



**DEVELOPMENT OF DIAGNOSTIC TEST:
MATHEMATICAL MISCONCEPTION ON THE TOPIC OF
NUMBER AND ALGEBRA**

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Abstract

This study aims to: (1) look for the highest and lowest values in number and algebraic material of Junior High School in East Lombok, (2) the percentage of errors made by students when answering math problems, and (3) the diagnosis of student's misconception in doing number and algebra at Junior High School in East Lombok. This research is a quantitative- descriptive research. For the sampling technique, this study used purposive sampling. The results of this study are as follows. First, in terms of the difficulty index, 40 items (47%) are easy category items, 8% are medium category items, and 45% are difficult category items. Out of the 40 problems, 82% of the items have good difficulty index, while 18% are not good. Of the four alternative answers, 88% of the distractor is in a good category, and 12% are not good. Second, based on the students' answers, the percentage of error is 52 %. Third, based on the result of the analysis using the Quest program, of the tow materials, the biggest misconception is in number with the percentage of 68%. The dominant error is in the indicator representing fractions in various forms, with a percentage of 22%.

Keywords: *Concept errors, quest, numbers, algebra.*

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Each human being deserves to get an education as it is that makes someone knowledgeable and faithful toward God. Human needs education whenever and wherever they are, since through education human is able to develop either rapidly or perfectly (Fadli, Idris, Ikram, & Hamid., 2015: 92).

There are many different perspectives of math among experts, one of them, Van de Walle, (2007: 13) defines math as “science of pattern and order”. Learning mathematics basically is learning about concept, conceptual structure, or looking for the correlation between one to another (Subarinah, 2006: 1).

The concept is the concluding result of a material based on the same or similar characteristic about that matter (Sumiati and Asra, 2009: 65). Errors in math are usually caused by students’ misconception that leads to carelessness. Students having misconception means that they do not understand the concept and it will create different chaos and incorrect hierarchy concepts relation (Irawan, 2012: 9). Diagnostics is a complex process in an action to take conclusion out of the symptoms investigation, predicting causes, observing and adjusting to the good category (Suwanto, 2013: 90).

Hansen, Dor, Mowen & Marianne. (2011: 11) states that a teacher in investigating mathematical misconception should have a specific skill; the term is known as diagnostics. Misconception can sometimes appear due to teacher’s carelessness in interpreting symbols or texts, inexperienced or less knowledgeable

teacher toward relevant conceptual purposes on the topic, teacher’s laziness or less awareness to check students’ answers, or the result of teacher’s own misconception. One of the factors causing misconception is that students are lack of conceptual, principal and operation mastery (Manibuy, Mardiana, Dewi, 2014: 393).

According to Gurel, Eryilmaz, & McDermott (2015: 11), the choice of diagnostic instrument types needs to consider several things including time availability, material range, some identified samples, the development of instruments and result analysis, and the implementation practicality. Diagnostic test is greatly useful to figure out students’ difficulties and is the first step to improve initial learning process for teaching and learning (Suwanto, 2013: 4). Meanwhile, according to Duskri M, Kumaidi and Suryanto (2014: 46) applies mathematical diagnostic test to look for the difference between students’ level of understanding, especially in understanding learning materials.

Misconception about prior knowledge will hinder the process of gaining new knowledge and eventually cause students to continue making mistakes when studying algebraic and other related materials (Rizky, AH Tri, EMS, 2014: 136). Based on that opinion, the problem is the question where the question is a challenge for student to be answered and it is an unusual procedure that requires rational thinking stronger or deeper than what he already knows (Farida. N, 2015: 43).

The TIMSS report conducted every four years states that the scores obtained by Indonesia are still below the international average score and are in the low category. This can be seen from TIMSS 2015, the distribution of Indonesian mathematics percentage gets an average of 397 and gets 43 of 55 countries with a score below 400 and with an international average score of 500 (TIMSS, 2015: 19).

The factors causing misconception are usually students who are lack in mastering concepts, principles and operations (Manibuy. R, Mardiana, Dewi, S Hospital, 2014: 393). If this misconception continues, students will face difficulties in learning mathematics. For students, difficulties in learning mathematics will result in laziness or despair, not being interested and eventually going to hate mathematics. (Duskri, Kumaidi, Suryanto, 2014: 45). Therefore, there are errors that need to be identified by the teacher, look for the factors that influence them and then find solutions to the problem. Thus, information about errors in solving problems can be used to improve the quality of student learning activities. (Sri. A. W, 2013: 107).

