Factors Causing Students' Errors in Solving Mathematical Problems Problem Solving Based on the NEA in terms of Gender

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Abstract. This study aims to describe the mistakes of students in answering mathematical problem-solving problems. This study used the descriptive qualitative method. This research data is primary and secondary. Data collection techniques are documents, tests, and interviews. The research subjects were 40 students consisting of 10 male upper grade, 10 lower male grade, 10 female upper grade, and 10 lower female grade. The data collection methods were tests and interviews. The results of the study were 1) male students made the most mistakes in the encoding aspect of 199 or 41.29%, 2) female students made the most mistakes in the process skill and encoding aspects of 189 or 28.64%, 3) upper-grade students made the most mistakes in the aspect of process skill and encoding by 175 or 36.31%, 4) lower grade students made the most mistakes in the aspect of encoding by 213 or 32.27%. The conclusion is the factors that cause students' errors in solving problem-solving problems, namely: 1) not being careful in reading the questions, 2) unable to identify what is known from the questions, 3) not memorizing the formula, 4) writing wrong formulas to be used and unable to determine elements, 5) misconception in the counting process and not knowing how to solve it, 6) incorrectly writing the final result of the questions.

Key words: factors causing students' errors; mathematical problems; nea.

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INTRODUCTION

Mathematics is universal science, important in education (Hwang et al., 2020), the core discipline (Sun et al., 2021). which is useful for human life and also underlies the development of modern technology, and has an important role in various disciplines and in advancing human thinking. The rapid development in the field of information and communication technology today is based on the development of mathematics in the fields of number theory, algebra, analysis, probability theory, and discrete mathematics. Mastering and understanding mathematics to create future technology. Many professionals, such as lawyers, judges, policymakers (Mamolo, 2018), require strong mastery and understanding of mathematics from an early age.

Mathematics subjects need to be given to all students starting from elementary school, to equip students with the ability to think logically, analytically, systematically, critically, innovatively, and creatively, and the ability to work together. Creativity is one of the keys to success in a growing global economy and is also a fundamental skill that is necessary for the 21st century (Novita & Putra, 2016). Creative in thinking (Wahyudi et al., 2020), structured reading and writing (Segundo Marcos et al., 2020), and developing deep conceptual understanding of mathematics (Hadar & Tirosh, 2019). Creative thinking is a monumental task (Gube & Lajoie, 2020). It is very important in the modern era so that it must be increased by making efforts such as creating lessons that train students to solve problems on their own (Nuha et al., 2018).

Mathematical problem solving has long been the focus of mathematics education and research (Li et al., 2020). Students are effective in performing mathematical problem solving, solutions (Taram et al., 2019), and thinking skills as well as their ability to understand mathematical perspectives and superior performance (Henschel & Roick, 2017). different phenomena (Haataja et al., 2019), they also learn to relate to other fields (Gürlen, 2015). Critical thinking accessed from Long-Term Memory which can play a role (Lee Swanson et al., 2019) in problem-solving aims to improve creative problem solving (Beda et al., 2020) is a very important part of learning, because in the learning process students are allowed to gain experience using the knowledge and skills they have to apply to non-routine problem solving (Winarti et al., 2019).

The main international scale assessment organizations are TIMSS (Trend in International

Mathematics and Science Study) and PISA (Program for International Student Assessment). It was found that Indonesia in the 2003 PISA acquisition was ranked 39 out of 40 countries, in 2009 it was ranked 61 out of 65 countries, in 2012 it was ranked 64 out of 65 countries, in 2015 it was ranked 62 out of 70 countries with an average score of 403 (Setyarto et al., 2020).

Based on this fact, should the effort to find the error pattern of student thinking in solving problem-solving. The government must be able to seek policies that can support the improvement of the abilities of students. This improvement effort is in line with the demands of the Industrial Revolution 4.0 for work in the 21st century (Kuswidyanarko, 2017), where the abilities that students will need in this century include study skills, innovation, literacy, life skills, and character. One of the efforts made by the government through the 2013 curriculum program to improve the ability to solve problems for students is contained in content standards and graduate competency standards. In connection with the need for a tool to find models for thinking errors and patterns of improvement in solving math problem-solving problems.

In connection with the need for a tool to help teachers analyze student errors in solving mathematical problem solving problems. In this study, we will use NEA (Newman's Error Analysis) in analyzing student errors. The NEA provides a framework for considering the reasons underlying difficulties and helps teachers to determine where misunderstandings occur and where strategies are targeted to be effective in overcoming them. NEA was designed as a simple diagnostic method. The NEA is designed as a simple diagnostic procedure. Newman (1983) states that when people try to answer a mathematical problem it is written in sequence: (1) reading (decoding), (2) comprehension, (3) transformation, (4) process skills, and (5) encoding.

METHODS

Research Goal

This study aims to determine the factors that cause students' errors in solving math *problems solving* based on *Newman's Error Analysis* (NEA). This research is qualitative. This research was conducted at SMPIT Bina Amal Jl Gunung Pati-Ungaran Km 1,5 Plalangan Gunung Pati Semarang.

Sample and Data Collection

The subject of this study is a class VII student of SMPIT Bina Amal Semarang. This research uses descriptive qualitative method and using primer and scunder data. The collecting data techinic is docoment test and interview. The research subject is as much as 40 learners. They are 10 male up grade, and 10 male under grade, 10 female up grade and 10 female under grade. The data collection method is a test and interview. Each class is divided into 2, namely the upper class and the lower class. Each of the upper and lower classes was taken by 5 children. Taking ten children from each class for the interview subject. Interviews are conducted outside of class hours. Each subject got 30 minutes. The interview focused on the factors that caused errors in solving questions in terms of five aspects, namely: reading, comprehension, transforma tion, process skills, endcoding. Student error analysis data in the form of written answers to the description questions given. The answers are then analyzed based on the NEA developed in this study.

