The Level of Junior High School Students' Thinking in Solving TIMSS Mathematical Problem in Bengkulu

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ABSTRACT
The purpose of this study is to describe the thinking level of junior high school students in Bengkulu in solving TIMSS mathematics problems based on the Bengkulu context. The thinking level is focused on three levels, namely: (1) knowing, (2) applying, and (3) reasoning. The research is a qualitative descriptive research. The subjects in this study were 96 junior high school students in Bengkulu City from eight grade. The research instrument consisted of 15 multiple choice items and 5 short answers which were reviewed from the modified TIMSS questions the Bengkulu context. Analysis of research data was carried out using descriptive statistics. The results of the study concluded that the mastery of junior high school students in solving the Bengkulu context TIMSS mathematics problems based on the level of thinking, namely: (1) the low level of knowledge is 28 students (29.17%), moderate 47 students (48.96 %), and high 21 students (21.88 %). (2) the applying level with low criteria is 37 students (38.54%), 40 students (41.67%) are moderate, and 19 students high is (19.79%). (3) The level of reasoning criteria is low as many as 56 students (58.33 %), moderate 32 students (33.33% %), and high as many as 8 students (8.33 %).

Keywords: *Analysis, Level of thinking, TIMSS questions.*

1. INTRODUCTION

The results of mathematic lessons in schools are one of the benchmarks for educational attainment both nationally and internationally. A survey conducted by the Trends International Mathematics and Science Study (TIMSS) which focuses on mathematics and science, states that Indonesia is ranked in the low category. Data from the 2011 TIMSS survey showed that Indonesian students were ranked 38 out of 45 participating countries. The national average score is 500 where each cognitive domain is: (1) knowing with a score of 378 (2) applying of 384, and (3) reasoning of 388 [1].

Meanwhile, in terms of mastery, the results of the analysis of the 2011 TIMSS questions, especially with the High Difficulty Index [2]. (1) The result of students' mastery of numbers in the cognitive domain of applying is 9% and knowing is 8%. (2) algebra in the reasoning domain is 1% and the application is 18%, (3) geometry in the applying domain is 25% and reasoning is 0%. (4) material data and opportunities in the domain knowing of 25% and applying of 35%. The results of the TIMSS analysis, especially in mathematics, in 2011, more than 95% of Indonesian students were only able to reach the intermediate level [3].

The TIMSS data shows that there is a need for emphasis on learning mathematics in the classroom which focuses on students working on non-routine questions. According to Leung [4] learning in Indonesia is more about mastering basic skills, but there is little or no emphasis on applying mathematics in the context of everyday life, communicating mathematically, and reasoning mathematically. Meanwhile, research by [5] showed that there was a mismatch between basic competencies and content in the 2013 curriculum and the demands of test material on the 2011 TIMSS.

Several studies have been carried out as an effort to improve students' abilities, especially in solving TIMSS-based math problems. One of them is the research conducted by [6] who developed the TIMSS

model of reasoning type questions. The results of the study obtained that the average student reasoning test results were dominated by the moderate category, namely 29.63% and the low category by 22.22% of the total students. Research by [7] developed a TIMSS type of math problem using a traditional house contest with an average score of 56 students answered. Based on this, the specially designed questions have not been maximally mastered by students.

The research conducted by [8] show that the level of junior high school students in Bengkulu in terms of content aspects, namely: (1) geometry content is 36.39% (low), (2) data and chance content with a mastery level of 50.40% (Low) and, (3) algebraic content and numbers of 59.18 (moderate). In this study, the ability of junior high students will be tested, especially in Bengkulu City, which has never been the subject of a TIMSS survey. The emphasis of the questions used is the Bengkulu context-based TIMSS questions which are expected to make it easier for students to use their abilities to solve problems.

