Metacognition skills of the gifted and talented students

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Abstract. This research is motivated by the importance of metacognition skills as one of the skills that supports student to be success in solving mathematical problems. The purpose of this study describes the metacognition skills of the gifted and talented students in solving mathematical problems of Pythagorean. This research is a descriptive research with qualitative approach. The method of collecting data was using both written tests and interview. The research subjects consisted of three the gifted and talented students from 8th grade at Junior High School in Jambi based on PMA (Prior Mathematical Ability) with the high, medium, and low capability. The results showed that the gifted and talented students have been able to meet some indicators of metacognition skills. A gifted and talented student with low mathematical ability is able to meet planning indicators, but unable to meet monitoring and evaluation indicators on all problems. Gifted and talented students with medium and high mathematical ability are able to meet planning indicators, but unable to meet monitoring and evaluation indicators on some problem. But, a gifted and talented student with high mathematical ability is able to monitor and realize the mistakes quickly.

1. Introduction
Problem solving is a key change factor in mathematics education [1]. It is accordance with the opinion of Pehkonen in the Siswono book’s which categorizes four reasons for teaching problem solving in mathematics, namely 1) problem solving develops cognitive skills; 2) problem solving encourages creativity; 3) problem solving is a part of the mathematical application process; and 4) problem solving motivates students to learn mathematics [2]. Similarly, Duque and Tan stated that an important aspect of mathematics was problem solving [2]. Walle also mentioned that problem solving in mathematics allows students to understand mathematics meaningfully [3]. Based on this, problem solving is an important component in mathematics learning and produces individuals who are able to solve problems that is an important goal of mathematics learning.

Problem solving according to Siswono is a process or an effort of an individual to respond or to overcome obstacles when an answer or a method of answer is not yet clear [2]. Whereas according to Solso, problem solving is a thought that directed to find a solution of a specific problem [4]. Polya explained that problem solving is an effort to find a way out that is not easy to achieve [5]. Krulik and Rudnick also mention that problem solving is a process [6]. Furthermore, Krulik and Rudnick mentioned that problem solving is the way an individual to use the prior knowledge, skills and comprehensions to meet the demands of unusual circumstances. From the statement above, problem solving has the meaning of the process of finding a solution about something that is not clearly known so to solve it, students have to use the prior knowledge, skills and comprehensions.
The success of the mathematical problem solving process is influenced by the process of metacognition. Metacognition is simply interpreted by Flavell as thinking about thinking [7]. Thinking activities intended to emphasize the role of the implementation process in monitoring and regulating cognitive processes. Metacognition is not about what I needed to learn but it is about how I can learn [8]. So, the process of metacognition trains one's thinking awareness which is related to cognitive abilities about what I knows and what I does not know. Then, based on the findings of Ozsoy et al. which states that metacognition skills help students succeed in solving mathematical problems [9]. Similarly Schoenfeld states that in the steps of solving problems there is an awareness which called as a metacognition awareness [10]. More clearly that before, during, and after solving problems, metacognition acts on cognition and regulates the achievement of cognition in problem solving. According to Tok and Stan, when students have metacognition abilities then the students have a strong and thorough understanding of the problem and its solution by using logical, controlled and thorough arguments so as to provide confidence in learning and solving problems, improving learning and memory processes, and bring about better management of learning and learning outcomes [11]. In other words, the results of problem solving will be more effective if they involve metacognition.

In addition to being one of the factors in the success of problem solving, metacognition is also related to problem solving skills, being an important factor in learning, and other high-level abilities. This was found by Tan who stated that metacognition is a tool that can predict academic success and problem solving abilities [12]. Likewise according to Shabibi which states that the students with high abilities will possess high metacognition [13]. Then, the finding of Othani states that metacognition is important in educational practice [14]. Therefore, metacognition is an important part to help someone to find an effective solution to problem solving, influence learning, improve thinking patterns and improve learning outcomes especially in mathematics learning.

Based on the results of observations in one of the schools in Jambi, the researcher has found a group of students who called the gifted and talented students. Gifted and talented children are different in many aspects (cognitive, affective, and social) in comparison with normal developing children [15]. The experimental studies carried out reveal that gifted and talented students have higher performance levels in comparison with normal developing students in terms of both academic success and self-perception [16]. This shows that gifted and talented students are students who have good cognition. Based on the description above, the researchers would like to know how metacognition skills of the gifted and talented students in solving Pythagorean material problems?

2. Methods
This research is a type of descriptive research with a qualitative approach. The subject of this study are 3 gifted and talented students of class VIII-CIBI SMPN 1 Jambi, each consist of 1 student with high, medium, and low initial mathematical ability based on midterm test score. The characteristics of the gifted and talented students in SMPN 1 Jambi are having higher academic abilities than other students in general. Data was collected using written tests and interviews. Written tests consist of two problems solving in the topic of Pythagorean. After the subject completed the test, the researcher conducted an interview with the subject to obtain more information about metacognition skills. The data were obtained then analyzed to find out the metacognition skills of the subjects. The data analysis technique used in this study is descriptive analysis, namely data reduction, data presentation, and verification. The metacognition skills of gifted and talented students were analyzed based on the settlement of the problems of Krulik and Rudnick, namely by read, explore, select a strategy, solve the problem, and look back [6].

