more accurate data the respondent reconfirms some statement in the interview transcript as follows:

Interview transcript :
Researcher : Is there another way to solve this problem besides the way you did?
HC-1 : "*I don't think so, because that's the formula to determining the heat*"
Researcher : When you solve this problem, you look serious, like there is no questions or problems in your mind? why?
HC-1 : "*Yes, I think so, because I think it is clear*"
Researcher : Based on this answer, did you do a good overall calculation?
HC-1 : "*hmm yes, I have multiplied all the m, then the c, and the ΔT*"
Researcher : Did you sure or not with this answer?
HC-1 : *"I'm sure, because it's clear for me, and I also was learned this is before*"

Based on the interview transcript, respondent HC-1 confirm the statement which showed that HC-1 was aware of the strategy that will be used. Respondents revealed, choose to use a strategy who related with what was asked in the question. Respondent HC-1 confirm again the statement to indicating that he was aware of the implementation process when solving the problem. Respondent said *"Yes, I think so, because I think it is clear".* Then, respondents stated that have make sure that the calculation process was correct, and sure about the results of the calculation. Respondents can consciously evaluate the results of their work its right.

Medium Ability Categories (MC-1) Question of Determining the Hydrostatic Pressure

A vessel with a height about 0,8 m filled with water about ½ of vessel. If the specific mass of water = 1 gram/cm^3 and the acceleration of gravity = 1000 cm/s^2. Determining the hydrostatic pressure at the bottom of the vessel!

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Thinking aloud transcript :

(Read the questions) "*I think I can answer this question, from this question it is known that first there is the height of the water, then there is the acceleration of gravity, the specific mass, and what was asked is determining the hydrostatic pressure at the bottom of the vessel, for this questions it can be complete by use a formula of hydrostatic pressure which its P = ρ . g . h"*

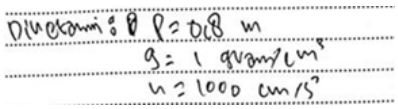
(See the answer) *"So I explain, the method for solution I use in here, first the value of ρ, g, h, I adjusted with the formula and I multiplied this all, i.e. 0,8 multiplied by 1 then multiplied by 1000, so I get the result of pressure about 0,008"*

Based on the *thinking aloud* transcript it can be seen that respondent MC-1 did not reveal the statement that indicating about understanding of what is known and what is asked in the questions. It can be observed that the respondent consciously only do the aspects for metacognition component of *awareness* about 2 times. First, respondent can consciously know about the ability to understand the problem, which the respondent expresses "*I think I can answer this question".* Second, respondent can consciously know and determine the right strategy that can used to solve the problem. In this case, respondent choose to use the Pressure formula *P = ρ . g . h"*

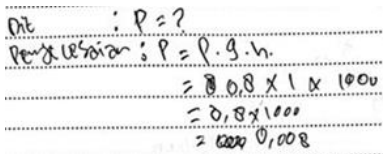
Furthermore, even though respondent MC-1 was able to carry out the problem-solving process according to the planned method before, but the respondent showed his unaware for monitoring the process he was carrying out. Respondent express "*I adjusted with the formula and I multiplied this all, i.e. 0,8 multiplied by 1, then multiplied by 1000, so I get the result of pressure about 0,008".* In this case, respondent had multiplied the value of quantities by incorrect with the wrong answer. Respondent can't aware about there is a relationship between what is known and the formula.

It can be observed, respondent also can't aware if the calculation done correctly. Respondents did not reveal the statement that showed the respondent's awareness to evaluate the results of his work.

The results obtained above are supported again by the quote of respondents' answers as follows:



(a)



(b)

FIGURE 3. The quote of respondent MC-1's answers about question of determining the hydrostatic pressure

Furthermore, to get more accurate data the respondent reconfirms some statement in the interview transcript as follows:

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Interview transcript :
Researcher : Is there another way to solve this problem besides the way you did?
MC-1 : *"It seems like.. no, because what is asked about the hydrostatic pressure, so I choose to use the pressure formula"*
Researcher : When you solve this problem, you look serious, like there is no questions or problems in your mind? why?
MC-1 : "*Hmm, because I think I can do it*"
Researcher : So, from part of what is known in here, there are 0,8 m, 1 gr/cm^3 and 1000 cm/s^2 can you explain the meaning of it?
MC-1 : "*Hmm that are from what is known of the questions, 0,8 for the ρ, 1 gr/cm^3 for the g, dan 1000 cm/s^2 for the h*"
Researcher : Why you think like that?
MC-1 : "*So, I just adapt from pattern of the formula, because I'm sure that the all the way to solve it was multiplied"*
Researcher : Based on this answer, did you do a good overall calculation?
MC-1 : "*Eee.. yes I do"*
Researcher : Did you sure or not with this answer?
MC-1 :*"Yes, I think I'm sure"*

Based on the interview transcript, respondent MC-1 confirm the statement about even the MC-1 was aware of the strategy that will be used but respondent showed the unaware to understand and monitor what is known from the questions. In this case, the respondent put the value of the known quantity from the problem with incorrectly, because just follow the pattern of the formula without analyzing it. Then the respondent also reconfirmed the statement that showed his unconsciousness in the implementation process when solving the problem.

