Research Article

Implementing Improved Learning Strategies on Achieving Metacognition Skills of Students in Junior High School

Rina Oktaviana Sihotang*, Siti Fatimah, Kusnandi

Department of Mathematics Education, Faculty of Mathematics and Science Education, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia

ORCID
Rina Oktaviana Sihotang: https://orcid.org/0000-0002-4379-9540

Abstract.

This research aims to examine the achievement of metacognition skills of students who obtain improved learning strategies with scientific learning compared to students who obtained conventional learning (Scientific). This research is a mixed method with concurrent embedded method. It consists of an experimental class that obtained improved learning strategies and a control class that obtained conventional learning (Scientific). The population of this research were students from one of the State Junior High Schools in Jambi with the characteristics of the average achievement of the National Final Examination score of 3.38 and the school accreditation was A. The sample of this research was students from class VIII of two classes. The results showed students who obtain Improve learning strategies have a tendency to perform metacognition skills with indicators of planning, monitoring, and evaluation more than students who obtain conventional learning (Scientific).

Keywords: improved learning strategies, junior high school, metacognition skills.

Corresponding Author: Rina Oktaviana Sihotang; email: viasihotang11@gmail.com

🔓 **OPEN ACCESS**

1. INTRODUCTION

In this 21st ethic, Indonesian education is faced with a number of challenges and opportunities that are certainly different from the previous era [1]. Indonesian education in the 21st century focuses on efforts to produce young people who have competence to think, work competence, competence in life and competence to master tools for work. Based on this explanation, it shows that thinking competence is the first competency that needs to be achieved in the 21st century.

Thinking competence in the 21st century means producing a generation who has problem solving abilities, metacognitive thinking skills, and thinking abilities [1]. This explains that thinking competence in the 21st century is a thinking competency that is

more difficult than thinking competency in previous times. Therefore, the process of cultivating thinking competence is something that must be done correctly and correctly.

Mathematics is one of the sciences that can grow thinking skills because in mathematics. it is in accordance with the notion that mathematics is a universal science that underlies the development of modern technology, has an important role in various scientific disciplines and is a scientific discipline that can advance human thinking, including students [2]. In addition, mathematics in its application uses the concept of everyday life problems that are able to train thinking skills. Therefore, if you are able to solve problems related to mathematics, then a student is declared to have good mathematical abilities.

Problems in mathematics are problems related to memory, facts, concepts, and theorems [2]. Then, mathematical problems are divided into two, namely routine problems and non-routine problems [3]. Routine problems are problems that may be difficult but not confusing [4] and have been worked on before [3]. Meanwhile, non-routine problems are problems whose answers cannot be found immediately [4] and have never been resolved before [3]. So, it is found that a mathematical problem that trains students' abilities is a problem or problem that cannot be solved routinely.

In order to be able to solve mathematical problems, in addition to mathematical problem-solving abilities, another factor that can help a person's success in solving problems is metacognition [5]. The metacognitive skills help students succeed in solving math problems [6]. When students have metacognitive skills, these students have a strong and comprehensive understanding of the problem and its solution by using logical arguments so as to give students confidence in learning and solving problems [7].

Metacognition is simply defined as "thinking about thinking" [8]. Metacognition is an attempt to recognize one's own feelings and thoughts through the process of cognition [2]. Metacognition has two components, namely metacognition knowledge and metacognition skills. Metacognition knowledge is awareness of its own cognitive processes. Meanwhile, metacognition skills show deliberate awareness in planning, controlling cognitive activity, and evaluating. So, it is important to have metacognition skills in order to train a person's thinking awareness which is related to his cognitive ability about what he knows, and what he doesn't know to solve problems.

In addition, in Indonesia stated that primary and secondary school graduates are expected to have a knowledge dimension in terms of factual, conceptual, procedural, and metacognition knowledge [9]. Metacognition is knowledge that complements factual, conceptual and procedural knowledge because metacognition is needed to

achieve expertise. Another reason is that metacognitive knowledge is the knowledge and understanding through the thought process of factual, conceptual and procedural knowledge. So that the knowledge obtained by students can be stored longer in memory and this knowledge can be used to survive and develop better in life.

So many developments have been made regarding metacognition in learning. However, there are still many metacognitive failures experienced by some students, even students at the college level when doing mathematical proofs [10]. In addition, students who have low learning independence bring out the characteristics of metacognition skills at the lowest level is *tacit use* [11]. Then, there were 2 students who had incomplete and irregular patterns and characteristics of the metacognition process [12].

Based on the description above, it indicates that there are still students who are less than optimal in using their metacognition, especially in solving math problems. Each student has different levels of metacognition skills in solving math problems. It also explains that students experience difficulties in problem-based mathematics learning, even though problem solving is very important to be mastered by each student.