2. RESEARCH METHOD

This research is descriptive research with a qualitative approach. Descriptive research is a research that aims to describe a situation or phenomenon as it is without manipulating the object of research [9]. The purpose of this study is to describe the ability of junior high school students in Bengkulu City in solving mathematics problems based on TIMSS Bengkulu context. The population in this study are students of Eight Grade junior high school students Bengkulu City who come from 40 schools.

The research subjects are 96 junior high school students from four public and private schools in Bengkulu City. Data collection techniques used are tests and interviews. The test is given to measure students' thinking level in solving TIMSS-based math problems in the Bengkulu context. Interviews are conducted to obtain more information about the reasons for students in answering questions. The test given is a written test in the form of multiple choice and short answer to measure students' spatial abilities in the TIMSS content domain question with the Bengkulu context. The test instrument refers to the TIMSS 2012 and TIMSS 2015 questions from the official website of the IEA (International Association for the Evaluation of Educational Achievement) which was later modified with the Bengkulu context. The distribution of research instruments is as follows.

Research data in the form of test and interview results were analyzed descriptive. Data analysis of test results to describe students' thinking level in each aspect, namely: knowing, applying, and reasoning. The data was calculated based on the percentage of students' mastery at each level of thinking (see Table 1). Student test results data were described qualitatively to provide information about how students complete and identify student errors given. The criteria for each level of student thinking based on a conversion score of 0-100 are presented in the following Table 2.

Table 1. Distribution of instruments

Cognitive Level	Questions	Percentage (%)
Knowing	6	30
Applying	9	45
Reasoning	5	25
Total	20	100

Table 2. Student level criteria

Interval Score	Criteria
0-33	Low
34-66	Moderate
67-100	High

3. RESULT AND DISCUSION

The research data were analyzed based on the scores obtained by the students in solving the TIMSS questions in the Bengkulu context. The scoring of each instrument was 1 if the answer is correct and a score of 0 if it was wrong and then converted into a score on a scale of 0-100. The general description of student scores from the four schools was shown in the following Table 3.

Table 3. Description of statistics

Statistics	Score
Mean	43.39
Max	85.00
Min	20.00
Std. Deviation	19.11

Based on Table 3, in general, the student's mastery score was less than 50.00%. These data indicated that on average students' mastery of TIMSS-based math problems in the Bengkulu context was still low. So it was necessary to emphasize learning that could facilitate students' abilities in solving TIMSS-based questions. The distribution of students' abilities from the selected sample of schools was not evenly distributed, it could be seen that the standard deviation

of the data was 19.11. These results showed that some schools have good basic mathematics abilities.

Furthermore, students' mastery in solving TIMSS questions in the Bengkulu context is grouped based on students' thinking levels. The analysis is carried out based on the questions of each level by calculating the percentage level of thinking in each domain. The distribution of questions based on cognitive level in this study, namely: (1) knowing of 6 questions, (2) applying of 9 questions, and (3) reasoning of 5 questions. The results of the analysis of the thinking level of junior high school students in solving the TIMSS questions in the Bengkulu context are as shown in the following Table 4.

Table 4. Distribution of students' thinkig level

Level	Low	Moderate	High
Knowing	28 (29.17%)	47 (48.96 %)	21 (21.88 %)
Applying	37 (28.54%)	40 (41.67 %)	19 (19.79 %)
Reasoning	56 (58.33%)	32 (33.33 %)	8 (8.33 %)

Based on Table 4, it is known that students' mastery in solving mathematics problems based on TIMSS in Bengkulu context at the level of knowledge of the highest percentage on moderate criteria (48.96%) and high criteria of 21.88%. Meanwhile, at the application level, the high criteria decreased to 19.79%, while some of the students' abilities on the criteria were moderate with a percentage of 41.67%. At the level of reasoning the low criteria reached 58.33% while students who had high criteria at this thinking level were 8.33%. Based on the results of the analysis, statistically, student mastery tends to be higher at the level of knowledge and application. This is because the level of thinking in solving the problem is lower than other levels. This is in accordance with the opinion of Sudarsyah [10] the difficulty of the questions will follow Bloom's cognitive taxonomy hierarchy. Easy category questions will be developed based on the level of cognitive ability to knowing and understanding. Moderate category questions are developed from the level of ability to apply and analyze. While the difficult questions categorized will develop from the level of evaluating or creating ability. In analyzing student answers, especially errors made by students, it was explored by observing students' answers in solving questions. The questions given were modifications of the TIMSS questions by relating them to the Bengkulu context. The following is an example of a question at the knowing level.

