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Effectiveness Learning Instrument Based On Meta-Cognition Approach For Improving Higher Order Thinking Skill

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Abstract*—HOTS improvement has become one of the priorities in 2013 curiculum cause of this skill important to improvement international competitiveness. So it is necessary study with learning instrument base on meta-cognition approach to improvement HOTS. Purpose of this research was to know effectiveness learning instrument base on meta-cognition approach to improve HOTS. The design of this research was one group pretest and post test comparing HOTS skill improvement before and after using learning instrument base on meta-cognition approach. The result of this research is known there is the improvement of the participants HOTS skill, previously 51.41% in pre test and 77.41% in post test. The result of studied $t_{value} > t_t$ was 8.71 > 2.045 with sig 0.05 so that a learning instrument base on meta-cognition approach effective to improve HOTS.

Keywords— ***meta-cognition, Higher order thinking skill (HOTS), learning instrument***

I. INTRODUCTION

Higher order thinking skills (HOTS) improvement has become one of the priorities in learning mathematics. This is based on several importance studies. This includes examining, linking, and evaluating all aspects of situations and problems, including collecting, organizing, remembering, and analyzing information in mathematics learning. Thompson [1] HOTS more than remembering, understanding and applying. Heong [2], HOTS was the use of the mind to find new challenges. HOTS require a person to apply new information or knowledge that belongs to him and manipulate information to achieve possible answers to new situations. Thus, HOTS is a thinking skill that not only requires the capability of remembering, but also other higher capabilities include the ability to analyze, evaluate, and create [3, 4, 5, 6].

Higher-order thinking in a nutshell can be described as the attainment of a high level of thinking to thinking from the mere repetition of the facts. Higher-order thinking requires that we do things over the facts. We must understanding, connecting to each other, manipulate, categorize, put them together with new ways, and to apply them in the search for new solutions to new problems [7]. Therefore, HOTS is believed to better prepare students to meet the challenges. HOTS placed the student to manipulate information and ideas with car change the meaning and its implications. The transformation occurs when students connect the facts and ideas in order to synthesize, generalize, describe, hypothesize or even to draw conclusions or interference of manipulating ideas. Through this process allows students to solve problem and find meaning and understand it.

Based on the implementation of the 2013 curriculum, the improvement of HOTS becomes one of the skills developed in learning mathematics. However, the increased ability of high-level thinking is not optimally developed in the learning of mathematics. The cause of less optimal achievement of HOTS was still lack of process involving learners' awareness in learning. As result, the ability to achieve low capability in the form of routine algorithms and memorization. The learning process undertaken only forms students who can perform certain mathematical procedures without knowing the underlying reasons. Finally, when encountering unusual problems students tend to give up and assume it is beyond his ability.

Awareness in the learning process is very important. Suherman [8] said that learning was a behavioral change that tends to settle and be made consciously. This means that awareness was an important component that must be involved in the learning process as a whole. Seeing the importance of involving the process of awareness in learning, it is necessary for us to use mathematical learning that involves the process of student awareness. One of alternative learning that involves students' way of thinking consciously is the learning with meta-cognition approach.

Kramarski [9], Learning by meta-cognition approach was a learning that instills awareness of how to design, monitor, and control what they know; what it takes to do; focusing on learning activities; assisting and guiding students when experiencing difficulties; and assist students in developing their self-concept while learning math. The contribution of meta-cognition approaches to HOTS to control and regulate their thinking and using meta-cognition

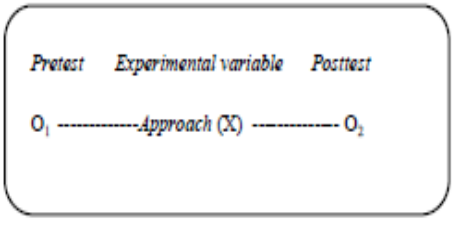
skills that use their meta-cognition knowledge of cognitive processes [10,11]. Meta-cognition skills may be viewed as a procedural component or meta-cognition executive [12]. Meta-cognition skills are essential for managing the thinking process and providing a link between meta-level knowledge of strategy and task and cognitive performance [10,12]. For example, students need to plan which HOT strategy to use, based on task demands, and then monitor and manage the use of that strategy

Therefore, it can be said that more specific meta-cognition makes it easier for a person to think higher than to conceptualize meta-cognition as a broad skill. In addition, more specific models will help when applying higher-order thinking. Individuals start using some meta-level resources that serve as a bridge to achieve critical thinking. When students were able to control their cognitive processes, they tend to be critical of the facts presented to them. So it can be said higher order thinking skill and meta-cognition as the process of organizing knowledge and high-level thinking as a refinement of knowledge, For students to have high-level thinking skills meta-cognition needs to be applied in achieving the success of thinking process.

Based on the above problems, it is designed a mathematical learning instrument based on meta-cognition approach that can improve HOTS. This learning has been validated by 5 experts. This study aims to see the effectiveness mathematical learning instrument based on meta-cognition approach that can improve HOTS. The question in this study is how efectiveness learning instrument base on meta-cognition approach ?