In line with the importance of metacognitive skills in mathematics education, in learning teachers are make efforts so that students achieve optimal results in mastering these metacognitive skills. Learning as a cognitive process that is influenced by several factors such as individual circumstances, previous knowledge, attitudes, individual views, content and presentation methods [13]. Then, Learning styles affect a person's level of metacognition awareness [14]. Therefore, one effort that needs to be made must pay attention to the learning process that is applied in the classroom.

One of the learning styles that the researcher thinks will help the achievement of metacognitive skills is The Improve learning strategy. The Improve strategy is a learning strategy based on the theory of cognition and social metacognition [15]. This strategy is a strategy designed for the first time by Mevarech and Kramarsky for heterogeneous classes [16]. The specialty of this Improve learning strategy is that the process of extracting knowledge is carried out by raising metacognition questions. Metacognition questions include comprehension questions, strategy questions, connection questions, and reflection questions [17]. So that the student's mindset is involved more actively and systematically.

In addition, The Improve learning strategy has an Enrichment stage aimed at students with low and high abilities. So that through this Enrichment process students with low ability can be used as a tool in order to be able to master the material being studied and so as not to be left behind with high-ability students. As for students with high abilities,

the Enrichment process is used as a tool to improve thinking skills so as to achieve expertise.

The results of the research that applied the Improving learning were able to improve students' mathematical understanding and logical thinking abilities. Using Improved learning which resulted in information that Improve learning can also improve students' critical thinking skills and the disposition of students who learn by The Improve learning is better than ordinary learning [18].

Based on this explanation, this study will try to compare the Improve learning strategy with conventional learning to determine the achievement of students' metacognitive skills using Improve learning strategies with students using conventional learning. In addition, which stages in the Improve learning strategy which greatly affect the achievement of students' metacognition skills. So that the results of the analysis of this study can be used as a reference for implementing learning strategies in the classroom.

2. RESEARCH METHOD

This research is a mixed method research with concurrent embedded method. The population of this research was students from one of the State Junior High Schools in Jambi with the characteristics of the average achievement of the National Final Examination score of 3.38 and the school accreditation was A. The sample of this research was students from class VIII of two classes, each consist of student with high, medium, and low initial mathematical ability based on midterm test score. 29 students from class VIII A as the experimental class who received Improve learning strategies with Scientific learning. 31 students from Class VIII B as the control class who received Scientific learning. Data was collected using written tests, observation and interviews. Written tests consist of four problems solving in the topic of Probability. The data collection technique is first to categorize the students with high, medium, and low initial mathematical ability based on midterm test score before the learning is given. Second, giving questions of problem-solving tests to students who obtain Improve learning strategies with Scientific learning and students who obtain conventional learning (Scientific). After the students solve the problems, the researcher conducted an interview with the student to obtain more information about metacognition skills. The data were obtained then analyzed to find out the metacognition skills of the students. The data analysis technique used in this study is descriptive analysis, namely data reduction, data presentation, and verification. The metacognition skills of students were analyzed

based on the questions in accordance with the Metacognitive Awareness Inventory [19] and indicators of metacognition skills [11].

3. RESULT AND DISCUSSION

3.1. Early Mathematical Ability

The determination of early mathematical ability is based on the mean and standard deviation obtained from the results of daily tests, midterm exams or final school exams for students. In this study, there were 60 students. Based on scores of the midterm exams for mathematics from the two classes, the average score was 67.98 with a maximum score of 100 and a standard deviation of 11.92. The results of grouping students based on their early mathematical ability are presented in Table 1.

TABLE 1: Number of students in high, medium and low early mathematical ability.

Class	High	Medium	Low	Total
Improve	8	17	4	29
Saintifik	2	21	8	31
Total	10	40	12	62

Although the number of students based on early mathematical ability category was different, based on the results of the teacher's interview in the school where the study was, it was explained that based on the achievements, activities and achievements of students from the two classes had the same tendency.

3.2. The Results of The Analysis of Students' Metacognitive Skills from The Two Classes

The results of research on students' metacognition skills in solving problems in both classes were analyzed from the results of students' work on problem solving questions and the results of interviews after students solved the problems. The data of students' metacognition skills in solving problems were analyzed qualitatively. The data analyzed came from 12 students, namely 6 students from the Improve class (I_1 to I_6) and 6 students from the Scientific class (S_1 to S_6). Subjects were selected by criteria, namely that in each class 2 students from high, medium, and low early matematical ability were taken. The selected subjects were students who had worked on problem solving questions and were then interviewed with the aim of knowing the students' metacognitive skills in solving problem solving problems after going through the Improve learning strategies

and conventional learning (Scientific). Problem solving problems were given as many as 4 questions.

