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Examining Middle School Student's Lower Order Thinking Skill

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ABSTRACT
Focusing in Higher Order Thinking Skill (HOTS) has been main goal in many education curriculums around the world including in Indonesia. Even though the ultimate goal is usually for students to achieve HOTS, it is also important to make sure student already mastered Lower Thinking Skill (LOTS) since it is a prerequisite in the process of using higher-order thinking. Therefore, the goal of the study is to examine student's achievement on LOTS. The paper pencil test with multiple choice format was developed and administrated to 347 students from five different middle schools in Manggarai Timur Regency. The test includes remembering, understanding and applying type of question. The data was analysed using descriptive (mean, maximum and minimum score, and standard deviation) and inferential statistic (Wilcoxon Signed Rank Test). Analysis of the data shows most of student's were categorized as poor level of LOTS. The student achievement on both of LOTS Level (Remembering-Understanding and Applying) also low. Based on the statistics test, it shows that most of students has higher achievement on remember-understanding level than applying level. Meanwhile, it is also found that the main difficulties faced by students related to their lack of understanding on mathematics concepts.

Keywords: *lower, order, thinking, skill, mathematics, middle, school*

1. INTRODUCTION

The development of knowledge, science and technology in the 21st century has created various new kind of needs and challenges in life. In order to deal with the changes, education field especially school must be equipped the students with various competencies to face the problems that might appear. One of the competencies is thinking skill. Cotton [1] defined thinking skill as *"The set of basic and advanced skills and subskills that govern a person's mental processes".* The thinking skill which includes critical thinking is usually employed to process data and information in the humas mind in order to understand and make conclusion on truth and falsehood.

One of the theories that has been widely used in educational field to explain about thinking skills is Bloom Taxonomy. In this taxonomy human cognitive domains classified into six hierarchical levels namely: remembering, understanding, applying, analysis, synthesis, and evaluation. The first three level usually called as Lower Order Thinking Skill (LOTS), meanwhile the last three called as Higher Order Thinking Skill (HOTS). LOTS were used in imparting the basic or factual knowledge, while HOTS requires students to interpret, analyze, or manipulate information [2][3].

Lately, HOTS become the central focus in education curriculum in many countries [4][5]. It has been promoted and integrated in classroom learning include mathematics. HOTS is consider important in the training of logical and critical thinking that are fundamental to everyday life. High level thinking skills students will produce: proficiency in problem-solving, increase confidence in learning mathematics, and increase learning achievements in non-routine problem that demands high level thinking skills. In short, it makes students more prepared for challenges and more creative in solving problems.

However the shifting towards the development of HOTS cause neglection towards LOTS [6]. Hence, experts tend to assume that HOTS is superior to LOTS by implementation and relevence [7][8]. On the other side, many study have shown that LOTS is important in providing a foundational platform for the application of

HOTS [8]. Bloom and other experts [9][10][11][12][7][13] agreed that the taxonomy was designed as a step process: to perform a higher level, one must first master cognitive processes at a lower level. So that, it is believed a person cannot apply value or judgment (evaluation thinking level) without knowing the facts, understanding the facts, being capable of applying the facts, and being able to disassemble and reassemble the facts [14][5]. Furthermore, LOTS is considered to be core and very important as it helps the students develop their line of thoughts, acquire knowledge on different topics and apply the knowledge effectively.

Based on the description above, it can be said that it is also important to evaluate student's LOTS achievement in order to determine the extent of students' LOTS in the learning process. Accordingly, the aim of the study is to examine the level of achievement for low order thinking skill as well as whether there is any difference between levels of student's Lower Order Thinking Skill (LOTS) achievement. Besides that, student's difficulties in complete the LOTS question also will be examined in this study.

2. METHOD

This study is descriptive quantitative which aims to determine student's level achievement of LOTS through solving LOTS type of question on mathematics as well as the student's achievement difference between LOTS level. For the purpose of the study, the total of 347 students of grade 7^{th} and 8^{th} from middle schools in Manggarai Timur Regency were asked to participated. The students were chosen from 5 different middle schools which consist of two high level school, one moderate level school, and two low level school. The data was collected using paper-pencil test. Multiple choices questions were designed which includes remembering, understanding, and applying type of questions. The tests were proven valid and reliable. The content validation has done based on the judgment of two expert in Mathematics Education. Meanwhile the Alpha Cronbach formula was applied to prove the reliability of the tests. The alpha coefficients for each tests respectively are 0,644 and 0,634, which satisfied the reliable criteria [15]

Initially, the data was analysed descriptively by calculating the total score of each student. Based on the total score, then the minimum and maximum score, the average score and the standard deviation were calculated. In order to get better insight on student's LOTS achievement's Level, the score of each student is qualitatively classified into 5 categories: "Very Well" for the score between 86-100, "Good" for the score between 71-85, "Adequate" for the score between 56-70, and "Poor" for the score between 0-55.

