ANALYSIS OF STUDENT ERRORS IN SOLVING ALGEBRA OPERATION PROBLEMS IN SMP STUDENTS BASED ON WATSON'S CRITERIA

Hendriyeti Andini Tagumara[1*], Sri Hariyani[2], Trija Fayeldi[3]

[1]Mathematics Education Study Program, Faculty of Teacher Training and Education, University of PGRI Kanjuruhan Malang, Jl. S. Supriadi No.48, Bandungrejosari, Kec. Sukun, Kota Malang, Jawa Timur 65148

ABSTRACT

The purpose of this study was to analyze student errors in solving algebraic operations problems based on Watson's criteria. This type of research is descriptive qualitative research with a qualitative approach. The research subjects were 2 low error students, 2 moderate error students, and 2 high error students. The instrument used is a written test about the operation of algebraic forms and interviews. Checking the validity of the findings using a source triangulation technique, namely, by comparing student test results and interview results. The results showed that the types of errors made by students were incorrect data, incorrect procedures, missing data, missing conclusions, skill hierarchy problems, response level conflicts, and indirect manipulation.

Keywords: Error Analysis, Algebraic Operation Problems, Watson Criteria

1. Introduction

Mathematics is a science that is very close to everyday life. Although there are many problems in our daily life, not all of them are mathematical problems, and mathematics has an important role in solving these daily problems (Nurdiawan and Zanthi, 2019). This means that mathematics is needed by everyone in everyday life to help solve problems. The importance of mathematics in everyday life to train logical, analytical, systematic, critical, and creative thinking skills and provide the ability to work together.

Errors are a form of deviation from the actual answer that is structured (Mubarok et al., 2017). Error analysis is an attempt to investigate a deviation event from an answer to find out what caused an answer deviation event to occur (Hoar et al, 2021). As according to Suciati and Wahyuni (2018), students' mistakes need to be analyzed to find out what mistakes were made by students.

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[*] Corresponding Author.
E-mail: yeti.tagumara20@gmail.com

Phone: +6281357028761

Through this analysis, the type and location of the error will be obtained, so that educators can provide the right solution so that errors can be corrected, and do not happen again.

Error analysis has proven to be an effective method for identifying students' mathematical errors. Analysis of student errors can be used to investigate the types of student errors so that appropriate solutions can be found as an effort to improve learning outcomes (Ariyana et al. 2019).

Based on the results of initial observations made at SMP PGRI 6 Malang, it was stated that there were still errors made by students when solving questions on the material in the form of Algebra. Mistakes made, for example, students are often wrong in determining the same variable so that it will have an effect in determining the final result.

Based on these problems, we want to analyze and identify the types of errors that students make in solving algebraic questions. If students' mistakes in solving problems are known, expected that students will not make the same mistakes when working on algebraic questions.

By knowing the types of errors in solving algebraic questions, the teacher is expected to be able to determine the things that are mastered when working on questions on algebraic form so that they can reduce the same mistakes.

In this study, Watson's criteria were used to idealize students' mistakes in solving the given questions. The error criteria according to Watson (Kasana & Khotimah, 2019) consist of eight errors, namely: (1) inppropriate data (id), (2) inppropriate procedure errors (ip), (3) omitted data (od), (4) omitted conclusion (oc), (5) response level conflict (rlc), (6) undirect manipulation errors (um), (7) skills hierarchy problem (shp), and (8) above other (ao).

Based on research conducted by Ningsi (2019), the results showed that various types of errors were caused, including: (i) the data was not correct, students did not understand the meaning and application of concepts that were not correct; (ii) in inappropriate procedures, students are less careful in performing multiplication operations and are wrong in working procedures; (iii) in missing data, students ignore one of the completion stages; (iv) in missing conclusions, students have not been able to conclude the final result; (v) in the response level conflict, students write answers by not using the correct method according to the concept; (vi) in the skill hierarchy problem, students have not been able to manipulate the basic formula into the required formula. The research conducted by Saputri, et al (2018). Based on the results of these studies, male students tend to make data omission errors with 13.33%, conflict response rate is 13.33%, and 16.67% above others. Female students tend to make mistakes eliminate the conclusion by 24.14%.