The example questions in Figure 2 showed that the ability required to answer was students' knowing of the concepts of reflection and rotation. Students would be able to answer correctly if students had the ability on how the image would change if it was reflected and rotated. The following (Figure 1) were examples of student answers that were wrong in solving questions at the knowing level.

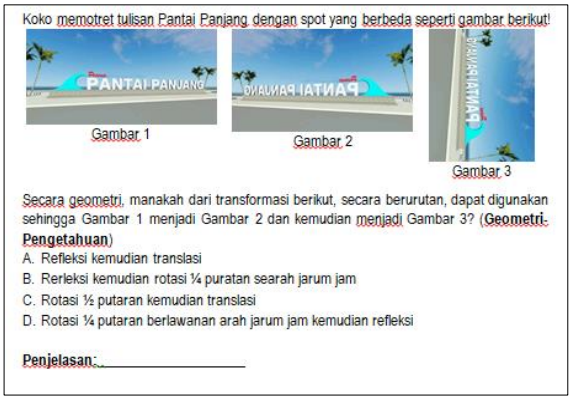

Figure 1 Knowing level questions

The student's answer in Figure 2 is wrong in determining the third picture. Meanwhile, to determine the relationship between the first and second picture, students can answer correctly where the second picture is a reflection of the first picture. However, to determine the relationship of the three pictures, the students were wrong by answering the relationship as translation. While the answer that should be the object is rotated round. So that it is concluded that the level of students does not yet have the knowledge or forget about the concept of translation, namely the movement of objects. The analysis of the student's answer sheet shows that in solving problems with a knowing level, it is necessary to master the existing concepts.

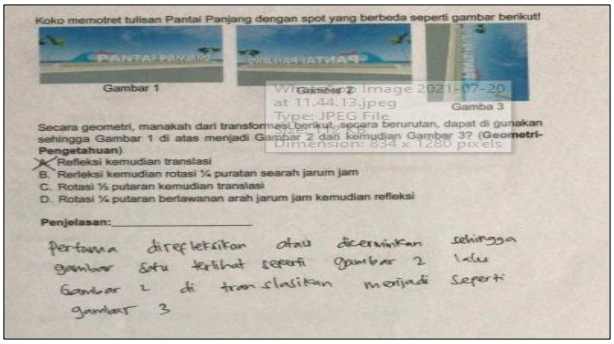

Figure 2 Examples of student answers on knowing level questions

One of the excerpts from the results of interviews with students who are wrong in answering the question

of the level of knowledge in Figure 2 for student 1 (S) is as follows:

R : "*How do you work about doing this*?"
S : "*I saw the picture sir, then checked the answer choices*"
R : "*How does picture 1 change to picture 2 in the question? Then to the position of picture 3*"
S : "*From the picture, I think it's a translation, sir, and the picture 3 changes upwards so it's translational*".

The results of the interview showed that students knew the concept of reflection but they did not understand the concept of rotation and dilatation. The error is also because students have difficulty understanding the pictures presented in the problem and connecting them with the material concept. Furthermore, in measuring the level of students' thinking at the level of applying, 9 questions were given. The questions were also adapted and modified based on the 2011 and 2015 TIMSS questions. The questions were modified in terms of language, numbers, and used the Bengkulu context. The following (Figure 3) is an example of a TIMSS-based math problem with the Bengkulu context at the applying level.