Meanwhile examining the difference between the LOTS Level were done using statistical hypothesis test assisted by the IBM SPSS 26.0 software. The Wilcoxon Signed Rank test was used to test the hypothesis since the data was not normally distributed. To meet the second research objective, the null hypotheses and alternative of the study are:

H_0 : There is no significance difference between student's achievement in remember-understanding level and understanding level

H_1 : There is significance difference between student's achievement in remember-understanding level and understanding level

3. RESULT

3.1. Student's LOTS Achievement

First step of analysis was done by calculating student's score for each LOTS level (Remembering-Understanding and Applying). Based on the scores, the descriptive statistics was calculated for overall student's score and each LOTS Level on each grade. The result was shown on Table 1.

From the Table 1, the 7^{th} grade students score ranged between 0 - 53,33 with the average score was 25,00. The score for 8 grade students were ranged between 0 – 55,56 with the average score was 27,65. The 7^{th} grade students average score in Remembering-Understanding items was greater than the average score of Applying items. In contrast, the 8^{th} grade average score in in Remembering-Understanding items is less than the average score of Applying items.

Table 1. The descriptive statistics of students' LOTS

	Minimum Score	Maximum Score	Mean	Standar deviation
Grade 7^{th}	0	53,33	25,00	11,74
Remembering-Understanding	0	100	30,53	19,08
Applying	0	55,56	10,77	13,57
Grade 8^{th}	0	56,25	27,65	13,30
Remembering-Understanding	0	66,67	25,75	14,93
Applying	0	71,43	30,09	19,81

Table 2. The amount of student on each category of LOTS level

Interval	Categories	Grade 7	Grade 8
85 < Score ≤ 100	Very Well	0	0
70 < Score ≤ 85	Good	0	0
55 < Score ≤ 70	Adequate	0	5
0 ≤ Score ≤ 55	Poor	196	146
Total		196	151

Further, each student's scores were categorize qualitatively as shown in Table 2. The result in the table showed that majority of students in both grade fall in poor category. None of them were categorized as "Very Well" and "Good" achievement. Then, the hypothesis testing was done by using SPSS software. Since the data was not normally distributed then the Wilcoxon Signed Rank test was used. Below the SPSS's output of the data analysis.

Table 3. The result of Wilcoxon signed ranks test

Test Statistics	
Z	-2.924[b]
Asymp. Sig. (2-tailed)	.003
a. Wilcoxon Signed Ranks Test	
b. Based on positive ranks.	

Based one Table 3, the significance value is 0,003 which is less than 0,05. So, it can be concluded that H_0 is rejected or there is significance difference between level of LOTS achievement for students. Based on Table 4, it is also shown that most of student's scored better on remembering-understanding level than applying

3.2. Student's difficulty in LOTS Type of Questions

In accordance with previous analysis, it is found that most of students has low achievement in solving LOTS problem. This situation indicates that the students face difficulty in finishing the LOTS questions. Furthermore, in this section we are trying to identify student's difficulties in accomplishing the LOTS problems. Since the question format was multiple choice, then the student's answer also is limited by the given options. So that, the analysis of student's difficulties was made by analysing the most selected answer choose by student for every question.

After accumulating the percentages of students who chose each option for each number, then the highest percentage of each number were analyzed in order to generalize kind of student's difficulties, Several example of LOTS questions along with the percentage of the total students who chose on each option are shown in the picture below.

What is $(-25) - 5 \times 28 : (-4)$?
a. -210 **(31,12%)**
b. -10 **(24,49%, CORRECT ANSWER)**
c. 10 **(25,51%)**
d. 210 **(19,39%)**

Figure 1 The sample question on number topic

Considering the line equations below.$x + y = 3$
I. $x = 3y + 6$
II. $2y - 6x = 27$
III. $y = 3x - 6$
IV. $x - \frac{1}{3}y + 5 = 0$
Which lines has slope $m = 3$?
a. I, II, IV **(41,06%)**
b. II, III, IV **(22,52%)**
c. II, IV, V **(15,89%)**
d. III, IV, V **(19,21%, CORRECT ANSWER)**

Figure 2 The sample question in linear equation

Based on the analysis of the most frequently selected option by students for the four questions, it can be concluded that students have insufficient understanding on mathematics concept especially on number and linear equation topic. For example, on Figure 1, most of students selected "Option a" which is incorrect. The answer were obtained when student finished the question as follows.

$$(-25) - 5 \times 28 : (-4) = -30 \times 28 : (-4) \quad (1)$$

$$= -840 : (-4) \quad (2)$$

$$= -210 \quad (3)$$

The answer was resulted as student did not understand the characteristic of integer number operations which precede the multiplication and division operation instead of addition and subtraction. Besides that, it indicates that student also has no enough understanding about the properties of operation between positive and negative number. The difficulties also found on student's answer on question in Figure 3. In this question most of students choose "$3 + (-4)$" instead of "$3 + 4$" as the equivalent form of "$3 - (-4)$".