3. Result and Discussion
When subjects solve a problem, they indirectly use aspects of metacognition. it is in accordance with the opinion of by Desmita that metacognitive activity occur when understanding and compiling a problem solving plan is typically also seen as an effort to realize and regulate or organize cognition
that includes planning about completing a task, selecting cognitive strategies to be used, and etc [17]. Therefore, to find out the metacognition skills of gifted and talented students used problem solving tests.

The number of problem solving tests given is 2 problems. The problem was validated by lecturers who were experts in the field of education and mathematics teachers at SMPN Jambi. The metacognition skills of gifted and talented students were analyzed based on the stages of problem solving Krulik and Rudnick. To protect their privacy, the subjects in this study use code. Gifted and talented students with low PMA will be coded $S_1$, gifted and talented students with PMA medium will be coded $S_2$, and gifted and talented students with high PMA will be coded $S_3$.

Based on the results of tests and interviews, it was found that the gifted and talented students were able to meet several indicators of metacognition skills. The metacognition skills of three subjects are almost the same. $S_3$ has a better problem solving process than $S_1$ and $S_2$. Whereas $S_2$ experienced a better problem solving process than $S_1$. The following is the result of the analysis of the gifted and talented students' metacognition skills based on the stages of solving the problems of Krulik and Rudnick.

### 3.1. Planning Indicators

Before solving the problem, the subject must understand the problem first in order to be able to plan a problem solving. The planning indicator is one of the metacognition activities that can be seen when the subject read, explore and select a strategy. Basically all subjects are able to understand each problem. Although at the first, subject had difficulty understanding each problem. When experiencing these difficulties, some subjects tend to control the thinking process by rereading each word and image of the problem slowly and carefully.

When viewed from planning indicators, all subjects are able to read each problem well. $S_1$ and $S_2$ initially had difficulty identifying things that would be used to solve problems. But they can be overcome it by reading and observing problems repeatedly. So that $S_1$ and $S_2$ are able to identify and explain things that are known and asked of problems. Whereas $S_1$ experienced a reading error on some problems so that there were errors when identifying things related to the problem used to solve the problem. That is because $S_1$ only reads the problem once. It was concluded that the gifted and talented students with high, medium, and low PMA at the read stage meet the indicators of metacognition planning skills on some problems.

In addition to the read stage, planning indicator is also found at the explore stage. All subjects are not making time predictions on each problem, but in some problems $S_1$ and $S_2$ are able to predict knowledge that can be used to solve problems. Meanwhile, on some problems $S_3$ tends to justify its own understanding without thinking about whether it is appropriate or not, so that errors occur in predicting the knowledge used to solve the problem. Therefore, the gifted and talented students with high, medium, and low PMA at the explore stage meet the indicators of metacognition planning skills on some problems.

In addition to the read and explore stages, this planning indicator is also found in the select a strategy stage. This stage focuses on the understanding and ability of the subject to involve the knowledge that is possessed with information on the problems to develop plans and choose how to solve problems. The gifted and talented students with high, medium, and low PMA at the select a strategy stage meet the indicators of metacognition planning skills on some problems.

At the select a strategy stage, $S_1$ is able to involve the information contained in each problem and able to utilize the knowledge to choose the right way to solve the problem. In some problems, $S_2$ and $S_3$ only use some of the information contained in the problem and not use the prior knowledge appropriately in choosing the right problem solving way. $S_2$ has difficulty to recall previous knowledge. While $S_1$ ignores other important information in choosing the right problem solving method. In other words, on some problems, all subjects are not controlling their thoughts about the important of prior knowledge and information from the problem that will be used to select the right solution.
3.2. Monitoring Indicators

Then, the monitoring indicator can be seen when the subject solve the problem. At this stage, the subject is required to be able to control the thinking process in solving problems to be in line with planning and in accordance with the purpose of the problem. If the planning made right and if the monitoring carried out properly, it can produce the right results. However, if the initial planning does not correct and if the monitoring carried out properly, it can produce two possibilities, namely obtaining the wrong results or finding discrepancies between the problem solving process and the purpose of the problem.

The results of the student monitoring process depend on the abilities of each student. S1 is able to explain the problem solving plan in stages and precisely by involving prior knowledge. However, S1 does not provide a solution to some problems. Based on the results of the interview, S1 explained that he had been thinking too long to understand the problem and thinking about the relationship between known and asked of the problem. In other words, S1 does cognitive activities only. So, S1 does not monitoring the solution of problems because the problem solving plan is not written down. S1 tries to monitor the progress of his work. But the results of monitoring that has not been correct. S1 involves incorrect knowledge in solving problems 1.a. S1 is not aware of these errors. So that, S1 also does not monitoring the results of his thoughts even though the solution of the problem is written.

