ISBN: 978-602-361-102-7

NEWMAN PROCEDURE: ASSESSING 4TH GRADE STUDENTS' ERROR ON FRACTION WORD PROBLEMS

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Abstract: Understanding the meaning of Mathematics symbols and formulas taught by teachers is always a challenge for students, not to mention when the questions are in form of word problems. This study, that analyzes students' error on written Mathematical tasks, aims to identify the forms of error made by students and to determine the cause factors of the errors. This qualitative descriptive study uses phenomenology design. Main research data were written answers from 29 grade four students that were analyzed to determined the composition of errors types. Ten students, purposively sampled, were semi-structured interviewed using Newman Procedure. Structured interviews with the teacher and other students were also conducted to collect supporting data about the cause factors of error. Observation resulted the external cause factors during teaching and learning process. This study concluded that students' errors on fraction word problems easy and medium levels were dominated by calculation errors. In those levels, few students had difficulties in understanding the task. In hard level, students' errors on fraction word problems were dominated by transformation and understanding task errors. Further, the study found that the influencing factors to those errors were originated from students' recklessness and misconceptions.

Keywords: Mathematical error, word problems, fractions, Newman procedure

INTRODUCTION

Until now, mathematics is still regarded as a difficult, unpleasant subject and challenging concepts for many students. These misjudgement views cause students to dislike mathematics, experience difficulties or errors in learning mathematics and cause problems in working on mathematics. Sajadi et al. (2013) states that in those situations, teachers must give verbal instructions to solve such problems for students to be able to meet their real-world problems. So according to Sajadi in situations where students experience difficulties, the teacher must give verbal instructions explicitly and provide concrete examples so that they can solve the problem. Difficulties and errors experienced by grade IV students while working on fractions word problems, from interviews conducted with class IV teachers at SD Negeri 3 Kenteng, showed mistakes made by students when working on the different denominators and the error occurred when equating the denominator. According to the Hajj in Ermawati and Mulyadi (2014), to solve mathematical word problems correctly students need initial abilities, namely the ability to: 1) determine what is known in question 2) determine what is asked to do 3)

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make mathematical models 4) do calculations and 5) interpret the model answer to the original problem.

Errors made by students in working on fraction word problems if ignored will lead to unsatisfactory results. In addition, these habits will remain until students grow up so that misconceptions are present in their daily life. To overcome this, the mistakes of students working on fraction word problems need to be analyzed, one of which is using the Newman Procedure. Saleh, et al. (2017) mentions that "many countries implement Newman procedures to determine the type of mistakes made by students in solving mathematical problems." The results of the error analysis will certainly provide a clear picture of the cause factors and support factual learning strategies for individuals. Thus, the teacher will be able to provide assistance that is really needed for his students.

APPROACH & RESEARCH METHOD

The study began by testing 29 fourth grade students in SDN 3 Kenteng with 4 fraction word problems in accordance with the fourth grade elementary school mathematics curriculum. The first problem has an easy level in the form of adding fractions with the same denominator. Questions number two and three have a moderate level because they involve the addition and subtraction fraction operations with different denominators. The last question is a question with a high level because it is a question with a mixed counting operation. The fourth problem solving has several stages. Ten test results were selected for analysis based on the lack of accuracy of the answers. Ten students, purposively sampled, were semi-structured interviewed using the Newman Error Analysis Procedure, with the consideration that they had different inaccuracies in answers and were representative of the variations of student errors. The first two stages of the Newman procedure, Reading and Understanding, indicate that students have captured the mathematical context of the question correctly, while in the next three stages, Transformation, Calculation, and Writing Answers, indicate that students have succeeded through the process of the mathematical stages needed to solve the problems (Prakitipong & Nakamura: 2006; Singh et al., 2010). Therefore, the Newman procedure is the apropriate procedure to find out whether students' difficulties originate from weaknesses in language skills or mathematical content in word problems.

Those data were then presented, described and examined with other field data: structured interviews with the teacher and other students were also conducted to collect supporting data about the cause factors of error and observation to record external cause factors during teaching and learning process.