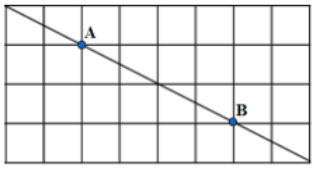
Table 4. The result of rank analysis

Ranks				
		N	Mean Rank	Sum of Ranks
Applying - Remembering_understanding	Negative Ranks	190a	158.71	30155.50
	Positive Ranks	128b	160.67	20565.50
	Ties	29c		
	Total	347		
a. Applying < Remembering_understanding				
b. Applying > Remembering_understanding				
c. Applying = Remembering_understanding				

The form "$3-(-4)$" is equal to …..
a. $3-4$ **(29,59%)**
b. $3+4$ **(22,45%, CORRECT ANSWER)**
c. $3+(-4)$ **(31,63%)**
d. $-3-4$ **(18,88%)**

Figure 3 The sample question in number topic

In the given figure, the gradien of Line AB is ….



a. -2 **(13,91%)**
b. $-\frac{1}{2}$ **(21,85%, CORRECT ANWER)**
c. $\frac{1}{2}$ **(35,76%)**
d. 2 **(28,48%)**

Figure 4 The sample question in linear equation topic

Meanwhile the answer on Figure 2 and Figure 4 also implied the same kind of difficulties. On the Figure 2, students were asked to find the equation line with slope $m = 3$ from the given equations. Majority of the student choose "Option a" which indicates lack of understanding about how to find the slope on line equations. Consequently, student answered the question relying on the visual form of equations. They merely choose the equation that contains the number 3 as the equation has slope 3. Similar with the question on the Figure 4, most of student's picked "Option c" which implied student's incomplete understanding on the concept of slope. The option was selected when student mistake the slope as the ratio between the change in the length of the vertical side and over the horizontal side without considering the direction of the line.

4. DISCCUSION

Remembering, understanding and applying are some levels of Bloom's Taxonomy that classified as lower order thinking skill. Remembering requires students to recall basic information; Understanding requires explain idea and concepts; Applying requires apply information in new way. Together, this three level form basis of student's cognitive process [16]. On this study, both grade 7th dan grade 8th achievement on respective level of LOTS is still low. This finding parallel with result of TIMSS 2015 that revealed Indonesian student's skill were remain in the 'knowing' and 'applying' domain [17] [18].

The overall average score achievement of grade 7th students was 25.00 while for grade 8 it was 27.65. This indicates that the average LOTS achievement in both classes is still in the poor category. This is also supported by the results of categorizing each student's score (see Table 2) where most of students are categorized on poor level of achievement. Total 338 out of 347 students on both grades were categorized on poor achievement. Little amount of them were categorized on adequate and good level of achievement, while none of them were categorized on very well level of achievement. The findings means that student's has poor LOTS skill.

Later, the poor performance revealed the common difficulty that might be experienced by the students. The students tend to have difficulties related to acquisition of the mathematics concepts. They has either no understanding or incomplete understanding on number dan linear equation topics. Students 'mistakes in constructing mathematical concepts are often the main source of students' weakness in mastering mathematical material [19]. The study of Kartianom and Mardapi [20] found that among the 11 different identified errors, the conceptual error was the most frequently occuring in student's work.

Additionally, the statistics test on the data shows there is difference between student's achievement on each level of LOTS. Furthermore, it is found that grade 7th student's achievement on remembering-understanding level is higher than applying level. This finding is in line with the hierarchical assumption of Bloom's taxonomy of knowledge processes. It means that the lower-level process usually involves simple cognitive process than the higher lever, so it is easier for student to complete the problem on lower level.

Besides that, the amount of student who scored higher on applying level than remembering-understanding. Even though this result differ from hierarchical assumption of Bloom's taxonomy, the similar result also found on study of Sari et al [21]. The study discovered the average level ability of students who can answer questions for the application level is higher than the average score of students who can answer questions for the understand level. This inconsistency later needs to elaborate more on the future studies. Meanwhile findings on others 61 students analogous with others claim before.

5. CONCLUSION

HOTS are the skills that need to be mastered by the students in the 21st century in order to cope with the ongoing technological changes and advancements. But it's also important to make sure student already mastered lower order thinking skill (LOTS) since it is one of the prerequisites to higher order thinking skill (HOTS). Findings on this study showed that most of the student for both grade 7th and grade 8th has low LOTS's achievement. It is also shown on their achievements on respective level of LOTS which is also low. The analysis also shows that the students endure conceptual difficulties in accomplishing the mathematics task.

Furthermore, it also can be concluded that there is difference between student achievement in remembering-understanding level and understanding level. Furthermore, it is also found that most of student achievement on remember-understanding level are higher than applying achievement. Other than that, there is inconsistency on finding about grade 8th student's achievement where the average of applying level score is higher than the average score on remember-understanding level. This could be caused by nature characteristic of multiple-choice type of questions. In this type of question, it is possible for student to randomly choose the answer without meaningful and careful consideration. Thus, there should be further study that can elaborate more on student's answer with the utilities of another type of question for example open-ended questions.

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