The students' metacognition skills in solving problems from the two classes will be explained based on indicators of metacognition skills, namely indicators are planning, monitoring, and evaluation. In planning indicators, metacognition skills can be analyzed based on the stages of understanding the problem and designing a plan. Monitoring indicator can be seen from the stage where students formulate plans when working on problem solving problems, implement plans and monitor during the problem-solving implementation stage. Evaluation indicator is included at the stage of checking back the results of problem solving. Data analysis in this study describes the students' metacognition skills in solving problems namely understanding problems, designing plans, implementing plans, and looking back [20]. The summary of the results of the analysis of students' metacognitive skills from the two classes is presented in Table 2.

Based on Table 2, it shows descriptively that first, in the planning indicator, the emergence of metacognition skills of students in class Improve was 6.67% higher than the emergence of metacognition skills of students in the Scientific class. Second, on the indicator of monitoring, the emergence of metacognition skills of class students Improve 13.34% higher than the emergence of metacognition skills of students in Scientific class. Third, in the evaluation indicator, the emergence of metacognition skills of students in Improve class was 13.89% higher than the emergence of metacognition skills of students in the Scientific class. Based on student answer sheets and interview results obtained:

1. Students in the Improve class have a tendency to perform planning indicator of metacognition skills more than students in the Scientific class.

2. Students in the Improve class have tendency to do more metacognition skills in monitoring indicators than students in the Scientific class.

3. Students in Improve class have tendency to perform metacognition skills evaluation indicators more than students in Scientific class.

Therefore, it can be concluded that students in Improve class tend to perform more metacognitive skills than students in scientific class. Based on this explanation, students in Improve class have tendency to do metacognition skills on indicators of planning, monitoring, and evaluation which is more than students in Scientific class. This is because students in Improve class at the metacognitive questioning stage are given metacognitive questions to help them understand and solve problems. Which instruction in metacognitive questions is useful for solving problems that require reasoning [21].

Table 2: Results of the analysis of the appearance of students' metacognition skills in working on problem solving problems.

Problem solving stages	Metacognition Skills Indicators	Students' metacognition skills that may be emerging	Percentage of Metacognition Skills Occurrence	
			Improve Class	Scientific Class
Understanding problems	Planning	Identifying problems by understanding and explaining what is known and asked in the problem.	100%	100%
		Predicting knowledge that will be used to solve problems.	100%	100%
		Predicting the time that it will take to plan and solve problems efficiently and precisely.	8,33%	8,33%
Designing Plans		Describing of the plan that used to solve the problem by involving the knowledge that has been acquired.	100%	83,33%
		Choosing the right way and involving information that is known from the problem.	66,67%	50%
Implementing plans	Monitoring	Working and explaining the answers to completion in a sequence.	100%	100%
		Appropriately involves previously acquired knowledge in solving problems.	58,33%	33,33%
		Overseeing the progress of work, whether it is in accordance with what is known and asked in the questions or not.	58,33%	58,33%
		Thinking has other ways of solving problems.	16,67%	0%
		Showing of where and how that it is necessary to make changes to work steps that do not match the problem.	33,33%	8,33%
Looking back	Evaluation	Showing that the results obtained are in accordance with the purpose of the problem.	100%	91,67%
		Revising of steps and calculations if there are discrepancies.	33,33%	8,33%
		Explaining the conclusion of the problem appropriately.	50%	41,67%

Metacognitive question instruction raises students' thinking awareness in a directed and logical manner in understanding and solving problems.

In addition, in Improve learning, there is an Enrichment stage, namely the Enrichment stage for students who have reached the skill criteria and those who have not reached the skill criteria. For students who have not reached the criteria of expertise, corrective

activities are carried out through problem solving problems. The level of difficulty of the questions being done is the same as the questions that have been done before. At the time of solving the questions, the teacher again repeats the understanding of the concept and repeats the steps to solve the problems with metacognition questions. For students who have reached the criteria of expertise in the form of Enrichment activities by doing problem solving exercises. The difficulty level of the questions being worked on is higher than the questions that have been given before. So that both students who have not reached the criteria for expertise and who have reached the criteria for expertise have an understanding of the concept that is longer stored in memory. Such understanding will also help students to achieve better thinking skills.

Then, metacognition skills help students succeed in solving math problems [22]. It can be seen from the data of this study which shows that the average posttest score of students in Improve class is higher than the average posttest score of students in the Scientific class. This also causes the tendency of class students 'metacognition skills in Improve class more than the tendency of student' metacognition skills in Scientific class.