2. Method

This study was an experimental Pretest-Posttest, Non-Equivalent Control Group Design research aimed at comparing the influence of meta-cognition approach to improvement HOTS. Subject in this research was students in Junior High School Grade VIII. In this study comparing the results of learning before using learning instrument base on meta-cognition approach with learning outcomes after using the meta-cognition approach described as follows:



information:
O1 : result before using learning instrument
O2 : result after using learning instrument
X: using learning instrument

The data of the research were collected using HOTS-test. The test is done twice are before studied using learning instrument base on meta-cognition approach and after using learning instrument base on meta-cognition approach. The both of test were validated by three mathematic experts, and then it was tried out to a group of eighth grade students to meet the validity and reliability criteria. Data type were kuantitatif data with the data were analyzed t-test and kualtatif data to discripe how meta-cognition approach can improvement HOTS.

3. Results and Discussion

The term of effectiveness in the Big Indonesian Dictionary means something is effective which means the effect, influence, impression[13]. So, the effectiveness means the impact, influence, and results arising from an action in this case towards the use of learning instrument. The effectiveness of this research was conducted to see how far the usefulness, impact and benefits of the device metacognition based learning on HOTS students. Learning devices can be said to be effective if the device has an effect on the HOT ability of students and provides improvement learning outcomes

Learning instrument the form of RPP and LKPD are based on metacognition approach. The learning steps implemented in the RPP and LKPD are learning steps that train HOTS students with a metacognition approach. In LKPD students are asked metacognition questions that can train HOTS to students. In LKPD, students are trained to understand the problem and then plan solutions so that students are trained in problem solving. In this activity students are given a stimulus with metacognition questions at the planning stage. The question asked can be in the form of "*What information do you get the table above?", "What strategy do you use to solve the above problem?"*. The submission of this question provides a stimulus to students to understand the problems raised to them and stimulate students to prepare their completion plans. This can be seen when this question is asked by the students to re-read the problem to understand and draw up a solution to the solution with the concepts they have understood. This means that students have the ability to plan and solve problems. One of the HOTS indicators according to Woolfook is problem solving. Thus means that students have fulfilled one of the HOTS indicators, namely problem solving [4].

Students are also trained to monitor their activities with the monitoring phase metacognition questions. In this activity students are given a stimulus with metacognition questions at the monitoring stage. The question asked can be *"Are you sure what you are doing right?", "After answering the questions above, what information do you need to remember?"*. The submission of this question provides a stimulus to students to correct what they are doing and monitor students' understanding. This can be seen when this question is asked by students to correct what they are doing and re-read the material to correct their understanding. This means that students have the ability to correct (check). One of HOTS indicators according to Karthwohl is checking and critiquing, namely the ability of students to track the inconsistency of a process and the inconsistency between results and criteria which this ability can also be said to be the ability to think critically on the HOTS indicator according to Woolfook. Thus means students have fulfilled one of the HOTS indicators, namely critical thinking [4].

In LKPD students are also given a stimulus with evaluation phase metacognition questions to be able to use various ideas and ideas and connect them to each other so as to produce creative ideas. The question asked can be "*Can you apply the way to think about solving this problem for other problems?", "What part of this material do you not understand?", "Can you solve it differently?".* The submission of this question provides a stimulus to students to evaluate students' overall understanding of the material being studied. This can be seen when asked this question where students write on the LKPD which part of the LKPD they do not understand and then ask the teacher, and try to find different ways to solve the problems they are working on. This means that students have the ability to evaluate and think creatively. There are two HOTS indicators according to Karthwohl which can be achieved in this case namely evaluation and create. Thus means students have fulfilled two HOTS indicators, namely evaluation and create [4].

In LKPD it is not only learning activities with metacognition approach in order to train HOTS students who are submitted repeatedly but the LKPD also presents questions at the HOTS level. Completion of training questions students are guided by metacognition questions. Limbach [14] there are five learning steps that can be taken in the development of HOTS, namely: (1) determining learning objectives, (2) teaching through questions, (3) practicing, (4) studying, sharpening and improving understanding, and (5) practice feedback and assess learning. Thus it can be said that learning devices based on metacognition approach give effect to HOTS students.

The effectiveness provides improvement learning outcomes after learning by using learning instrument based on meta-cognition approach. The HOTS of students gained in this study comes from the tests given. Where in the study there are two tests that are executed the initial test and the final test.

Based on the analysis pre-test and post-test data in this research obtained directly from the results of HOTS students. From HOTS data, the calculation, so that the highest value (X_{max}), the lowest value (X_{min}), the mean ( ), the standard deviation (s) and variance (s^2) can be seen in Table 1. Hypothesis test results can be seen in Table 1

TABLE 1. MEAN, HIGHEST VALUE, THE LOWEST VALUE THE STANDARD DEVIATION AND VARIANCE

NO	test	$\bar{x}$	X_{max}	X_{min}	s
1	Pre-test	51.4	68.75	25	21.09
2	Post-test	77.4	90.62	65	20.3

Table 1 indicates that the average score of the pre-test was higher than post-test. The highest score obtained learners on the final test. From both tests the post test class variance is lower than the pre-test. This showed that the HOTS of students at the post-test were more than pre-test. This result of research is parallel to the result of research done by Yerizon [15] about effectiveness development of Worksheets Base on Contextual Approach to Increase Student's Mathematical Problem Solving Ability by LKPD is effective to improve student problem solving ability with level of mastery 75,11%.

