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HIGH ORDER THINGKING SKILLS AND SELF REGULATED LEARNING OF JUNIOR HIGH SCHOOL STUDENT IN BANDAR LAMPUNG CITY

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Abstract

The development of mathematics high order thinking skills (MHOTs) is currently the main goal of learning mathematics. With these changes, the vision of school mathematics more emphasis on achieving "mathematical proficiency" that requires an integrated achievement of conceptual understanding, procedures fluency, strategic competence, adapted reasoning, and productive disposition. It encourages teachers to act more as a model, facilitator, trainer than as a conduit of information and students act as an independent learner and has thinking skills. This study describes MHOTs and self-regulated learning (SRL) of junior high school students in Bandar Lampung city before following study using interactive media based on open-ended problem. Based on the analysis of data, it is concluded that MHOTs and SRL of students on high-rank school, middle-rank school, low-rank school, and all of students before using interactive media based on open-ended problems are has not met expectations. Therefore, it is necessary to develop a learning that can improve the MHOTs and self-regulated learning of students.

Key words: MHOTs, SRL

INTRODUCTION

Changes in mathematics education stating that the student must learn to recognize the elements of mathematics in context, applying the appropriate mathematical tools, and engaging in mathematical reasoning. However, develop and implement learning activities appropriate load, thus enabling students to develop higher order thinking skills, not an easy thing which is easily done by most teachers of mathematics. Based on research conducted by Suryadi (2001) note that there are several ways to do this include in mathematics learning needs of students are exposed to a variety of problems that require an effort to try a variety of alternative solutions, and the problems given to students must be adapted to their development. In addition, research Noer (2007, 2008, 2009, 2010, 2011) suggests that problem-based learning and open-ended learning can be used to increase the range of mathematical skills, particularly in improving MHOTs.

Mathematics High Order Thinking skills (MHOTs) is one of the objectives and needs special attention in the study of mathematics in junior high school. This is related to the needs of students to solve problems encountered in everyday life. Webb and Coxford (1993) said that the High Order Thinking (HOT) includes the understanding of mathematical ideas in more depth, observe and explore ideas implied, preparing conjecture, analogy and generalization, reason logically, solve problems, communicate mathematically and associate something mathematical ideas with other intellectual activities. Heningsen and Stein (1997) stated that HOT ability is basically a non-procedural thinking skills, include (1) seek and explore patterns and to understand the mathematical structure underlying the relationship, (2) using available materials

provided appropriately and effectively at the time of formulating and solving problems, (3) to make the mathematical ideas significantly, (4) and reasoned thinking flexibly,(5) develop conjectures, (6) generalization, (7) justification, and (8) communicate mathematical ideas.

Once the importance of this capability, but MHOTs of junior high school students are generally still low. This is reflected in the low percentage of correct answers of students in the study of the international Trends in International M*athematics and Science Study* (TIMSS) dan *Program for International Students Assessment* (PISA). In the TIMSS study, the student is weak in solving non- routine problems related to the justification or evidence, solving problems that require mathematical reasoning, find generalizations or conjectures, and find relationships between data or facts provided. In the PISA study, the weak of students are use mathematics to solve problems in everyday life.

Development of thinking skills, needs serious attention, because a number of studies, for example, Henningsen and Stein, 1997; Peterson, 1988; Mullis, et al, 2000 (Suryadi, 2005: 2) suggests that the learning of mathematics in general is focused on developing the low thinking ability that procedural nature. In addition, the analysis of the learning of mathematics in several Secondary Schools in Bandar Lampung in 2011 showed that learning mathematics is still ongoing and more traditionally that train Low order thinking abilities (LOT). This method resulted in MHOTs and Self-Regulated Learning (SRL) of junior high school students is generally low.

Low of students SRL give an overview of learning has not been able to optimally make students independent in learning. Rochester Institute of Technology (Hargis, 2000), identified several characteristics of the SRL, namely: selecting learning objectives, see hardships as challenges, selecting and using sources available, in cooperation with other individuals, construct meaning, to understand the achievement of success is not enough just to effort and ability alone, but must be accompanied by self control. Paris and Winograd (the National Science Foundation, 2000), suggests that the characteristics contained in the SRL are: awareness would think, the use of strategies, and ongoing motivation. SRL is not just thinking about thinking, but also help individuals to use the draft process of thinkong, selecting learning strategies, and interpret its appearance so that individuals can solve the problem effectively.