Respondents said did not find any difficulties or obstacles. Furthermore, respondents were unable to realize the results of their work that were not quite right. Respondents said that they have make sure about the calculation process they carried out was correct, and was confident in the results of the calculations.

Medium Ability Categories (MC-2) Question of Determining the Specific Heat

> 250 grams of silver is heated from 16 °R to 40 °R. If the silver receives 1725 calories of energy, determine the specific heat of silver.... $^{kal}/_{g\,^{\circ}C}$

Thinking aloud transcript :

(Read the questions) "*I think, for* ***this last question might be a little same with previous question, but I understand a little****, according to the questions there is 250 grams of silver was heated from 16 °R to 40 °R, then the silver receives 1725 calories*

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of energy, and what is asked about the specific heat of silver, ***I think the the solution may be multiplied too****"*

(See the answer) "*Hmm.. so I do in here… hmm,.. its .. hmm so, I think I know that this is all must be multiplied, hmm.. and the solution also use the heat formula, hmm… I try to remember, but hmm…. I… hmm I've confused too, it seems I can't finish this problem"*

Based on the *thinking aloud* transcript it can be seen that respondent MC-2 did not reveal the statement that indicating about understanding of what is known and what is asked in the questions. It can be observed that, the respondent consciously only do the aspects for metacognition component of *awareness* about 2 times. First, respondent can consciously know about the ability to understand the problem, which the respondent expresses "*for this last question might be a little same with previous question, but I understand a little".* Second, respondent can determine the strategy that used to solve the problem by expressing "*I think the the solution may be multiplied too"*.

Furthermore, it can be seen that respondent MC-2 was unable to carry out the problems solving process. Respondent revealed that knew the pattern of the formula, but could not to solve it. In this case, the respondent cannot realize and monitor the relationship between what is known and the strategy, to carry out the process of problem solving. Respondents also could not express a statement about where the confusion point in the question.

It can be observed, the respondent do the aspects from metacognition component of *evaluation* about 1 times, by being aware of their own limitations when solving problems. Respondents can evaluate the results of their own thinking is not quite right. The respondent expresses "*I try to remember, but hmm…. I… hmm I've confused too, it seems I can't finish this problem".*

The results obtained above are supported again by the quote of respondents' answers as follows:

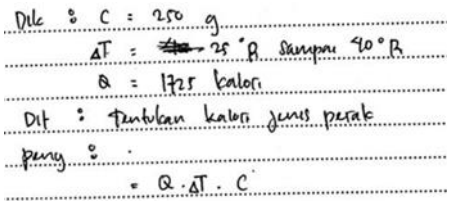

FIGURE 4. The quote of respondent MC-2's answers about question of determining the specific heat

Furthermore, to get more accurate data the respondent reconfirms some statement in the interview transcript as follows:

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Interview transcript :
Researcher : Is there another way to solve this problem besides the way you did?
MC-2 : *"Hmm maybe, but as I know this all will be multiplied"*
Researcher : In this case, you choose to not complete the answer, did you have questions or problems in your mind?
MC-2 : *"Hmm.. I'm just confused, but I think that's enough,.. I don't want to complete it because I've confused"*
Researcher : So, where is the point of the confused that you think ?
MC-2 : "*Hmm.. I don't know.., I may not be enough for learn"*

Based on the interview transcript, respondent MC-2 confirm the statement about even the MC-2 was aware of the strategy that will be used, but respondent showed the unaware to understand and monitor what is known from the questions. The respondent cannot express which the right formula for solve the problem, but just know pattern of the formula. Then the respondent also reconfirmed the statement that showed his unconsciousness in the implementation process when solving the problem. The respondent expressed feel confused in the implementation process when solving the problem, but can't confirm where the confused point, and then respondent choose to not complete the answer. Furthermore, the respondent can aware and evaluate the result of own thinking is not quite right. Respondent said to not complete the answer, because not enough to learn the material.

Low Ability Categories (LC-1) Question of Determining the Weight of an Object in Water

It is known that an object has a weight of 30 N when weighed in air, if the object's volume = 9×10^{-4} m^3, the density of water = 1000 kg/m^3, and the acceleration of gravity is 10 m/s^2. Determine the weight of the object when it's weighed in water!