Based on the t-test using SPSS obtained t-value > t-table that is 8.71 > 2.045, so it can be said that the learning module media quite effectively used in the learning process.

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Based on the tests that students do individually, it is seen that the difference in the average of each indicator thinks high level of students. This can be seen in Table 2.

TABLE 2. HOTS INDICATOR [4]

No	HOTS Indicator	Question number	Pre-test	Post-test
1	**Analize**			
	Differentiating	1 and 2	100%	100%
	Organizing	7 and 1	32%	96%
	Attributing	2 and 4b	69%	91%
2	***Evaluate***			
	Checking	6	59%	96%
	Critiquing	7 and 1	12%	88%
3	**Create**			
	planning	8 and 4a	43%	65%
	Generating	5 and 7	33%	95%
	Producing	3 and 5	22%	59%

In Table 2 It is seen that the score of each HOTS indicator was higher than the pre- test. This was due to the effect of treatment given prior to the post-test. This fact showed that learning tools based on meta-cognition approach can improve students' HOTS capability.

This result of research is parallel to the result of research done by Yerizon [16] about effectiveness developing learning material instruction to operation reaseach course base on problem base learning, it will help students in decreasing and evaluating their thinking ability such as using test.

In this case, the using learning instrument base on meta-cognition approach is one of alternatives for teachers to train and determine student's HOTS level. By doing meta-cognition questions,students can give suitable answers based on their thinking ability, so that teachers know how good the students thinking ability .

4. Conclusion

Based on the result of the research, it can be concluded that the average of learning outcomes after using learning tools based on meta-cognition approach was better than the average of learning outcomes in pre-test before treatment. Increased ability to think high-level students also increased in each indicator of high-level thinking ability. Based on t-test using SPSS results obtained t value > t-table i.e. 8.71> 2.045, so it can be said to be quite effective learning instrument used in the learning process. In general can be said learning device based on meta-cognition approach is

effective in improving the ability of high-level thinking of learners.

5. References

[1] T. Thompson, "Mathematics Teachers Interpretation of Higher-Order Thinking in Bloom's Taxonomy in International Electronic Journal Of Mathematics Education (IEJME)," Jurnal International Electronic Journal of Mathematics Education, vol. 3 no. 2, 2008.

[2] Heong, Y. M.,Othman, W.D.,Md Yunos, J., Kiong, T.T., Hassan, R., and Mohamad, M.M, 'The Level of Marzano Higher Order Thinking Skills Among Technical Education Students," (Online), Vol. 1, No. 2, p: 121-125, 2011.

[3] Ganaphaty, Malini, "Promoting Higher Order Thinking Skills via Teaching Practices," vol. 23(1): 75 – 85, http://doi.org/10.17576/3L-2017-2301-06, 2017.

[4] Krathwohl, David.R, "A Revision of Bloom's Taxonomy: An Overview," (Online), vol. 41, No. 4, 2002.

[5] Limbach , Barbara, "Developing higher level thinking", Journal of Instructional Pedagogies, 2004.

[6] King, FJ., Ludwika Godson and Faranak Rohani, Higher Order Thinking Skills. Center for Advancement of Learning and Assessment, 2011.

[7] Tran Vui, Effective Mathematics Teaching Strategies Inspiring Progressive Students: Student-Centered Approach. Penang, Malaysia: Recsam, 2001.

[8] Suherman, Erman Dkk, Strategi Pembelajaran Matematika Kontemporer. Bandung: UPI, 2003.

[9] Kramarski, B dan Zoldan, S, Using errors as spingboard for enhancing Mathematical Reasoning With Three Metacognitive Approaches. Proquest Journal, 2008.

[10] Moshman & Schraw, "Metacognitive Theories. Educational Psychology," Review, vol 7, No 4, 1995.

[11] Schoenfeld, A. H. Learning to think mathematically: Problem solving, metacognition, and sense-making in mathematics. In D. Grouws (Ed.), Handbook for Research on Mathematics Teaching and Learning. New York: MacMillan, 1992, pp. 334-370.

[12] Veenman, Marcel V. J., Bernadette H. A. M.,Van Hout-Wolters and Peter Afflerbach, Metacognition and learning: conceptual and methodological considerations, 2006.

[13] Salim, Peter, Kamus Bahasa Indonesia Kontemporer. Jakarta: Modern English Press, 1991.

[14] Limbach , Barbara, "Developing higher level thinking", Journal of Instructional Pedagogies, 2004.

[15] Yerizon. 2018. "*Developing Learning Material of Instruction to Operation Research Base On Problem Base Learning" (*online). IOP Puplishing (diakses Juli 2018)

[16] Yerizon, "Developing of Worksheets Base on Contextual to Increase Student's Mathematical Problem Solvng Ability", International Journal of Progressive Sciences and Technologis Vol.9 No 2, 2018.