Addressing the problems that arise in mathematics in junior high school and hopes to be achieved, it would require innovative efforts to do is make innovations in learning by applying the Problem Based Learning (PBL) and development of the interactive learning media based on open-ended problem. PBL begins with the presentation of contextual issues. Issues rose so students need to interpret the problem, gather the necessary information, evaluate alternative solutions, and present a solution. When students develop a method to solve the problem, students integrate knowledge and skills of its concepts. Therefore the use of interactive learning media based on open-ended problem can be used to improve student MHOTs and SRL.

The use of PBL in learning mathematics based on several previous studies on the PBL which shows satisfactory that an increased of thinking ability of student in PBL. Research conducted by Noer (2009a, 2009b) on development of learning model and instrument of PBL concluded that : (1) level quality of mathematical thinking skills of students are obeying the contextual problem-based learning is better than students who learned in the conventional; (2) there is no interaction between the learning model and school rankings in development of mathematical thinking skills. Further research conducted by Noer (2010a, 2010b) on the evaluation of mathematical critical, creative and reflective (C2R) thinking ability of junior high school students concluded that students' mathematical critical, creative and reflective (C2R) thinking ability generally still low. Noer Research (2010c) concluded that: 1) quality improvement of mathematical C2R thinking skills in the PBL are better than students in conventional learning, 2) there is no interaction between learning and the factors (school rank, gender differences, prior knowledge of mathematics) in development of mathematical C2R

thinking skills.

This study is a preliminary study to assess the extent MHOTs and SRL of junior high school students in Bandar Lampung before participating in learning using interactive learning media based on open-ended problem. These results are expected to provide an overview of these capabilities, especially the ability of mathematical reasoning, critical thinking skills and mathematical representation of student. In addition, this study also used to determine whether the instrument can be used to retrieve data for further research.

The study population was Junior High School students in Bandar Lampung, which is divided into three categories, namely high-rank school, middle-rank school, and low-rank school. Schools rankings selected in this study are based on the total value of national examinations (UN) last 3 years ie 2010, 2011 and 2012. Sampling study conducted stratified random sampling, ie by selecting a random sample of schools for each qualifying school, so that the samples came from 3 schools. Based on random selection are obtained SMPN 24 Bandar Lampung as a representative of low-rank school, SMPN 12 Bandar Lampung as a representative of middle-rank school, and SMPN25 Bandar Lampung as a representative of high-rank school.

Instruments to measure MHOTs students in each school rankings matter shaped in the form of a number of essays which includes all indicators MHOT ability to be measured. For low- rank school, test instruments of MHOTs is mathematical critical thinking skills test consisting of 4 essays for the Circle material. For middle-rank school, MHOTs test instruments such as mathematical reasoning ability test consisting of 4 essay for tangent of the circle material. For high-rank school, test instruments of MHOTs is mathematical representation ability test consisting of 3 essay for space material.

Instruments to measure SRL students used in this study refers to the SRL instruments that have been developed by Noer (2010c). SRL scale in this study was given to the students to determine the independence of students in learning mathematics. This scale is made based on the shape of a Likert's scale with four options, with no neutral option. Instrumen of SRL consists of positive and negative statements. This meant that students did not answer because the origin of the monotonous statement that makes the students tends to be lazy to think. In addition, the provision of positive and negative statements requires students to read these statements carefully.

The processes of preparation of the tests performed are (1) construct the lattice problem which includes sub-topic, the ability to measure, indicators, as well as the number of grains of matter. Followed by preparing questions and answer keys and scoring rules for each of the items were. Once a matter is composed, it is requested consideration to the expertise to validate the content and advance the test.

After the tests were revised based on the results of consideration of the expertise, the test then tested. Test trials conducted in SMPN 24, SMPN 12 and SMPN 25 Bandar Lampung with as many as 84 people. To check the quality of these pilot tests, in addition to the consideration based on the results of the weighing of the content validity and face validity, also made about the validity of the analysis, reliability testing, discrimination power, and level of difficulty. Data results of these trials also used to reveal the students MHOTs to further mathematics learning

DISCUSSION

Data obtained through testing of MHOT and charging capabilities of SLR scale by 84 students. The students consisted of 32 student from high-rank school, 30 student from middle-rank school and 22 student from low-rank school. Distribution of the sample are presented in Table 1.