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RESULTS AND DISCUSSION

a. Errors made by fourth grade students in working on the fraction word problems

The results showed that 4 questions worked out by 29 students were answered correctly in question number 1 by 7 students, number 2 by 5 students, number by 3 students, and question number 4 by 4 students. Students' mistakes in completing mathematical fraction word problems are analyzed using the Newman procedure, which consists of (1) reading and knowing the meaning of symbols, keywords, and terms in the question; (2) understand the contents of the question; (3) problem transformation; (4) process skills and (5) answer writing. The following are the results of the recapitulation of students' mistakes in solving fraction word problems based on the Newman procedure:

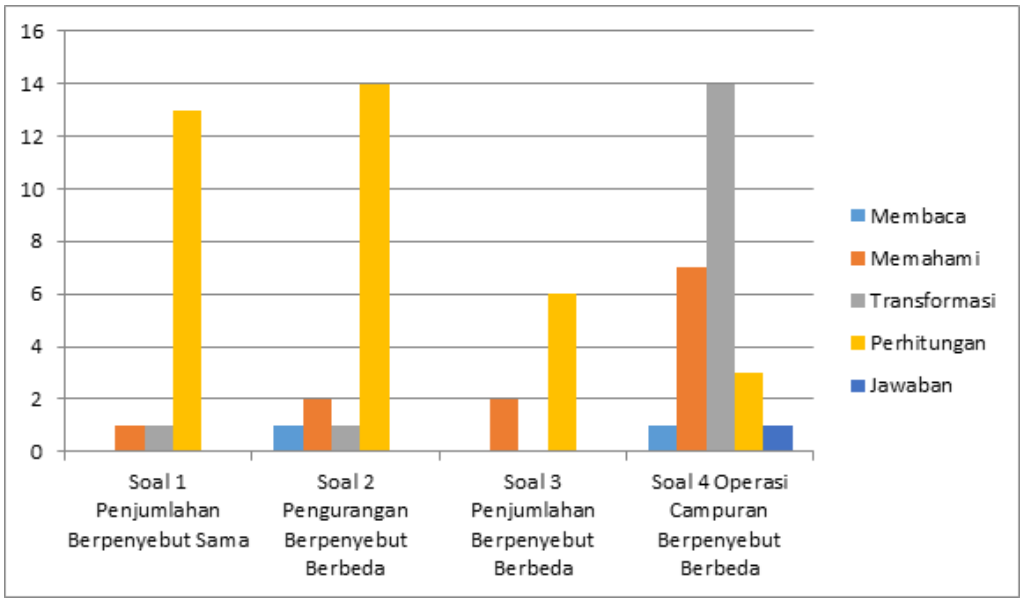

Diagram 1. Recapitulation of Student Errors in Resolving Mathematical Fraction Word Problems Based on Newman's Procedure

Diagram 1 shows error types made by students in each item. In question number 1, most students, 13, have an error in the calculation process, 1 student have misunderstanding or misconception and 1 student have a transformation error. However, there are 14 students answered correctly on item number 1. Similar data were withdrawn from students' answer of item number 2. There are 14 students who experience errors in the calculation, 1 student have an error in reading the task, 2 students have misunderstanding or misconception, and 1 student have transformation error. Eleven students answered correctly for question number 2. In the students answer for question number 3, there are 6 errors in calculation and 2 errors in understanding. There are 11 students who answered correctly in question number 3, which showed that the calculation error was the dominant errors made by students. And for the last question, most students' error are transformation, as many

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as 14 students. Reading error occurs in one student, misunderstanding or misconception in 7 students, counting mistake in 3 students and answer error in 1 student. There are only 3 students answered correctly and 1 student did not answer the question. The calculation errors and transformation errors are 47 times and 16 times. Error in understanding the problem occurs 12 times, reading error occurs twice and writing errors of answers is present once. The following is an explanation of each student's erros in working on fraction words problems and questions:

1. Reading Error

The reading error is caused by inability to read or recognize symbols or keywords and unable to understand the meaning of the symbol (Jha, 2012). It is in line with Cockburn (2005) that expressed mistakes in reading questions occur when students misrepresent each word contained in the problem. In this study, there are 2 reading errors. An example of this type of error is shown below:

Student 3 (S3), question number 2

"Pak maman memiliki pipa sepanjang $\frac{7}{9}$ m. Kemudian pipa tersebut dipotong sepanjang $\frac{3}{4}$. Berapa meter sisa pipa Pak Maman sekarang ?"
Interview record S3:
P : Dek dibaca soal Nomor 2?
*S : Pak Maman memiliki pipa sepanjang **dua per sembilan** meter. Eh bukan mbak tujuh per sembilan deng. Kemudian pipa tersebut dipotong sepanjang $\frac{3}{4}$. Berapa menter sisa pipa Pak Maman?*

Based on the interview, S3 read number 7 (tujuh) as 2 (dua). A few reading errors in the class, indicate that students do not have a significant problems in reading the questions given (Yusof & Malone, 2003). Two indicators in reading errors are errors in reading keywords or symbols in the question and errors in reading the questions. Zakaria, et. al. (2010) suggested that reading errors do not due to misconceptions but due to carelessness in working. This error in reading is low because generally grade IV students can read well but only a few students make mistakes. Reading errors are included in the low category (Singh et. Al., 2010; Mulyadi et al. 2015).

2. Error in Understanding Mathematical Problem

Error in understanding the problem is an error caused by inabilty of students to understand the overall meaning of a problem, to write what is known and asked, and to explain the problem (Jha, 2012). Cockburn (2005) suggests that misunderstanding is not just when students cannot understand the meaning of words or sentences. Students may know various possible meanings of a word or sentence but cannot use it in accordance with the context in question. The following is an example of one of the research subjects who did not write down what was known and asked.

ISBN: 978-602-361-102-7

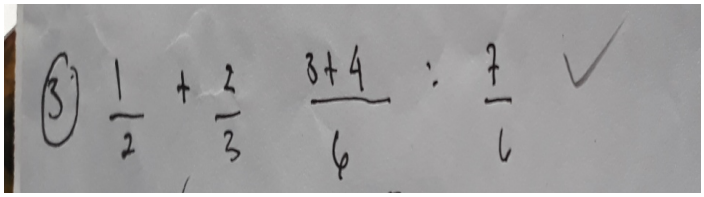

Figure 1 S18 inability to write his understanding thoroughly.

Based on the answer sheet of S18, it can be seen that he did not write down thoroughly, even though he is able to answer the questions correctly. Errors in understanding a problem are usually happening because students do not understand the meaning of the problem. Priyani & Ekawati (2017) said "some of the conceptual errors were translating word problem to mathematics problems". This shows that students must be able to understand the problem by using mathematical language. The indicator in understanding this problem is not writing down the known and asked in the answer sheet. All students did not write down what was known and asked at all that made the researcher enter into the wrong perception. However, based on the student answer sheet it turns out most students can understand information well even though they are not writing clear known and asked information from the word problems.

3. Transformation Error

Transformation errors occur because students cannot determine what formulas are used to solve problems and cannot determine mathematical operations or operations to solve the problem (Jha, 2012). Priyani & Ekawati (2017) suggest that students who cannot calculate correctly are included in the category of operational errors. In the results of the study there were 16 errors in transformation errors. The following is an example of an error that S4 made in question number 2.

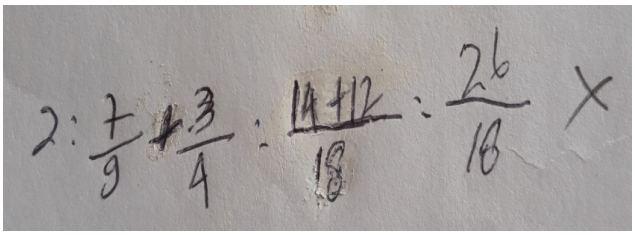

Figure 2 S4 error in transformation.

Based on S4 answer, his mistake is in determining the count operation. In the answer, S4 uses an addition operation as an attempt to find the same denominerator. This result implies that even though the student is able to read and understand but he cannot process it correctly. This is in accordance with the results of the research by Yusof & Malone (2003) that transformation errors have

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a high percentage. The indicator for this transformation error is an error in determining the calculation process.

4. Calculation Error

The error of the calculation process occurs because students do not know the process to solve the problem even if they have determined the formula correctly or cannot run the procedure correctly even though they have been able to determine the mathematical operations that are used correctly. The analysis and result show the calculation errors in a sum of 47 times. Following is an example of an error made by S29 on item number 1.