METHOD

This type of research is a developmental research, which aims to describe the development results of diagnostic test on misconception made by students in solving math problems. In this study, what will be analyzed is the student's answer sheet

on math test, the test results are analyzed based on the errors made by seventh grade junior high school students. Data collection used is through purposive sampling. For the form of instrument, the researcher used multiple choice questions. The trial was conducted in five schools with total number of students was 200 students. The trial was conducted to determine the characteristics of the problem to be analyzed further, to decide which is valid as misconception diagnostic test, and to be tested back as the research sample. The results of student responses taken will be analyzed using Quest assistance, and the student sample instruments tested were 361 students from five schools in junior high school.

FINDING AND DISCUSSION

Results of Analysis Using the Quest Program to Seek for the Students' Highest and Lowest Score (Tabel 1). From the 361 students who were given the instrument test, the results of the Quest program calculation on the test (Ca) were only 3 people who scored the highest with a score of 37 correct, and only 1 person scored at least 5 correct from 40 questions. From the results of the Quest program, we found students still had a lot of difficulties in answering questions about conceptual diagnostic test instruments. Code of student names that made a lot of errors is 351, students are correct 5 of 40 questions with estimate -2.11. That is, the ability of students is below the average, and the code for the name of the student who did the right is 113, students actually 37 out of 40

Table 1. Students' highest and lowest score.

Name Code	Score	Estimate	Information
14	37	1.88	High
54	37	1.88	High
113	37	1.88	High
351	5	-2.11	Low

Table 2. The Most Frequent and The Least Error Items

Material	Item	Score	Estimate	Information
Number	2	280	-1.51	High
	28	120	0.74	Low
Algebra	33	148	0.39	High
	39	94	1.14	Low

questions with an estimate of 2.68. That is, the ability of students is above average.

Finding the Misconception of Students in the Most Frequent Correct Answers and the Most Frequent Incorrect Answers.

From those 40 questions about diagnostic development test on mathematical misconception on the topic of number and algebra at Junior High School in East Lombok, the Quest program calculation on the test instrument (It), the highest score was 280 from item no. 2, while the lowest score on the topic of number was 120 from item no. 28. It means the students still have misconception in determining the form of rational number because in the rational number students still make errors in doing random fraction. Next, on the topic of algebra, the highest score was 148 from item no. 33, while the lowest score was 94 from item no. 39. It means students still have misconception in doing sum or subtraction in algebra which can be simplified by classifying and simplifying the equal

terms. However, most of the students still face misconception in doing the algebra operation in the rational form.

Percentage of Student Errors of the 40 questions about developing a diagnosis of mathematical misconception tests in junior high school, the percentage of student errors can be identified through responses from test participants, the percentage of student errors from material numbers and algebraic material seen from student error scores of 52%, for more details see figure 1 number of errors percentage (Figure 1).

From the picture above, the percentage of errors is 52%, and the correct percentage is 48%. This shows that students still have difficulty in working on math problems with number material and algebra in junior high school. Because most students are mistaken in the sum and subtraction of material numbers and algebra can be simplified by grouping and simplifying similar terms, similar terms in the algebraic form may only differ in the coefficients.

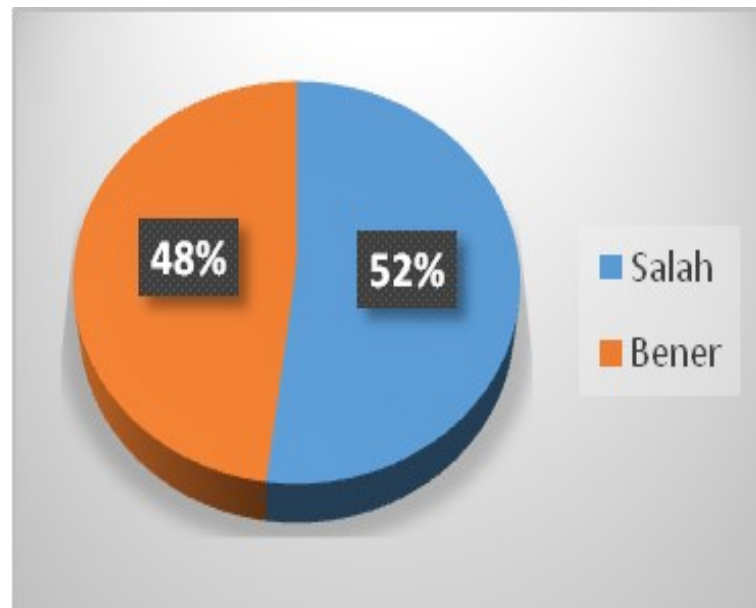


Figure 1. Percentage of errors.

