Analysis of students’ error in solving math problem-solving problem based on Newman Error Analysis (NEA)

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Abstract. This study aimed to describe the students' fault in finishing the problem-solving questions. This research uses the descriptive qualitative method. The research subjects are as much as 40 learners. The results are 1) most of the male students' fault are in encoding aspect 199 or 41.29%, 2) most of the female students' fault are in the process skill and encoding aspect 189 or 28.64%, 3) most of the fault of the grade learners are found in the process skill and encoding aspect 213 or 32.27%, 4) the fault of the under grade students are found in encoding aspects 213 or 32.27%, 5). The causes factor errors 1) The students cannot identify information of questions, 2) The students do some false in writing the formula and cannot determine the elements up flat, 5) The students do not know how to count the concept and to finish it, 6) The students write the answer incorrectly. The recommendation to solve the cause of the error are reading errors, comprehension errors, transformation error, error process skills, and encoding error solution.

1. Introduction
Mathematics is very important in our lives. Mathematical ability is important not only for learning but for human life as well. Ideas on math education to participate in real life [1]. Mathematics learning became the foundation of children in the future [2]. In the curriculum of learning mathematics is a comprehensive process [3]. The purpose of learning mathematics so that students can use their knowledge in real life [4]. To help students develop their critical thinking skills, teachers need to model critical thinking skills and dispositions in front of their students [5]. Mathematics lessons from kindergarten to college. To continue to the higher education level of mathematics knowledge [6]. Mathematics equips students for logical, analytical, critical, and creative thinking, as well as cooperation. A country's mathematical achievements are seen from TIMSS and PISA. Program for International Student Assessment (PISA) is an assessment of scholastic abilities [7]. TIMSS and PISA form problem-solving. That requires mathematical creativity [8]. In the 21st century, mathematical thinking and the absence of two critical and creative thinking skills are urgently needed [9].

Pisa test results in 2015 and TIMSS 2016, show that Indonesia is ranked below, It shows the low ability of students in solving problems. The resolution of the problem is not assisted in the resolution [10]. Problem solving and creative design, using analogies, mapping the analogous properties and
relationships of the domain of knowledge [11]. Students have not been able to use the stages in solving problem-solving problems.

Upgrade the ability of students to complete the stages of problem-solving problems. This study requires a tool to analyse students' mistakes in solving problems. The following tool that can help solve this problem is Newman's Error Analysis (NEA). Students' errors in problem-solving were analyse using Newman's Error Analysis [12]. Newman procedure stages; reading errors, comprehension errors, transformation errors, processing skill errors, and coding errors [13]. Newman Error Analysis knows students' difficulties and knows the extent of their thinking skills [14]. Analyse student errors using the Newman Procedure stage; reading, understanding, transformation, process skills, and coding [15].

2. Methods
This research is a qualitative research which assumes that qualitative research is a study aimed at grouping and analysing phenomena, events, social activities, attitudes, beliefs, perceptions, thoughts of people individually or in groups. The research was conducted in class VII SMPIT Bina Amal Semarang. Grade VII has 4 classes, namely the grade upper for the male, the grade for lower the male, the grade upper for the female and the grade for lower the female. Students of class VII complete questions problem solving validated. Data collection in this study was conducted 3 times. The first data collection of students did not receive any information. The next day the researchers entered all classes to explain the objectives of given questions and the stages of solving questions based on the NEA. The first data collection was questions number 1 - 4, the second number 5 - 8, and the third number 9 - 12. The results of the students' completion were corrected and given a score. The score for each question is the same, which is 11 with the following details. Process skill score 3, reading, comprehension, transformation, and encoding for each score 2. The test results are then analysed to find out the mistakes of students in solving problem solving questions.

Interviews in this study were to determine the causes of students' errors in solving problem solving problems. The data were obtained from scoring the test results completed by students. The scores are sorted from lowest to highest. Each class is divided into 2 groups, namely, the upper group and the lower group. Each of the upper and lower groups was taken 5 children. So every class there are 10 children who will be interviewed to find out the factors that cause errors in solving the questions. Data collection techniques in this study using test documentation, and interviews. The research is focused on errors and the factors that cause students' errors which are studied in five aspects based on Newman's Error Analysis (NEA), namely reading, comprehension, transformation, process skills, and encoding. Data analysis technique carried out in the test, evaluation, and revision phases.

3. Results and Discussion
Qualitative data analysis was obtained by looking at students' answers and interview results. The data were analyzed use student test answers and interviews. The analysis was finding out the types of errors. In general, the types of errors of research subjects in solving problems in Table 1.

| NO | Aspect            | Amount | Many Problems | %    |
|----|-------------------|--------|---------------|------|
| 1  | READING           | 11     | 480           | 1.06 |
| 2  | COMPREHENSION     | 19     | 480           | 1.83 |
| 3  | TRANSFORMATION    | 236    | 480           | 22.67|
| 4  | PROCESS SKILL     | 387    | 480           | 37.18|
| 5  | ENCODING          | 388    | 480           | 37.27|