4. CONCLUSION

Based on the results and discussion in a whole, it can be concluded that the metacognition skills of students who obtain Improve learning strategies with Scientific learning in the topic of Probability in class VIII from Junior High School 1 Pelepat Ilir have a tendency to do metacognition skills indicators planning, monitoring, and evaluation more than students who obtain conventional learning (Scientific).

In addition, the achievement of metacognition skills of students who obtained of Improve learning strategies was classified as moderate. In order for the achievement of students' metacognition skills to be more optimal, students must be accustomed to answering questions of connection and reflection. Then, students need to get used to making predictions of time in solving problems so that students have focused thoughts that will help students understand the meaning of each problem and use appropriate and efficient problem-solving methods.

Acknowledgments

References

[1] Sparrow R, Dartanto T, Hartwig R. Indonesia under the new normal: Challenges and the way ahead. Bull Indones Econ Stud. 2020;56(3):269–299.

[2] Byers V, Erlwanger S. Memory in mathematical understanding. Educ Stud Math. 1985;16(3):259–281.

[3] Mayer RE. Cognitive, metacognitive, and motivational aspects of problem solving. Instr Sci. 1998;26(1):49–63.

[4] Gardiner T, Zeitz P. The art and craft of problem solving. Math Gaz. 2021;84(499):18–158.

[5] Holton D, Clarke D. Scaffolding and metacognition. Int J Math Educ Sci Technol. 2006;37(2):127–43.

[6] Özsoy G, Memiş A, Temur T. "Metacognition, study habits and attitudes.," International Electronic Journal of Elementary Education. vol. 2, no. 1 SE-Articles, pp. 154–166, 2017.

[7] Anggo M. Pelibatan metakognisi dalam pemecahan masalah matematika. Pelibatan Metakognisi Dalam Pemecahan Masalah Matematika. 2011;01(April):25–32.

[8] Flavell JH. Metacognition and cognitive monitoring: a new area of cognitive–developmental inquiry. Am Psychol. 1979;34(10):906–11.

[9] Permendikbud, "Standar kompetensi lulusan no. 20 tahun 2016.,". Kemendikbud. 2016;3(2):13–22.

[10] Nizlel H, Subanji N, Toto N, Susiswo, Akbar S, Swasono R. Toto, Susiswo, S. Akbar, and R. Swasono, "University students metacognitive failures in mathematical proving investigated based on the framework of assimilation and accommodation.,". Educ Res Rev. 2016;11(12):1119–28.

[11] Erlin E, Fitriani A. "Profile metacognitive awareness of biology education students in microbiology course." Journal of Physics: Conference Series. vol. 1157, no. 2, p. 2019. https://doi.org/10.1088/1742-6596/1157/2/022066.

[12] Israwati D, Johar R, Ansari BI. The development of students' metacognition in mathematical problem-solving. AIP Conf Proc. 2021;2331(April):2021.

[13] Dunlosky J, Rawson KA, Marsh EJ, Nathan MJ, Willingham DT. Improving students' learning with effective learning techniques. Psychol Sci Public Interest. 2013 Jan;14(1):4–58.

[14] Samsudin D, Hardini TI. The influence of learning styles and metacognitive skills on students' critical thinking in the context of student creativity program. Int J Educ. 2019;11(2):117.

[15] Marantika JE. Metacognitive ability and autonomous learning strategy in improving learning outcomes [EduLearn]. Journal of Education and Learning. 2021;15(1):88–96.

[16] Kramarski B, Mizrachi N. Online interactions in a mathematical classroom. Educ Media Int. 2006;43(1):43–50.

[17] Becker CJ. "The effect of the metacognitive question-answer relationship (qar) strategy on student reading comprehension and articulation of strategy use.," p. 2012.

[18] Saepuloh D, Sabur A, Lestari S, Mukhlishoh SU. Improving students' critical thinking and self-efficacy by learning higher order thinking skills through problem based learning models [Jurnal Pendidikan Indonesia]. JPI. 2021;10(3):495.

[19] Schraw G. "Promoting general metacognitive awareness bt - metacognition in learning and instruction: theory, research and practice." (2001).

[20] Polya G. How to solve it: a new aspect of mathematical method. 2nd ed. 1978.

[21] Rivas SF, Saiz C, Ossa C. "Metacognitive strategies and development of critical thinking in higher education.," Frontiers in Psychology. vol. 13, p. 2022. https://doi.org/10.3389/fpsyg.2022.913219.

[22] Fadillah R. Budiyono, Nurhasanah F. "The Analysis of students' metacognition in solving math problems based on self-efficacy," IOP Conference Series: Earth and Environmental Science. vol. 1808, no. 1, p. 2021.