Table 3. Details of errors in each indicator on topic numbers.

Indicator	Number of Errors	% Errors
Sort integers	629	12,08
Complete the count operation	905	17,39
Calculate multiples and factors	583	11,20
Express decimal fractions in default	624	11,99
Express fractions in various forms	1164	22,36
Determine the results of rounding	241	4,63
Determine estimates in numbers	217	4,16
Determine the form of rational numbers	614	11,79
Determine results of appointment	227	4,36
Total	5204	99,96

Diagnosis of student errors

The cause can be identified through the response of the test participant's answer, identification of the test participant's errors focused on the steps that the test taker did not do correctly in completing the junior high school math test in 2018. For more details, see the details of the biggest error indicators (Table 3).

The number of students' errors in answering diagnostic instrument test questions is 5204. It is a miscon-

ception in the largest number in the indicator stating fractions in various forms with the amount of 22%. This happens because students misunderstand the concept of operating or students do not know the concept of answering junior high school mathematics in the seventh grade. Examples of questions as students do not know the concept, the mixed fraction form of 4.67 is...

Some students answered $4,67 = \frac{4,67}{100}$ (because there are 2 decimal places, so the number

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Table 4. Details of errors from each indicator on the topic of Algebra.

Indicator	Number of Errors	Percentage of Errors (%)
Do the operation on algebraic form.	1107	46,80761
Complete replacement of numbers in algebraic form	215	9,090909
Complete factorization of algebraic forms	275	11,62791
Complete rational form of operating algebra	768	32,4477
Total	2365	324544,5

is divided by 100), and other students

answered $4,67 = \frac{4,67}{1000}$ (because there are 3 numbers, that is the denominator), actually the correct answer

is $4,67 = 4 \frac{67}{100}$. Next, the indicator for the least wrong number is the indicator for determining the number, because most students already know the concept of how to do it. The sample problem, the estimated distribution of 225: 24 is... Some students answered 225: 24 = 9. Some students also answered 225: 24 = 8 because it was less than 225. Next is a table that shows the details of errors from each algebra indicator, for more details, see the table that shows the biggest error indicators (Table 4).

Students' errors in answering the diagnostic test on misconception for the seventh grade students were calculated as 2365 errors, and the largest percentage was 46%, since most of the students had misconception in doing the operation on algebraic form. Below is the example of student who failed to simplify the algebraic form of $9p + 8q - 2q + 5p$.

$$\begin{aligned} &9p + 8q - 2q + 5p \\ &= (8q - 2q) + (9p + 5p) \\ &= 6q + 14p. \end{aligned}$$

From this answer we knew that student misunderstood of the concept in

simplifying algebraic form.

$$\begin{aligned} &9p + 8q - 2q + 5p \\ &= 9p + 8q - 2q + 5p \\ &= (9 + 5)p + (8 - 2)q \\ &= 14p + 6q \end{aligned}$$

In algebraic indicators, students experienced a lot of misconceptions in operating simple algebraic forms and the results of their mathematical operation can be seen from questions 31 to 35. These results indicate that the seventh grade students of Junior High School still make misconceptions in determining various forms of fractions.

CONCLUSIONS AND SUGGESTIONS

Based on the results of data analysis, this study about the development of diagnostic test on students' misconception in answering number and algebraic questions can be summarized as follows: 1) from the results of the Quest program analysis, the percentage of student errors from 361 students was 52%. This means that students somehow still misunderstood in operating arbitrary numbers, which have been associative, closed, and commutative. Meanwhile, in algebraic material, students are still misunderstood in determin-

ing the sum of results and subtraction in the form of algebra which can be simplified by grouping and simplifying similar tribes; 2) based on the analysis using the Quest program, from 361 students who were tested and the number of 40 questions, students experienced the biggest misconception in numbers on 'stating fractions in various forms' indicator which took 22 of the participants. The largest misconception was in algebra on 'counting algebraic forms', which was 46. Among these materials, the dominant error is in the algebra with an indicator of 46.

Based on the results of study, discussion, and research limitation, the researcher wants to propose several suggestions as follows: 1) suggestion to school principal and teacher: a) to the school principal, it is suggested to invite an expert who will provide training to the teachers, so they will be capable of designing valid and reliable instruments, especially the questions that can detect misconception from each study lesson; b) if the teacher has figured out the students' difficulties, it is better for the teacher to provide assistance in preventing misconception; dan 2) suggestion for the next researcher To the researcher who will conduct study about misconception on particular lesson, it is suggested to focus on one single lesson students considered difficult to narrow down the range of study. By that, the misconception can be identified in a more detailed analysis.

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