Based on table 1 student errors in solving problem-solving for reading aspects 1.06%, understanding 1.83%, transformation 22.67%, process skills 37.18%, and coding 37.27%. The students' error data in resolving each class question is presented in Table 2.
Table 2. Subject-by-class incorrect answer results

| ASPEK             | CLASS | GAPa % | GBPa % | GAPi % | GBPi % |
|-------------------|-------|--------|--------|--------|--------|
| READING           | 2     | 0.83   | 6      | 1.95   | 0      | 0.00   | 3      | 1.04   |
| COMPREHENSION     | 6     | 2.48   | 7      | 2.28   | 0      | 0.00   | 6      | 2.08   |
| TRANSFORMATION    | 52    | 21.49  | 79     | 25.73  | 36     | 17.65  | 69     | 23.96  |
| PROCESS SKILL     | 91    | 37.60  | 107    | 34.85  | 84     | 41.18  | 105    | 36.46  |
| ENCODING          | 91    | 37.60  | 108    | 35.18  | 84     | 41.18  | 105    | 36.46  |
| JUMLAH            | 242   | 100.00 | 307    | 100.00 | 204    | 100.00 | 288    | 100.00 |

When viewed from the mistakes of students in solving questions based on clustering, the data obtained are: the grade upper male aspect is reading 0.83%, the aspect is comprehension 2.48%, the aspect is transformation 21.49%, the aspect is process skill 37.60%, and aspect encoding 37.60%. The percentage of the grade lower male aspect is reading 1.95%, aspect is comprehension 2.28%, aspect is transformation 25.73%, aspect is process skill 34.85%, and aspect is encoding 35.18%. The percentage of the grade upper female in aspects was reading 0.00%, aspects were comprehension 0.00%, aspects transformation 17.65%, aspects process skills 41.18%, and aspects encoding 41.18%. The percentage of grade lower female aspect reading 1.04%, aspect comprehension 2.08%, aspect transformation 23.96%, aspect process skill 36.46%, and aspect encoding 36.46%.

Based on the results of the data analysis above, it can be determined the factors that cause students' mistakes in solving problem-solving problems. Each question that is tested in addition to having different types of errors, this question also has different factors that can cause errors.

The number of students who participated in three data collection times was 204 children and the research subjects were 40 children. 12 questions were done. In the aspect reading that was completed correctly, there were 1067 or 36.77% and the research subjects were 469 or 34.51%. In the aspect comprehension that was completed correctly, there were 1052 or 36.19% and 461 or 33.92% research subjects. In the aspect transformation that was completed correctly, there were 486 or 16.72% and 244 or 17.95% research subjects. In the aspect of process skills that were completed correctly, there were 154 or 5.30% and 93 or 6.84% research subjects. In the aspect encoding that was completed correctly, there were 146 or 5.02% and 92 or 6.77% research subjects.

Based on Table 1, the results of the analysis of students' wrong answers show that in general the mistakes of students in solving problem-solving problems were obtained the most errors in the aspect encoding 37.27%, then process skill 37.18%, followed by transformation. 22.67%, comprehension 1.83%, and low reading 1.06%.

Coding Errors is the biggest mistake because this stage is the final stage in the process of analyzing answers for learners. Other factors that cause errors in determining the final answer, cannot determine the conclusion, miss-determining the unit. Mistakes are made not only at the concluding stage but also at an earlier stage. Students do not master the concept of the material taught [13].

According to the results of the analysis of the students' answers, it can be concluded that the level of error of the students experienced by the students of Bina Amal SMPIT depends on clustering. Based on test scores grades on the upper for boys are always superior to grades for lower boys, grades upper for girls are always superior to grades for lower girls. If you combine the clustering ratings, namely, the grade upper girls have an average score of 69.76, the grade lower girls have the average score of 63.95, the grade upper girls have the average score of 61.85, and the grade lower girls have the average score 38.29.

Error analysis when viewed from data collection as follows. The first data collection is questions number 1 to 4. The second data collection is number 5 to 8. The third data collection number 9 to 12. The indicator's problem solving for questions number 1, 5, and 9 are the same, namely applying and adjusting various kinds of suitable strategies to solve problems. indicators Problem solving for problems number 2, 6, and 10 are the same, namely solving problems that arise by involving mathematics in other contexts. indicators Problem solving for problems number 3, 7, and 11 are the same, namely adding new
knowledge of mathematics through problem-solving. Indicators Problem solving for questions number 4, 8, and 12 are the same, namely observing and developing process problem-solving. The most disadvantages of students lie in the second, third and fourth stages which are the understanding, transformation, and process skills [14].

Based on the analysis of students’ errors in solving questions and interviews, Newman Error Analysis can help students solve problems [12], weaknesses in the reading and aspects comprehension of students were less thorough in reading questions. Many students do not understand if there are combined shapes. The weakness of the aspect is a transformation that students are incomplete or do not memorize the flat shape formula. The weakness of the process aspect skill, many students do not understand the elements of flat shapes. Some students have misconceptions about calculating multiplication.

4. Conclusion
Factors that influence and analysis of student errors help teachers: 1) The students cannot identify the information of the questions, 2) The students ever do some false in writing the formula to be used and cannot determine the elements up flat, 5) The students do not know how to count the concept and to finish it, 6) The students write the answer incorrectly. Visible problems of students in the transformational stages of understanding, process skills and coding based on the NEA [16]. The recommendation to solve the cause of the error 1) reading errors, the solution is teaching how to identify all known through the answer sheet, 2) comprehension errors started by writing the question on the answer sheet, 3) transformation error, the solution is the teacher teaches how to write a complete, 4) error process skills are teachers provide learning solutions in solving the orderly and sequential problem solving, 5) encoding error solution is teaching teacher concludes answer questions correctly.

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