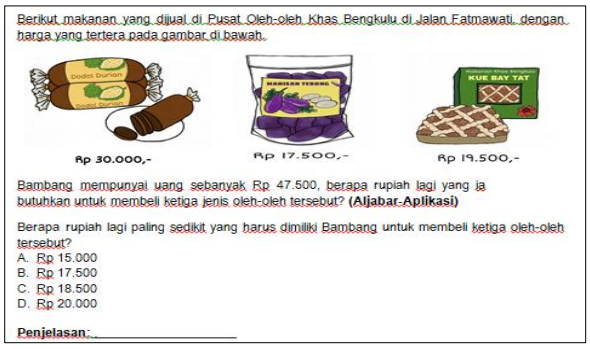

Figure 3 Knowing level questions

The questions above measure students' abilities at the level of thinking at the applying level. In answering these questions, students are required to apply algebraic procedures or operations, namely addition and subtraction. The following is an example of a student's incorrect answer in answering the question above.

The analysis of students' answers in Figure 4 shows that at that level students have been able to apply addition and subtraction procedures. The student's answer, which was Rp19.500, was correct. However, when choosing the answer available for the wrong option, which is Rp18,500, the minimum money you should have is Rp20,000 based on the answer choices. While in Figure 4 the student is wrong in performing a number subtraction operation.

The results of interviews with students (S) related to answers to applying level questions in general show that students have been able to apply algebraic concepts.

R : "*How do you answer that question*"?
S : "*Adding up all the prices of cakes and then subtracting Bambang's money"*
R : *" is the result of the sum correct?"*
S : *"Yes sir, but the answer choices don't exist"*

The results of the interview showed that students were able to apply the algebraic concepts of addition and subtraction. Students were wrong in determining the minimum amount of money that must be owned.

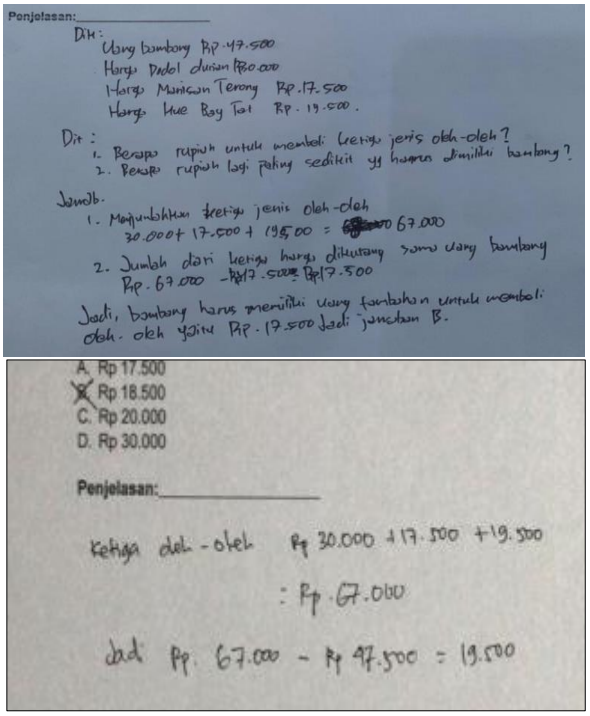

Figure 4 Examples of student answers on the applying level

4. CONCLUSIONS AND SUGGESTIONS

Based on the results of research and analysis of research data, it was concluded that in terms of students' thinking level was namely: (1) the low level of knowledge is 28 students (29.17%), moderate 47 students (48.96 %), and high 21 students (21.88 %). (2) the applying level with low criteria is 37 students

(38.54%), 40 students (41.67%) are moderate, and 19 students high is 19.79%). (3) The level of reasoning criteria is low as many as 56 students (58.33 %), moderate 32 students (33.33% %), and high as many as 8 students (8.33 %). Suggestions are expected for secondary mathematics teachers, especially in Bengkulu City, it is very necessary for students to train students' thinking skills by providing TIMSS-based practice questions so that students are accustomed to solving them.

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