Critical thinking level in geometry based on self-regulated learning

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Abstract. Critical thinking ability of mathematics students affected by the student’s ability in solving a specific problem. This research aims to determine the level of critical thinking (LCT) students in solving problems of geometry regarding self-regulated learning (SRL) students. This is a qualitative descriptive study with the purpose to analyze the level of Junior High School student’s critical thinking in the Regency of Banyumas. The subject is taken one student from each category SRL (high, medium and low). Data collection is given problem-solving tests to find out the level of critical thinking student, questionnaire, interview and documentation. The result of the research shows that student with SRL high is at the level of critical thinking 2, then a student with SRL medium is at the level of critical thinking 1 and student with SRL low is at the level of critical thinking 0. So students with SRL high, medium or low can solve math problems based on the critical thinking level of each student.

1. Introduction

Mathematics is an important subject that is given to students to equip the ability of logical thinking, analytical, systematic, critical, creative and the ability to work together. The development of a world that is constantly changing, who can understand and master the math then it will have wider opportunities to determine his future [1]. One of the main goals of the learning of mathematics is students can solve problems in daily life. Solving the problem is not only a goal in learning math but at the same time as the main tool in the learning process [1].

Through problem-solving, students can develop their ability to think. One of the material in mathematics that must be learned in school is geometry. Geometry contributes to develop student’s spatial, awarness, visualizations, good reasoning, analysis the problem and solve natural problems in daily life [2]. Many students find difficulty in geometry because their understanding concept. Geometry is often used to solve daily life problems that require critical thinking skill. According to Heong's that weakness in understanding concepts, logical thinking and lack of knowledge strategy that causes errors in problem-solving. Also students also can not understand a problem and don't know how to plot and carry out the strategy of problem-solving [3].

Implementation of problem-solving is necessary as one to think critically or creatively, and it is a systematic process [4]. In the current global era, students need the ability of think that can help them make a strong decision to gain knowledge quickly. One of the dominant ability needed in the 21st century this is the critical thinking ability. Critical thinking means reflective thinking that focuses on deciding the believed the act or something done. Other ideas also suggested that critical thinking is an
ability in examining assumptions, discerning a hidden values, assessing, evaluating evidence and conclusions [5]. This resulted in that critical thinking is a skill in need to cultivate students thinking ability [6].

From the explanation above seen that at a time when the process of solving the problem required an appropriate capability that is one of the critical thinking ability. To know the difference in critical thinking skills can be seen from the process of solving the problem [7]. When students understand the problem, then they will make a plan to solve their problems. Great ideas needed to find a solution that is effective and accurate. The ideas gained if students want to understand the critical thinking on every issue. Critical thinking is used as a means in solving problems, making decisions, to seek answers, to enrich the meaning and desire to know us something. Critical thinking skills can help a person in proper decision-making, systematic, logical and consider from a variety of viewpoints. In developing problem-solving students need for critical thinking ability in analyzing information [8].

Criteria to measure critical thinking can be seen from the five indicators according to Ennis was formulating the subject matter, revealing the facts, choosing a logical argument, detect errors from various points of view and drawing conclusions [9]. Based on indicators of critical thinking from Ennis, in this study using three levels to categorize critical thinking ability [9]. The Level 0 answers given when students do not meet the critical thinking indicators according to Ennis. Level 1 is granted when the student's answers correspond to the two critical thinking indicators according to Ennis. Level 2 answers given when students meet the four indicators while the level 3 answers given when students meet all critical thinking indicators. Critical thinking is the process of searching, analyzing, evaluating, obtaining syntesizing and conceptualizing information as a guide for developing one's thinking with self-awareness and the ability to use this information by adding creativity and taking risks [13]. Solving the problem is critical and is higher-order thinking skills (HOTS), but can be learned [14]. Critical thinking is one of the higher-order thinking skills. Higher-order thinking skills is a combination of critical thinking, creative and knowledge [15].

Critical thinking ability in solving math problems that student also influenced how the independence of the student learning. Factors affecting solve the problem is the mental attitude of the individual, a personal situation against attachment, stress and frustration [10]. Furthermore, the metacognition also affects each in resolving the problem. The attitude of metacognition that affect students one is self-regulated learning (SRL). SRL is one of attitude that can enhance the acquisition of academic value and problem-solve in the process of learning [11]. SRL can be done if the student can control themselves in solving problems and then evaluate and planned at the time of the learning process. SRL efforts made students in the learning process to obtain results that correspond to specific objectives in this regard are complete math problems to obtain success in the field of mathematics.

