How to use metacognitive strategy in the open-ended approach?

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Abstract. Mathematical thinking ability of elementary school students is still less than expected. The students need mathematics learning which could encourage them to think mathematically, one of the alternative is open-ended approach. Open-ended approach is an instruction that provide an opportunity for the students to solve the open-ended problems. During the students solve open-ended problem, they need to set their mind using metacognitive strategy. This study aims to explain the use of metacognitive strategy that could be used by the teacher in open-ended approach. The method of this study is literature study which summarizing and analyzing the result of various research that has been done. Using metacognitive strategies will encourage the student to solve the open-ended problem and think mathematically. It is because the students think about their way of thinking in solving the problem through the questions, journal, and mind map. The impact is the metacognitive strategies could be applied in open-ended approach.

1. Introduction
Metacognitive strategy could be used on mathematics learning through open-ended approach. Such as known, the open-ended approach is an alternative approach that could developing student various mathematics ability. The open-ended approach had increased mathematical creative thinking ability [1], [2]. Open-ended approach also could be increase activeness, learning outcomes, and knowledge competency student’s elementary school [3], [4]. It showed that open-ended approach have a positive impact to increase student mathematics ability.

Student could get knowledge and information through open-ended problem solving. However, solving problem in open-ended learning more focused to problem solving step structured. In line with it, student solve the open-ended problem that they had difficulty to make reasoning in choosing solution from their used, which is students more focused on structural problem solving [5]. In problem solving, student just know the best solution, but they had difficult to giving the reason from their solution that choose.

Student have difficulty to understanding the problem especially on word problem. Result from interviews with fifth grade teachers that student have difficulty to solving word problem and giving their mind expressions on writing. This is supported by the result of research that the error in solving word problem is to understand and read the problem [6]. This suggests that the student ability in
problem solving not sufficient to perform structural operations, but students have to understand the problem and express their mind. So it is necessary to development of learning where are able to solve non routine problems and give their mind expressions. An open-ended approach combined with the right strategy could be train the student to think deeply in understanding the problem, solving problem with various solutions, and finding the reason in every step solution their use.

Metacognitive strategy could be used in open-ended learning. Metacognitive strategy in open-ended learning are very important. It is because the student will know the reason from their solving problem that used. In line with, using metacognitive the student know about their known [7]. If the student know their known, they would be conscious and know what they doing. So that the learning more meaningful. Metacognitive strategy make student think reflectively to determine the best solving problem. With reflective thinking, the student could solving the problem and more understand the context of problem [9].

Metacognitive strategy that teacher used, could be encourage student to using metacognitive in solving open-ended problem. However in the implementation are needed the way and the true learning phase. It is combine metacognitive strategy in an open-ended learning. Therefore in this article aims to explain how to use metacognitive strategy in the open-ended learning.

2. Experimental method
The method of this study is literature study. The study was conducted by summarizing and analyzing the result of study has been done. The literature was analized about open-ended approach and metacognitive strategy. To reply the question of this study was conducted to analysis and synthesis open-ended approach and metacognitive strategy in mathematics learning. So that an idea was appeared to using metacognitive that combined with open-ended approach in mathematics learning.

3. Result and discussion
Open-ended approach is one of mathematics approach that could use in elementary school. Open-ended approach provide the problem with various solution in mathematical learning [9]. In open-ended learning, the teacher give open-ended problem in the beginning learning to student. Student could find knowledge from solving problem with various solution.

Three problem are provided in the open-ended learning. There are the proses are opened, the answer are opened, and the problem have developed solution [10]. It could use and developed in open-ended learning. The problem are used have to contain material and knowledge that known by student. So that, choosing and using problem in open-ended learning are important.

The learning that using open-ended problem have not persistent phase. However the important in open-ended learning is using open-ended problem that provide in the beginning learning to solve by student. There are some opinion about phase of open-ended learning. In open ended learning could be conducted with take of time allocation, individual work, group work, and group presentation [11]. An open-ended learning could use with combine individual work, group work, and presentation. In line with, open-ended learning could be conducted with phase understand a problem, solve the problem for himself, report the solution, and discuss about solution [12].

Using question which are given by the teacher most important in open-ended learning. It is conducted to develop the student’s thinking to understand and solve the problem. The question such as ‘What did you know from the problem? What is asked? What the solution can be use?’ And the other questions are expected could encourage the student to find various solution too. The question that could use in discussion, so that student find the appropriate various solution, such as ‘What the same idea in this solution? Which one the most appropriate solution? Could you use this solution for another problem? [12].

Referring to paragraph above could made a planning about open-ended learning that could use. The phases of open-ended learning are combined between group works, individual work, presentation, discuss, and using question that could solved the problem. As for the phase of learning in figure 1.
Figure 1. Figure the phase of open-ended learning.

Figure 1 showed learning process with open-ended approach. Learning is started with understanding the problem, which is the student identify the problem through read and answer-question with the teacher. In this activity is expected the student could find what have to solving and determine the way what to do. Next phase, student is given chance to solve the problem for himself, and the result could be present in the class. Next the student is given a new problem to solve with their group. The problem that is given could be a development or related problem from the previous. After that, each of group presenting the result from their group activity. The last students and teacher discuss to find the best solution that have to use.