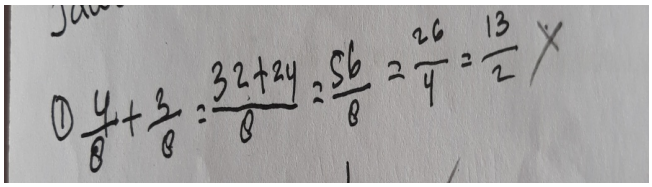

Figure 3 S29 error

From S29's answer, it can be seen that she completed the task but has difficulty in the process of counting, namely making mistakes in determining the denominator. She changed the denominator, yet in the addition and subtraction operations if the denominator is the same then there is no need to change the denominator.

Morales (2014) suggests that students at all levels (elementary to college) often have difficulty calculating fractions correctly. In this error, students are able to understand the problem, are able to determine the count operation that is used but because they misunderstand the concept of the denominator and numerator, the student is incorrectly work on the answer. This is in accordance with the study of Zakaria et. al. (2010) that students make miscalculations because they do not understand the concept.

5. Answer Writing Error

Error answer writing occurs when students are able to do calculations but are wrong in writing down the answers, Cockburn (2005). This error occurs once. The student has done the process of doing it correctly, but because of the forgotten factor, the unit is not written in the answer sheet or the answer is written differently than what was intended. This is consistent with the study of Zakaria et. al. (2010) where he found 4.41% respondents who are knowing the concept but careless when working on it. The following is an example of S15 in point number 4.

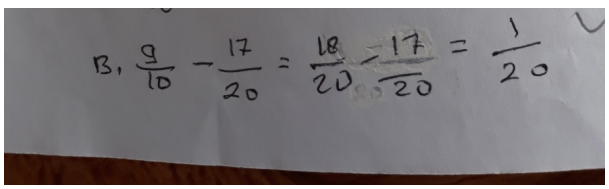

Figure 4 S15 error to not write the unit.

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Based on the answer S15, it can be seen that the student does not write down the unit in the answer to question number 4, even though he completed all steps and wrote the correct calculation.

b. Errors Causing Factors

The cause factors were obtained from the results of student interviews and analysis of student answer sheets. The following are the difficulties and factors causing errors in students:

Table 1 Cause Factors

No.	Cause Factors	Questions				Total
		1	2	3	4	
1.	In haste	0	1	2	1	4
2.	Forget	0	0	0	1	1
3.	Careless	0	1	0	0	1
4.	Misconception/misunderstanding	1	0	0	1	2
Σ	Jumlah	1	2	2	3	8

Based on the table above, the factors causing student errors in working on fraction word problems are mostly because students want to finish their work as early as possible. This is in accordance with the results of the study of Paladang et al (2018) which suggested that one of the factors that caused students to make mistakes in working on mathematical questions was not thorough and in a hurry to do the questions. The second cause factor is due to students' misconception, especially related to the different denominator. Students are having difficulties in grasping the concept of why they have to change the denominators of the two numbers into the same denominator. Based on the observation of the teaching and learning process, teacher did not give concrete activities for his student to understand that concept. The other two cause factors are careless and inability to remember. The factor of forgetfulness is the smallest factor of this study because forgetting is a natural thing so not all research subjects experience these errors.

CONCLUSION

Based on the results, it can be concluded that the students' error in working out the questions in the fraction word problems are dominated by calculation errors, transformation errors, and errors in understanding the problem. Calculation errors are caused by students not knowing the concepts being taught so they cannot understand the questions. Transformation errors occur because most students do not know the counting operation used to solve the problem. The questions presented in the form of words require high understanding to translate in mathematical language. Errors in understanding the problem are evident from students who did not write the known and asked on their sheet. Factors that cause students to make mistakes in working on fraction

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word problems are factors of haste, forgetting, mistakes in calculating operations, and not understanding the concept. The solution that can be done by the teacher to minimize the mistakes of students working on the fraction word problems is to provide motivation, provide concrete and hands-on activities, explain and correct the misconceptions, and give rewards to excellent and responsible students.

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