Thinking aloud transcript :

(Read the question) "*Maybe, it's also difficult I don't know, uh… like… if… hmm so… there is an object, the object is 30, uh... and the density of water hmm, and the acceleration of gravity is 10 then uh... determine the weight of the object when it's weighed in water, so that's what asked … hmm … the solution I also don't know, um maybe I didn't learn, I think I'll just continue to the next question"*

Based on the *thinking aloud* transcript it can be seen that, respondent LC-1 did not express the statement that indicating about the awareness to understanding what is known and what is asked in the questions. The respondent can't monitor the relationship between what is known and what is asked in the questions. The respondent can't determine the strategy to solve the problem.

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Furthermore, it can be seen that the respondent LC-1 its unable to carry out the process of problem solving. The respondent did not express the statement that show about the awareness to implementing the process of problem solving. In this case, respondent can't realize and monitored the relationship between what is know and the strategy for implementing the process of problem solving. The respondents choose to blank the answer sheet.

It can be observed, the respondent just do the aspect for metacognition component of *evaluation* as 1 times, by being aware of their own limitations when solving problems. In this case, respondents can evaluate the results of their own thinking is not quite right. The respondent said *"um maybe I didn't learn, I think I'll just continue to the next question"*

Furthermore, to get more accurate data the respondent reconfirms some statement in the interview transcript as follows:

Interview transcript :
Researcher : So, for this question you choose to make the blank answer, why you didn't speak up about your problems in your mind?
LC-1 : *"Eem.. I don't think so anymore, I also don't know what the things that I want to asked anymore, so I think enough and just make a blank answer"*

Based on the interview transcript, respondent LC-1 reconfirms a statement that show about the respondent its unable to carry out for implementing the process of problem solving.

Low Ability Categories (LC-2) Questions of Determining Heat Absorbed

Mr. Tono heats two liters of water from temperature 25 °C until 95 °C. How much heat is absorbed by the water? (c_{water} = 4200 $\frac{J}{Kg\,°C}$)

Thinking aloud transcript :

(Read the question) *"I think this is little difficult, what is known in here about heat up two liters of water, from 25 until 95 and then how much heat is absorbed by the water? Umm.. maybe I…"*

(See the answer) *"I think I'm just like before, maybe I… umm.. I try to multiply, and add again with this temperature, and… so, 2 multiply by 25, and add by 95 and then… uh.. hmm…. Maybe,.. um,,.. maybe I can't, um that is all I know"*

Based on the *thinking aloud* transcript it can be seen that, respondent LC-2 did not express the statement that indicating about the awareness to understanding what

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is known and what is asked in the questions. The respondent can't monitor the relationship between what is known and what is asked in the questions. The respondent can't determine the strategy to solve the problem.

Furthermore, it can be seen that the respondent LC-2 did not express the statement that show about the awareness to implementing the process of problem solving. In this case, the respondent its unable to carry out and monitored the relationship between what is known and the strategy for implementing the process of problem solving. The respondent reveal the confusing flow of implementation, which is not related to the heat material.

It can be monitored, the respondent only do the aspect from metacognition component of *evaluation* about 1 times, by being aware of their own limitations when solving problems. In this case, the respondent can evaluate the results of their own thinking is not quite right to solve the problem. The respondent said *"Maybe,.. um,,.. maybe I can't, um that is all I know".*

The results obtained above are supported again by the quote of respondents' answers as follows:

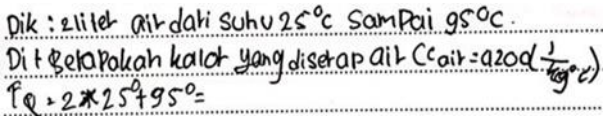

FIGURE 7. The quote of respondent LC-2's answers about question of determining heat absorbed by the water

Furthermore, to get more accurate data the respondent reconfirms some statement in the interview transcript as follows:

Interview transcript :
Researcher : In this case, you choose to not complete the answer, why you didn't speak up about your problems in your mind?
LC-2 : *"I think that's enough, I'm just don't want to completed"*

Based on the interview transcript, respondent LC-2 reconfirms a statement that show about the respondent its unable to carry out for implementing the process of problem solving.