2. Method

This type of research uses theories grounded, suitable for analyzing data unstructured or semi-structured is qualitative descriptive[12]. The purpose of this research is to analyze the level of critical thinking (LCT) according to Ennis in students in solving math problems on geometry as seen from the category of self-regulated learning students. The research was carried out on even-numbered years on semester lesson 2016/2017 in SMP 2 Kembaran, Indonesia. The subject was taken using a purposive random sampling technique based on the category of self-regulated learning students given at Class VII E that add up to 32 students. The subject selected each one subject of self-regulated learning categories of high, medium, and low. Research on the subject gives the test to find out the level of critical thinking of students and conducted interviews to find out how the students ' critical thinking ability.

3. Results and Discussion

The instrument used to determine the selection of the subject is the use of a detailed questionnaire that was then categorized into SRL of high, medium and low. Results category SRL high, medium and
rendang each selected one student who was then given a test problem-solving material geometry. Tabel 1 shows how to determine the level of critical thinking in students.

| Table 1. The level of critical thinking students in solving problems |
|---------------------------------------------------------------|
| **Category** | **SRL** | **Step in problem-solving** | **Level of Critical Thinking** |
|---------------|---------|-----------------------------|-------------------------------|
| SRL High      | 1.     | understanding the problem   | LCT 2                         |
|               | 2.     | devising a plan             |                               |
|               | 3.     | carrying out the plan       |                               |
| SRL Medium    | 1.     | understanding the problem   | LCT 1                         |
|               | 2.     | devising a plan             |                               |
|               | 3.     | Not perfect carrying out the plan |                     |
| SRL Low       |        | understanding the problem   | LCT 0                         |

The results of Table 1 show that high SRL in solving problems reached the stage three which means said the level of ability of critical thinking. Based on indicators of critical thinking ability according to Ennis, LCT 2 can meet the four indicators were students can formulate the issue, disclose the facts, choosing a logical argument and can detect errors from the point of view. It is seen from the machining process test students and reinforced with the interview process.

Categories of SRL the results showed that the level of critical thinking ability in the LCT 1. LCT 1 can be interpreted that the subject can be up to two indicators of critical thinking ability according to Ennis. As for the SRL in this research are categorized in the LCT 0 which means the subject does not meet the critical thinking indicators.

3.1 Analysis of a subject with a high SRL (S1)

Subject high SRL (S1) according to table 1 shows that can solve the problem by passing through the stages of understanding the problem, problem resolution plan, and do the plan. For more details, look at Figure 1 and Figure 2.

![Figure 1. The answer of S1 for number 1](image1)

![Figure 2. The answer of S1 for number 2](image2)

In Figure 1, it is seen that S1 can write down what is known and the intent of the question based on a given issue. This means the subject can understand the intent of the question is given. S1 first stage performs in solving problems is to understand the problem. Then, in a second phase of the plan in the settlement of problems, S1 is planning completion with determining what formula will be used. In the figure, it looks that the initial steps of knowing the Degree that is looking for a larger room and ceramics, then both the wide divide each other resulting in a large number of ceramic may need. The next step
carries out calculation according to plan, the S1 can link calculations to find the number of ceramics with equating unit area in advance resulting in a large number of ceramic. After a large number of ceramics obtained then, S1 can deduce the amount of money required. The last step is a reflection, S1 did not do so. S1 based on the results of the interview are not doing reflection when you're done working on. So S1 for indicators of problem-solving question number 1 only until the third stage.

In Figure 2 it can be seen the S1 is already capable of reaching the second stage, on the third stage of carrying out a plan so that the calculation mistake S1 results obtained are wrong. This occurs because of the Degree of working on not doing reflection to the results of the work that is marked by concluding the results obtained. Based on the results of the analysis and interviews obtained that Degree capable of achieving the third indicator of the ability of problem-solving, which can solve the problem based on planning done and what is known problem but are not doing stages reflection so the possibilities can make mistakes.

Based on the results of the stages of problem-solving on question number 1 and 2, S1 reaches the critical thinking level 2. It is reinforced by the results of the interview; the S1 can formulate principal problems solved, revealing the facts. Also when in an interview regarding the reason the answers to questions number 1 and 2, S1 provides a logical argument so that it can detect errors from various viewpoints. Level 2 is the critical thinking level constructive thoughts but his thoughts yet profound. By the opinion of the Elder and Paul that begining thinking began to modify some of the poison in his ability but having limited insight[9] The S1 has a less systematic American in his thinking ability. So, in this case, S1 is included in category 2 LCT which means the subject can analyze his thoughts but not in depth.