Analyzing of Data

The results of the analysis will obtain a description of the factors that cause students' errors in *solving problem-solving problems*. The results of the students' answers were also scored to choose the interview subject. The range of scores used was 0 - 100. The data were analyzed using statistics, namely, tables, histograms, and diagrams. Each question was analyzed using these statistics. The table also displays the percentage of students' answers. The collected interview process data is in the form of verbal data which is stored in the form of an electronic recording device. To facilitate analysis, data transcripts were made. The data transcript will provide an overview of the reasons why students cannot solve *problem-solving problems*. The data that has been collected is then reduced to obtain the necessary data, and discarding the ones that are not needed. The results obtained in all the analysis processes were then concluded descriptively comparative.

RESULTS AND DISCUSSION

The data obtained from this study consisted of two types, namely quantitative and qualitative data. As stated in Chapter 3, quantitative data analysis is used to select research subjects. The

research was conducted in grade seven which consisted of four classes. The four classes are *grade* male upper(GMU),*grade* male lower(GML),*grade* female upper(GFU) *and grade* female lower(GFL). Subjects were selected from each class, namely five upper-class children and five lower-class children. Quantitative data were obtained from the test taker's answers followed by calculating the test taker's score in solving the questions.

The results of qualitative data analysis were obtained by looking at the steps for solving the questions written by the students and completed with the results of the interviews. Data analysis was carried out on students' answers to the questions given through tests combined with the results of interviews, to trace the types of errors. In general, the types of errors of research subjects in solving questions will be presented in Table 1.

Table 1. Type of Error 40 Students in Completing 12 Questions

NO	ASPECT	AMOUNT	OF PROBLEM	%
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

The error data of students in solving the questions for each class is presented in Table 2.

Table 2. Subjects Wrong Answer Results by Class

ASPEK	KELAS							
	GMU	%	GML	%	GFU	%	GFL	%
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

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 a different type of error, this question also has different factors that can cause errors.

Based on the results of data analysis and interviews, it was determined the types of errors of 40 students in *solving problem-solving questions* as many as 12 questions based on gender. The number of students based on gender consisted of 20 male students and 20 female students. Types of errors based on gender are presented in Table 3.

Table 3. Type Error unfounded

ASPECTS	MALE	%	FEMALE	%
READING	8	1.46	3	0.61
COMPREHENSION	13	2.37	6	1.22
TRANSFORMATION	131	23.86	105	21.34
PROCESS SKILL	198	36.07	189	38.41
ENCODING	199	36.25	189	38.41
JUMLAH	549	100.00	492	100.00

Factors Cause of Errors

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%, continued with *transformation* 22, 67%, *comprehension* 1.83%, and

low *reading* 1.06%.

Error *Encoding* is the largest error because this stage is the final stage in the process of analyzing the answers to learners. Other factors that cause errors are wrong in determining the final answer, unable to determine conclusions, incorrectly determining units. The investigation of other factors that influence the error is not only carried out at the error stage to conclude but also at the previous stage. Students do not do the reading and conversations but make mistakes at the next stage, namely the Transformation, Process Skills, and Coding stages (Rr Chusnul et al., 2017).

Errors based on Gender

Table 3 shows the types of errors of 40 students in solving 12 *problem-solving questions* based on gender. The number of errors from the 12 questions that the 20 male students did was 540. The number of errors from the 20 questions that the 20 female students did was 492. The percentage of errors for male students in the aspect
was *reading* 1.46%, *comprehension* 2.37%, *tran sformation* 23, 86%, *process skill* 36.07%, and *encoding* 36.25%. The percentage of female students' errors in the aspect was *reading* 0.61%, *comprehension* 1.22%, *tran sformation* 21.34%, *process skill* 38.41%, and *encoding* 38.41%.

Discussion

Based on the analysis of students' errors in solving problems and interviews, weaknesses in the aspect of reading and comprehension learners are less careful in reading the problem. Many learners do not understand if there is a flat wake combined. Weaknesses aspect transformation, learners are incomplete or do not memorize the formula wake flat. Weaknesses aspect of processskill, many learners who do not understand the elements of flat wake. There are also learners who mis-conceptualize in calculating multiplication.

Weaknesses in solving problem solving problems based on NEA in general can be improved by practicing solving problem solving problems. Aspects of transformation can be corrected by memorizing formulas. Aspects of process skills can be corrected errors by understanding the elements of flat wake, the concept of multiplication, and changing units.

CONCLUSION

Based on the results of research and discussion, the following conclusions can be drawn. Factors that cause students' mistakes in *solving problem-solving problems*. (a) Not careful in reading the questions. (b) Cannot identify what is known from the problem. (c) Do not memorize the formulas for triangles and rectangles. (d) Wrong writing of the formula to be used. (e) Cannot determine the elements of the triangle and rectangular shape. (f) The misconception in the counting process. Students cannot determine the concept or procedure in solving problems (Dj Pomalato et al., 2020). (g) Do not know how to solve it. (i) Wrong writing of the final result of the question questions. Based on the results of the study, it was seen that there were differences in the results of working on the questions, male students made more mistakes than female students.

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