The emergence formation aspects of metacognition component for all respondent categories in solving problems in two physics contexts i.e. static fluid and heat is summarized in Table 1. as follows:

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Table 1. Formation of respondents' metacognition component

Categories	Respondents	Formation of Metacognition Component			
		Static Fluid		Heat	
High	HC-1	AAA,RR,E	AA,RRR,EE	AAA,RR	AA,RRRR,EE
	HC-2	AA,RR,EE	AAA,RRR	AAA,RR,EE	AAA,RRR
Medium	MC-1	AA	AA	A,E	AA
	MC-2	AA	AA	AA	AA,E
Low	LC-1	E	E	E	E
	LC-2	-	E	E	-

Information :
A : Awareness
R : Regulation
E : Evaluation

Based on Table.1 it can be seen, that the emergence formation aspects of metacognition component for all respondent categories when solve the problems of static fluid, and when solve the problems of heat have the same formation. In this case it can be seen, the difference of material context that used have no effect with students' metacognition behaviour in problems solving. The difference actually showed to the respondents with high, medium, and low ability categories, which have the dissimilar patterns according to each category. Respondent with high ability generally have a complete patterns of metacognition (A,R,E). Respondent with medium ability generally have a patterns of metacognition (A,E). Respondent with low ability generally just have a pattern of metacognition (E). In this case, it can be seen that the ability level is influence the patterns of metacognition in problems solving. Furthermore, it can be seen that metacognition component of (E) is the component that always present to all categories in problems solving.

Based on the results of data analysis, there is some important information as the findings for this research. First, students with high ability categories do the aspect for metacognition component of *awareness, regulation, and evaluation* very well in problems solving. In this case, the students are consciously be able to know, monitor, and understand their abilities when planning, implementing and evaluating the problems that they faced. Then, students with high ability categories more often do the aspect for metacognition component of *evaluation* to the difficult problems. In this case, the students can monitor the result of the answer is right or not. This is relate with the research by [17,18] which revealed that children with high categories in problem solving were able to monitor the right and wrong answers of their work.

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Second, students with medium ability categories only do the aspect for metacognition component of *awareness* and *evaluation*. Students with medium ability categories know what is asked in the question, but not be able to monitor and understand the component of what is known in the questions, so they have a mistake when determine the value of known quantity from the question. The students with medium ability categories can determine the strategy, but in the implementing process of the problems solving, the students with medium ability categories give an explanation which show about their unconsciousness to the strategy they use. Then, the students with medium ability categories occasionally do the aspect for metacognition component of *evaluation* when they faced the difficult problem. In this case, the students with medium ability categories can evaluate the result of their own thinking it's not quite right, so they choose to not complete their answer. This is relate with the research by [19]. which revealed, the most differences between students with high and medium ability categories that found in the problem solving is the implementation analysis.

Third, students with low ability categories not be able to use the metacognition very well. In the process of planning, the students with low ability categories can't monitor what is known and what is asked in the questions. The students with low ability categories also not be able to determine the strategy of the problems. In the process of implementation, students with low ability categories give an explanation that shows their incompetence in problems solving, which the students with low ability categories give confused explanation for the flow of implementation process, and have not relate with the materials that discussed in the problem. It can be observed, the students with low ability categories just do the aspect for metacognition component of *evaluation,* by being aware of their own imitations when they solve the problem, so they choose to blank the answer sheet on several questions. This is relate with the research by [20] that revealed, the student with low ability categories confirm the steps of implementation process with confusingly, students with low ability categories not be able to understand what is known and what is asked in the questions, students with low ability categories only mention the components that are known in the questions without any explanation and choose to blank the answer sheets on several questions.

Fourth, there is no difference of metacognition process when students solve the problems in static fluid and when students solve the problems in heat. But, found that metacognition component of *evaluation* is the component that always present in every student category when they solve the problems. This is relate with the research by [10] that revealed, *evaluation* process in metacognition is the general type that identified in problem solving. Furthermore, in this research found that the emergence for the metacognition component of *evaluation* will more often, when students face questions that are considered difficult. In this case, if students have good ability of understand learning material, then the aspect from metacognition component of *evaluation* will getting less. Otherwise, if students have not good ability of understand learning material, then the aspect from metacognition component of *evaluation* will getting more emergence in problem solving.

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CONCLUSION

Base on the result of data analysis and discussion it can be conclude that, the difference of material context that used have no effect with students' metacognition behaviour in problems solving. Furthermore, the difference actually showed to the level ability categories of students. The students with high ability categories do the aspect of three metacognition component *awareness, regulation, evaluation* (A,R,E). In this case, the students are consciously be able to know, monitor, and understand their abilities when planning, implementing and evaluating in problems solving. The students with high ability categories more often do the aspect for metacognition component of *evaluation* to the difficult problems. The students with medium ability categories only do the aspect for metacognition component of *awareness* and *evaluation* (A,E). In this case, the students with medium ability categories are consciously be able for planning, but show the unconsciously in implementation when they solve the problem. The students with medium ability categories occasionally do the aspect for metacognition component of *evaluation* when they faced the difficult problem. The students with low ability categories only do the aspect for metacognition component of *evaluation* by being aware of their own imitations when they solve the problem. It can be seen, the metacognition component of *evaluation* is the component that always present in every student category. The metacognition component of *evaluation* will more often emergence, when students face questions that are considered difficult. The ability of understand learning material is influences the problem solving, which is closely related to the metacognition behavior.

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