Then, S2 also not write answers on some issues. S2 was doubtful about the truth of his thoughts. Based on the results of the interview, S2 was also explaining that the problem solving plan was inappropriate. S2 tried to overcome difficulties by rereading the problems and revisiting the images presented from the problem but S2 cannot be success getting the solution. So, S2 is also unable to carry out the monitoring process because the problem solving plan is not written down. In other words, on all issues, S2 has not met the indicators of monitoring metacognition skills at solve the problem stage. S2 monitors its work with prior knowledge appropriately. S2 realized that there was a mistake in the Pythagorean formula. However S2 was not realizing a mistake from the calculation, so S2 obtained incorrect result. S2 has carried out the monitoring process on some problems. In other words, on some problems, S2 has not met the indicators of monitoring metacognition skills at solve the problem stage.

While S1 worked on the problems according to the plan. However, on some problems, the problem solving plan had made wrong and the monitoring process had not implemented so that the work plan making to solve the problem was not right. S1 not monitors the results of his work, so S1 is not aware of any errors in the thinking process in the previous stage. Therefore, in some problems S1 gets incorrect results. S1 improves and shows the existence of work that is not comporting with the problem. S1 is aware of his mistakes and improves the mistakes after being interviewed by the author. From the explanation, it was found that on some problems, S1 has not met the indicators of monitoring metacognition skills at solve the problem stage.

From the results of the interview obtained another privilege of the gifted and talented students. In the problem solving process, S1 is able to monitor and to realize mistakes quickly through questions from the researcher. In contrast to S1 and S2, they are not able to monitor and to realize their mistakes and are unable to control themselves well even though the researcher has asked deep questions to help S1 and S2 realize their mistakes.

Note that the consciousness obtained by S1 has not arisen from the subject's own self. This proves the findings of Smith about collaborative metacognition. Collaborative metacognition is a metacognitive activity that arises from the discussion process [18]. The discussion process will help someone to reflect on themselves. Metacognition that arisen as a result of discussion activities will form a problem solving solution that is getting better and confident in its truth.

3.3. Evaluation Indicators

After monitoring indicators, the last indicator of metacognition skills is evaluation. This aspect of the assessment is reviewed when the subject conducts the examination again as look back stage of problem solving. At this stage students are required to think about the results of solving the problem, whether it is in accordance with the purpose of the problem or not. But not all subjects are able to
conduct through this stage well. Subjects often just repeat the cognitive process without relating it with the problem.

Based on the results of tests and interviews of all problems, S1 is not able to show that the results obtained are in accordance with the purpose of the question or not. Because S1 was thinking too long to understand the problem and find a way to solve the problem. Therefore, S1 does not provide a solution to some problems and S1 does not revise the steps and calculations that are not appropriate. Then, the solution to the problems expressed by students is inappropriate. S1 also does not to think of other ways to solve all problems. This means, S1 was not meeting the metacognition evaluation skills indicator at the look back stage for all problems.

In some problems, it was found that S2 does not revise the steps and calculations that are not appropriate. Then, S2 does not think about whether the thought process is in accordance with the request or not. Therefore, S2 was unable to realize that the solution of the problem is incorrect. S2 is also not thinking about another way to solve the problem. This means, S2 was not meeting the metacognition evaluation skills indicator at the look back stage for some problems.

In some problems, S3 explained that the conclusions of the problem deem right. S3 was not realizing the mistake of the thinking process for some problems. Therefore, S3 not improve the steps and calculations that are not appropriate.

S3 also explained that S3 was not checking the answer because the numbers obtained were integers. S3 reveals that there is no other way for some problems. S3 does not try to use other methods because according to her way on the process is easy and appropriate. S3 does not think about whether the thinking process is appropriate or not. Therefore, the results or conclusions are not appropriate for some problems. It was concluded that S3 was not meeting the metacognition evaluation skills indicator at the look back stage for some problems.

Based on this explanation, high academic abilities are not guaranteeing students' success in solving problems. This is concordant with contention by Putra and Othani that students who have a high level of intelligence also have the possibility to have achievements and learning outcomes below their potential abilities [14,19].

Then, it was found that evaluating thought processes and results should begin to be taught to gifted and talented students because evaluating provides benefits in problem solving. In accordance with what was revealed by Syah that by evaluating we can know the level of ability and progress of ourselves, students have self-consciousness, namely a straightforward awareness to know their existence and also metacognition, namely correct knowledge of their own limits [20].

4. Conclusion
Based on the results and discussion in a whole, it can be concluded that the metacognition skills of gifted and talented students in solving the mathematical problems in the topic of Pythagoras in class VIII SMPN 1 Jambi for students with high PMA generally have better metacognition skills than students with moderate and low PMA. Some of the gifted and talented students are able to solve problems well and correct on some problems. Gifted and talented students with low, medium and high PMA are able to meet several indicators of the first metacognition skills, namely planning. Gifted and talented students with low PMA are unable to meet several indicators of metacognition skills monitoring and evaluation on all problems. Gifted and talented students with moderate and high PMA meet several indicators of monitoring and evaluation metacognition skills on some problems. This shows that not all of gifted and talented students selected as research subjects use metacognition skills in solving problems in the topic of Pythagoras. But, a gifted and talented student with high mathematical ability has another privilege. A gifted and talented student with high mathematical ability is able to monitor and realize the mistakes quickly.

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