Table 1 Distribution of the Sample Study

Scholl Rangkings	Number of students		
	Man	Woman	Total
High	13	17	30
Middle	10	12	22
Low	16	16	32
Total	39	35	84

Consideration of the content and face validity of the third expert judgment to test of mathematics high-order thinking skills were analyzed using the Q-Cochran test statistic. This analysis was conducted to determine the uniformity expert judgment in giving consideration to the test. Based on the analysis of face validity is obtained that Asymp. Sig = 0.306 and content validity analysis shows that the Asymp. Sig = 0.255. This means that the third consideration expert judgment against each item on the test is uniform. In this study, the validity of the items was also tested to determine the items to support a total score. To measure the correlation coefficient between the item score and total score is used Pearson product moment formula rxy. To test the significance of each correlation coefficient was used t-test with the following criteria: if thit> ttable at significance level of $\alpha = 0.05$ and df = n - 2, then H0 is rejected (valid). Otherwise H0 is accepted (not valid). In this study, the reliability of the test was also measured to determine the level of reliability of the test. Interpretation of test reliability coefficient (R11) using the benchmark as follows: (1) If R11 is equal to or greater than 0.70 means that the test has high reliability, and (2) If the R11 is smaller than 0.70 means that the test does not have high reliability. Calculations about the validity, reliability, discrimination power, and level of difficulty of the test are summarized in Table 2.

Table 2. Recapitulation of Mathematics high-order Thinking Ability Test

School rank	**Item**	**Validity**	**Reliability**	**Discrimination Power**	**Level of Difficulty**
High	1	Valid	0,64	Good	easy
	2	Valid		Good	Moderate
	3	Valid		Moderate	Difficult
Middle	1	Valid	0,93	Good	Moderate
	2	Valid		Less	easy
	3	Valid		Good	Moderate
	4	Valid		Good	easy
Low	1	Valid	0,77	Good	Moderate
	2	Valid		Good	Moderate
	3	Valid		Good	Moderate
	4	Valid		Very Good	Moderate

Based on the results presented in Table 2, shows that in general for each rank school, test instrument has met the standard tests that can be used to measure higher-order thinking skills. There are some items that are made about, showed unexpected results in discrimination power and level of difficulty. Based on interviews with students after testing, obtained information that some students have difficulty in understanding the purpose of the question. Therefore, test instrument should be revised in terms of language and image.

Measurement of initial ability of MHOT and SRL to determine the initial ability of MHOT and SRL before the learning process takes place. Tabulation of the results of the initial

tests conducted on scores of initial ability of MHOT and can be obtained the average value and standard deviation. Summary of the results of the calculation of average, standard deviation and initial tests of MHOT and score of SRL are presented in Table 3.

Table 3 Data of MHOTs and SRL by School Rankings

School rank	Mathenatical Skills	Scor			Average	Standar Deviation	percentage of Achievement
		Ideal	Min.	Max.			
High	Mathenatical	100	8,33	66.67	35,56	12,94	36
	SRL	179	107	145	102,32	11,96	57
Middle	Mathenatical Reasoning	100	25	90	64,38	17,95	64
	SRL	179	119	134	105,22	11,53	59
Low	Mathenatics Critical Thinking	100	16,67	94,44	60,83	7,80	61
	SRL	179	115	144	108,32	9,08	60

The data in Table 3 suggests that the lowest score, highest score, and the average of the initial capabilities MHOT ranked by schools is relatively diverse. There is only one thing in common for the school ranked, namely the achievement of the ability MHOT and SRL students are still below 65 percent. The average value of the mathematical representation ability test of 35.56 to a high rank-school, far below from the score of mathematical reasoning ability and also well below from score of the critical thinking ability. This becomes an interesting study material for further research. There could be other factors besides learning model that causes this to happen. For example, the subject matter, students and other characteristics.

CONCLUSION

Based on the research conducted it can be concluded that

1. The experts give a uniform judgment about the validity of the content and face validity of the test and give some suggestions for improvement.
2. MHOT Test has met the criteria of a good test, that is valid, reliable, as well as distinguishing features and a good level of difficulty.
3. Mathematical representation ability, mathematical reasoning, critical thinking skills and SRL students are still not satisfactory with the percentage achievement of less than 65 percent.

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