3.2 Analysis of the subject with moderate SRL (S2)

S2 can apply the first indicator (understand the problem) and the second Indicator (making plans) while the S2 still has problems in the third indicator (implementing the plan) and of the four indicators (reflection). For more details, look at Figure 3 and Figure 4.

In Figure 3, it is apparent that the subject S2 can write down what is known and ask in a matter and the intent of the question based on the given problem. This means the subject can understand the intent of a given problem. Thus, the subject can pass through the first stages of a Master problem-solving that are understanding the problem solved. Next on the second stage of revising a plan, master plan completion by determining what formula would be used as a settlement. Based on the pictures and interviews obtained that S2 is not confident with the plan will be made in resolving the problem. S2 know that to find the money needed must know the number of ceramics in advance. However, in the
third stage of the S2 does not perform perfectly, there is an error in the calculation and imprecision in the workmanship. The number one question S2 only until the second stage.

In Figure 4 looks that the Master has done a first stage with a sketch drawing based on a known problem, this means S2 understand the intent of the question. In the next step, S2 does revise a plan. S2 knowing that to determine the price of the entire paper is seeking a spacious and multiply by price each cm². But S2 does not know looking for the height of the trapezoid. So the S2 only until the second stage has not been perfect. Based on the results of the analysis and interviews obtained that the S2 indicator capable of achieving second and third S2 indicators do so inappropriately, where students can figure out what the intent of the problem and planning will be done but can't pursue stage of carrying out the plan. So it cannot solve the problem of S2.

Based on the stage of problem-solving questions number 1 and 2, the subject S2 reaches the level of the basic idea. Strengthened by results of interview questions answers based on the Master number 1 and 2, S2 knowing trees existing problems on the question and can reveal facts from these problems. However, when being asked to provide an argument, S2 cannot explain it logically. Moreover, it also cannot know any perspective errors. This means S2 only meet two critical thinking indicators because the new S2 understood the concept and problems when resolving problems is still not right. The basic idea include understanding of the given problem[9] So the Master can understand the problem but does not solve the problem so that S2 is included in the LCT 1.

### 3.3 Analysis of the subject with low SRL (S3)

S3 cannot apply all of indicators problem-solving, for more details look at Figure 5 and Figure 6.

**Figure 5.** The answer of S3 for number 1

**Figure 6.** The answer of S3 for number 2

In Figure 5, to see that the subject of the S3 can write down what is known and asked in a matter and the intent of the question based on the given problem. This means the subject can understand the intent of a given problem. Thus, the subject can pass through the first stages of the S3 problem-solving which is understanding the problem solved. Next on the second stage of revising a plan, S3 plan completion by determining what formula would be used as a settlement. S3 know that to find the amount of money that is necessary is to calculate results for a wide room with ceramic tile. But the S3 does not understand the units used in the process of the calculation. Therefore the S3 can not revise a plan, because it is not able to connect between the known problem with what formula will be used. The results obtained for existing S3 is wrong. So for the next stage is carrying out a plan and reflection is not implemented correctly.

In Figure 6, the subject of the S3 doing sketches as a sign he represents what is known problem and asked. But from the sketches retrieved, S3 could not be stated with the correct layout of the letter as a sign of the point angles of a trapezoid. Next on stage of revising a plan, the S3 formula does not know of the wide trapezoid but he learns to solve the problem is to find a breadth-first and then multiplying
with the price of each unit area. Based on the results of the analysis and interviews, it can be concluded that S3 only up to the stage of understanding the problem or can be said to have not mastered the ability to problem-solving.

Based on the statement above, it is clear that students are not able to know the principles of problem, do not know the facts of the issue and could not explain the problem. Also, S3 obtained from the interview could not formulate points of the problem let alone detect errors with varying viewpoints. In this case a S3 of the answer given to question and interview there is no critical thinking indicators that meet, since S3 only as given and do not understand the problem given correctly. The lowest rate of students think that do not understand the problem and just remember thinking[9] So S2 is included in the LCT 0.

4. Conclusion

Based on the data analysis was done by the researcher regarding the level of critical thinking in students in solving math problems on geometry based on self-regulated learning, retrieved that students with students with SRL categories the high are at the level of critical thinking (LCT) 2. Students with SRL are on the level of critical thinking (LCT) 1 and students with low level to categorized SRL critical thinking (LCT) 0.

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