In previous studies, the material used was Circles and Functions, while the material in this study was the material for operations on algebraic forms. The reason the researcher chose the material was because when the researcher made observations on the material, there were still many students who had difficulty in solving the problems of the operation of the given algebraic form.

2. Research Methods

The type of research used in this research is descriptive qualitative research. The researcher uses qualitative descriptive research because the researcher wants to describe the situation that will be observed in the field more specifically and in depth. The place of this research was carried out at SMP PGRI 6 Malang. The school was chosen because there are still many students who make mistakes in working on the questions. The research subjects were selected from class VII B students consisting of 2 students having low errors, 2 students having moderate errors and 2 students having high errors. The procedure for this test includes: (1) creating a grid of algebraic operations; (2) arrange the questions according to the grid; (3) create alternative answers and scoring guidelines; (4) validate test questions to mathematics lecturers and teachers; (5) question revision.

Interviews were used in this study in order to find out information on research subjects slowly and more clearly. Semi-structured interviews were used in the analysis of this research, with the aim of finding students' mistakes in solving test questions on algebraic operations material more openly, where the interviewed subjects began by asking structured questions, then one by one deepened to seek further information. . This interview was conducted after the implementation of the test.

The data analysis technique used in this study is a qualitative descriptive analysis technique with the following steps: (1) data reduction; (2) data presentation; and (3) drawing conclusions.

Checking the validity of the data in this study using triangulation techniques. The triangulation used in this study is the triangulation method, with the aim of comparing test result data, interview data and documentation. The research stages used are the planning stage, the implementation stage and the final stage.

3. Results and Discussion

Based on the results of the written test students completed, the students were then divided into 3 groups, namely the low error group, the medium error group and the high error group. Then each group took 2 subjects to be interviewed. The following is a list of research subjects selected for the interview.

Table 1. Interview Subjects

No.	Subject Code	Category
1	P_6	Low error
2	P_{14}	Low error
3	P_7	Moderate error
4	P_{19}	Moderate error
5	P_{15}	High error
6	P_{24}	High error

Subjects P_6 representing low error groups

The results of the P_6 test work can be seen in the following figure 1.

Figure 1. Results of the P_6 test against S1

Based on the results of the work that has been done P_6 in figure 1, the researcher analyzed that P_6 did not provide conclusions at the end of solving the problem, even though P_6 had obtained the final result of the given problem. From the results of the work, it can be seen that P_6 made a mistake in the omitted conclusion.

Subjects P_{19} representing the moderate error group

The results of the P_{19} test work can be seen in the following figure 2.

Figure 2. Results of the P_{19} test against S2

Based on the test results above, researcher concluded that P_{19} was able to solve question number 2, but there were still several

mistakes made including incorrect data errors, the results of the work above showed that the data asked, P_{19} wrote it was not right. P_{19} also made another mistake, namely improper procedures, P_{19} can solve the problem, but the procedures used are not appropriate. P_{19} directly determines the final result. Another mistake made by P_{19} is the problem of the skill hierarchy, P_{19} there is a problem in doing calculations, so that P_{19} directly determine the final result. Another mistake made by P_{19} is undirect manipulation, because P_{19} obtain an answer by not providing a way in the completion stage, but rather P_{19} directly writing the final result. In addition, P_{19} make a mistake the omitted conclusion, because P_{19} do not write the conclusion of the final result obtained.

Subjects P_{24} representing high error groups

The results of the P_{24} test work can be seen in figure 3 below.

Figure 3. Results of the P_{24} test against S3

Based on the test results above, the researcher concluded that P_{24} was able to solve question number 3 given, but there were still some mistakes made including incorrect data errors, P_{24} had written down the data that was known completely, but P_{24} made mistakes because they did not write down the data asked in full. P_{24} also made another mistake, namely inppropriate procedures, because P_{24} could not solve the given questions. Other mistakes made by P_{24} are skill hierarchy problems, P_{24} not solving the given questions because they are unable to do calculations, omitted data, because P_{24} are unable to solve the problem until they find the final result, response level conflict errors, because P_{24} confusion in doing the questions, and other mistakes made P_{24} namely undirect manipulation errors, because P_{24} cannot continue working on the question, and P_{24} make mistakes the omitted conclusion, P_{24} does not write down the final conclusion, because at the stage of work P_{24}

cannot solve the problem according to the expected procedure.