Open-ended learning activity have given many positive result to mathematic learning. This is proven that open-ended learning have improved the result of mathematic learning in elementary school [3], [13]. In other that, open-ended problem more improved than conventional learning in problem solving ability for elementary school student [14]. This is because students get used to solving the problem, however the student could not explain their reason from their solving problem that used. Shimizu said that students have difficulty to suggest their reason, so that the student could not explain the reason from solution a problem that using another way with different procedural [5]. That showed when the way of solution is not put procedural, the student could difficulty to giving the solution is right or false. It could be said that in open-ended learning, student get used to solving problem with procedurally. It needed a strategy that facilitate students to suggest their mind about solving problem in open-ended learning.

Open-ended learning could combine with metacognitive strategy. Reflective thinking in problem solving learning assist the student to solving the problem and understand the context [15]. It is one of solution to train the student to suggest the reason from their problem solving that used. Not only reflective thinking, but also need a way that make the student to find a problem, solving a problem, evaluate a solution, and suggest the reason from decision that taken. One of them with using metacognitive strategy in open-ended learning. With using metacognitive strategy could give consideration for student to use prior knowledge in solving the problem [16].

Metacognitive is think about thinking or know about knowing. Which is in metacognitive students planning and evaluating their thinking so that they know what their known and not yet. Metacognitive could be divided as knowledge, experience, goal, and strategy or control metacognitive. Flavell said that metacognitive divided into knowledge, experience, task, and strategy [17]. Metacognitive knowledge is a knowledge in cognitive person and a high level knowledge if seen from level of thinking by Bloom revised Anderson [18]. Metacognitive experience is a condition that involve using metacognitive knowledge. Task of metacognitive is a task that have to do which is involved their metacognitive knowledge. Such as to answer the question like ‘What must to do? Why must to do? What the information in this task that have to do?’ Metacognitive strategy is using the
appropriate way so that the goal would be get. In here the meaning of metacognitive is metacognitive strategy.

In this article, strategy is a method that used by teacher in learning activity so that the student get the learning goals. Through metacognitive strategy, the student are expected to be able to control and evaluate their minds, so that to solve the problem through an open-ended approach. Metacognitive strategy use in open-ended problem in order to student be able solve the problem and think mathematically, start from planning, monitoring, and evaluating [19], [7].

There are some metacognitive strategy that could use the teacher in learning mathematic. There are 1) planning the strategy, 2) questioning, 3) choosing with consciously, 4) setting and pursuing goals, 5) evaluating the way of thinking, 6) identifying difficulties, 7) doing paraphrase, elaboration, and reflective idea, 8) clarifying learners terminology, 9) problem solving, 10) thinking aloud, 11) journal keeping, 12) cooperative learning, and 13) modelling [20]. But in this open-ended learning, metacognitive strategies that are used focused to using metacognitive question, journal, and mind map. This third strategy could be assist the student to control and evaluate their way of thinking in open-ended problem solving.

The question is very important in problem solving with using metacognitive strategy. The question as a metacognitive source, where it is use carefully by teachers in using it [17], [21]. The question that could be used such as ‘what do you understand the problem? What do you think the solution of problem? Why your answer like this? Are you sure that your solution can solve the problem? Is that true your answer? How if the answer like this? Which one is the way that easy? What do you need student or teacher to solved the problem?.’ The teacher could give the follow up question to student with questioning the way of their solution. Such as, ‘How to use? Why are you choose it? Is that true? and another question that encourage the student to explain their reason and control their way of thinking to solving the problem.

The journal use in open-ended learning with metacognitive strategy to identify the problem and control problem solving. Journal is one of metacognitive strategy that recommended in mathematic learning [20]. Journal could be included on student worksheet, so that every solving problem activity could be recorded.

Mind map could use at the beginning and the end of learning to plan and evaluate thinking process of student. With using mind map, student be able evaluate what their known and not yet. Metacognitive strategy that could use with expressing their mind, writing, planning, and make self-regulation [22]. In line with the use of mind map in open-ended learning.

Based on description above, metacognitive strategy could be used to train the student solving the problem. Using metacognitive strategy with metacognitive question, journal, and mind map. In line with the research that have done, it is in problem solving could use question, journal, mind map, and discuss [15]. As for the phase of open-ended learning with metacognitive strategy in figure 2.

![Figure 2. Figure using metacognitive strategy in open-ended learning.](image-url)
Figure 2 showed metacognitive strategy that combine with open-ended learning, so that expected the student could be solving the open-ended problem. The phase of learning is the same of phase open-ended learning as defined above. In every learning phase using metacognitive strategies. The first phase is understand the problem, which is the student identify the problem with metacognitive strategy and mind map. The second phase is solving the problem for himself, which is the student solving the problem individually with using metacognitive question and journal. In this phase, the student evaluate their solution of first problem with explain their answer in the class. The third phase, students are given the second problem that development of the first problem. In this phase, the student solve the problem in group work with included metacognitive question and journal. Next phase, the student presenting the result of group work in the class. The last, the students and teacher doing the discussion to determine the best solution of the problem and evaluate their problem solving with metacognitive question and mind map.

Using metacognitive strategy could observe the student do the problem solving. In order that assist the student to making the best decision in problem solving. Through using metacognitive strategy student could conscious in determine solution decision that their taken [17]. Hence, metacognitive strategy could use in mathematic learning in elementary school that one of with open-ended approach.

4. Conclusion
The mathematic learning with open-ended approach could be use in primary school. It is support the student to develop their mathematical thinking. In open-ended learning, student have focussed to solving problem structurally. Through use metacognitive strategy the student could be conscious with their mathematical problem solving. Besides that, the student get used to giving their reason about problem solving that their used. Metacognitive strategy that use in open-ended learning include metacognitive question, journal, and mind map.

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