Incorrect data errors are mistakes made by students because they do not write down known data and data asked about the question. In addition, the research subject was wrong because they did not write down the complete data known and asked about the problem, resulting in improper problem solving. This is in line with the opinion of Fathiyah (2020) which states that the form of student error is generally because students only write the final answer without a process of work, misinterpret the intention of the question, are unable to mention the components that are known and asked in the question, and do not know the meaning of the symbols on the question.

The error of students who cannot determine the initial formula or is wrong in determining the initial formula of working on the problem, resulting in the final result of the completion experiencing an error. In line with Eviati, et al (2019) stated that the mistakes in working on student questions were caused by students who did not understand the concepts, were not careful and hadty in doing the questions. In line with Mafruhah (2019) stated that the error in solving the given questions was because students did not know the formula to be used.

Students do not write down data in the process. Students lose data, resulting in an incorrect end result. In line with Sartika (2020) stated that the missing data errors made by students were caused by students who lacked focus in calculating existing data. Data loss is the result of inaccuracy and inaccuracy when solving problems, according to Sari (2018).

The mistake of the omitted conclusion is the mistake of the student not writing the conclusion after finding the final result. There are also students who give conclusions, but they are not in accordance with what is meant in the questions or conclusions written incompletely. In line with Aisyah, et al (2019) stated that the symptoms of missing conclusions are that students show the right reasons then fail to conclude with the results of the right answers.

Students make mistakes in response level conflicts because students are confused in the process of working on the questions, so students are unable to solve the questions until they find the final result. In line with Mulbar, et al (2022) stated that in this response level conflict error, students did not understand the concept of working on the problem so they failed to get the right conclusions.

The mistakes made by students are undirect manipulation errors, obtaining answers by not providing a way in the completion stage, but directly writing down the final result of solving the problem. In line with Suryani, et al (2021) stated that students find the final result without the process of work because the student is in a hurry so they do not describe the process to get the data anymore.

The reason why students make mistakes is a skill hierarchy problem because students are not careful when doing the questions. It is marked that the student has done the calculation, but the results obtained have an error. In line with Wahyuningtias (2018) stated that students are not careful in doing calculations and students are wrong in calculating because students are in a hurry in doing the questions. This is supported by Kasana and Khotimah (2019) stated that the error of the skill hierarchy problem was caused because students lacked confidence in solving problems and were not careful when carrying out the calculation process.

Errors in addition to the other seven categories, in this error, it is interpreted that the student is unable to answer the question or just write back the question. The error in this criterion is the student's ability to understand the problem is low. In line with Fadiastuti (2018) stated that students' mistakes in working on math problems are low ability to understand the meaning of the problem. Then, errors other than the other seven categories occur when students do not respond to the question because they do not understand the material (Kamariah, 2018).

4. Conclusions

From the results of research on students of SMP PGRI 6 Malang in the 2021/2022 academic year and the discussion, it can be concluded that the errors made by students are as follows: (1) Incorrect data errors made by students, namely students did not write down known and asked data. . (2) The student's error in the incorrect procedure was not being able to work on the problem until he found the final result, even though the initial steps used were correct in solving the problem. (3) Omitted data made by students, namely losing data at the problem solving stage. (4) Omitted conclusion made by students, namely not writing conclusions even though students have obtained the final results, students writing conclusions but not being precise or incomplete and students not giving conclusions

because they cannot complete the questions to the final result stage. (5) The response level conflict error made by students is that students are confused in the process of solving the problem. (6) Undirect manipulation errors, students do not write down the process of working on the questions and students find the final results without any process of working on the questions. (7) Errors in skill hierarchy problems, students are not able to do calculations in working on questions and do not perform calculations correctly. (8) Errors other than the other seven categories, are marked by students not answering at all the questions given. In this study, there were no research subjects who made mistakes other than the other seven categories.

The results of this research and findings can be input for further researchers to develop more details about better research instruments, so that student errors can be identified.

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