JOURNAL LA EDUSCI

VOL. 02, ISSUE 01 (020-027), 2021
DOI: 10.37899/journallaedusci.v2i1.367

Mistakes in Mathematics Problems Solving Based on Newman's Error Analysis on Set Materials

Sutidte Noutsara[1], Tumkom Neunjhem[1], Watchaeeya Chemrutsame[1]

[1]*Faculty of Education, Silpakorn University, Thailand*

**Corresponding Author: Sutidte Noutsara*

Article Info

Article history:
Received 14 April 2021
Received in revised form 19 May 2021
Accepted 27 May 2021

Keywords:
Set Material
Error Analysis
Problem Solving

Abstract

The purpose of this research is to illustrate students' errors using Newman's methods for working on problems in mathematical set materials as a basis for description. For the purpose of gathering data, researchers make observations both before the start of a study and throughout the course of the study, that is, when students are working on the exams that are provided. Unstructured observation is the kind of observation that will be utilized by researchers in their investigations. The exam is also used to evaluate students' errors in completing math narrative problems using provided material, which is based on Newman's Error Analysis. During the interviews, students are interviewed one at a time in order to make it simpler for researchers to explain the errors they made while attempting to solve the provided issue. The result of the study shows that High Ability Category experience reading and comprehension errors. They also experience a transformation error in the problem-solving stage of the problem. The problem of process skill is to determine the slice of the set. The answer obtained is not correct and does not match the answer on the question, so the subject makes a mistake at the skill stage of the process.

Introduction

One of the methods or processes that can be used to analyze students' mistakes in working on math problems, especially in the story, namely Newman's Error Analysis. Newman's error analysis is a procedure that can be used to investigate a mistake while working on a story-shaped math problem. Newman's procedure was obtained by Australian maths teacher in 1977, Anne Newman. There are 5 procedures that we work on to get information about the mistakes that students make when working on math problems in the form of stories.

Newman's procedure is the process of investigating mistakes made while working on the story (Baumeister & Newman, 1994). In the Newman method, there are 5 types of errors or errors in working on the story, namely: (1) Reading Errors (errors in reading the problem), (2) Comprehension Errors (errors in understanding the problem), (3) Transformation Errors (errors in problem transformation), Process Skill Errors (process skill errors), and (5) Encoding Errors (errors in writing answers).

A set is a group of things that can be defined in real terms until it is able to be clearly understood objects that do not belong to the set. Studying a set of learning means having to study a basis even though the material does not have various formulas but uses various notations, variables and venn diagrams (Oldford & Cherry, 2006). The basic characteristics of the set when solving problems that are problems in the form of stories require basic thinking in order to be able to analyze and work on the set problem (Jonassen, 2010).

In solving math problems, of course, many mistakes are experienced. Errors are defined as deviations from the truth and are systematic, consistent, or incidental in certain areas. In the

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

learning process, teachers must be able to understand the errors experienced by students and the causes of these errors. By understanding and knowing it, the teacher can work on solving the problem. Problems in mathematics are usually related to math problems. There are many forms of math problems, one of which is the form of story questions (Ahmad et al., 2010). Solving math story problems is not just getting results in the form of answers to the questions asked, but more importantly students must know the steps to get the answers (Ball et al., 2005). The steps in solving story problems include reading and understanding, making calculation models, and doing calculations and drawing conclusions (Nurkaeti, 2018; Arafahanisa et al., 2020). If there is an error in one of the resolution steps, it will result in an error in the next step.

In math lessons there are several methods or procedures in analyzing students' mistakes in solving problems (Hwang et al., 2007; Rushton, 2018). One of the procedures in analyzing errors in solving problems, especially in the story, is the Newman's Error Analysis method or procedure (Priliawati et al., 2019; Yunus et al.,2019).). The beginning of the introduction of the Newman Error Analysis procedure was in 1977 by Anne Newman who was a maths teacher in Australia. Newman's procedure is the process of investigating mistakes made while working on the story. In the Newman method, there are 5 types of mistakes or mistakes in working on the story, namely; Reading Errors, Comprehension Errors, Transformation Errors, Process Skill Errors, and Encoding Errors.

In accordance with the observations and interviews conducted to teachers of mathematics subjects, it is obtained an explanation of the material that is considered difficult to understand until there are 20 out of 27 students still always experience mistakes when working on the story of the set material. Lack of understanding of learners when working on the form of stories becomes a common problem (Jupp, 2013). The reason is because there is still a lack of proficiency of learners to do analysis on the problem and still very little understanding of the concept

Methods

The type used in this study is a qualitative descriptive research type that aims to describe students' mistakes based on Newman's procedures for working on problems in mathematical set materials. In collecting data, observations are made by researchers at the beginning of the study and at the time of the study, namely observations while students are working on the tests given. The type of observation that will be used by researchers is unstructured observation. The test is also used to determine students' mistakes based on Newman's Error Analysis in solving math story problems on set material. Interviews are conducted one by one in turn so that researchers are easier to describe the mistakes experienced by students in solving the given problem.

Results and Discussion

Table 1. Math Initial Ability Test Result Score List

NO	Early Math Skills of Students		
	High	Moderate	Low
1	90		
2	80		
3		70	
4		70	
5			50
6			40

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Table 2. Student's Work in Completing Diagnostic Tests in accordance with Newman's Various Mistakes

No	Category	Group 1					Group 2					Amount
		RE	CE	TE	PSE	EE	RE	CE	TE	PSE	EE	
1	High			√				√		√	√	4
2	High				√	√		√				3
3	Moderate		√			√		√	√	√	√	6
4	Moderate	√							√	√	√	4
5	Low		√		√	√			√	√	√	6
6	Low			√	√	√		√	√	√	√	7

RE: *Reading Errors*
CE: *Comprehension Errors*
TE: *Transformation Errors*
PSE: *Process Skill Errors*
EE: *Encoding Errors*

Subjects of High or High Ability Category

Reading Errors

Problem number 1 is determining the slice of the set, the subject has written the main information contained in the question correctly and has read the question correctly during the interview process so that it is said not to experience misreading. From question number 2 which is to determine the combined set, the subject has written the main information according to the question correctly and is able to read the question correctly during the interview process so that it is said not to make mistakes when reading the question.

Comprehension Errors

Question number 1 is to determine the slice of the set, the subject has written the known thing and the question is asked correctly and with the symbol of the right set and at the time of the interview process the subject can present all the information of the question and also has understood the requested and the questioned matter, therefore the subject does not misunderstand the question. From question number 2 which is to determine the combined set, the subject has written what is known in the question and the question correctly and with the right set symbol and at the time of the interview process the subject is able to explain all the information on the question and able to understand what is asked or asked of the question so that the subject does not experience a mistake in understanding the question.

Transformation Errors

Problem number 1 is to determine the slice of the set, the subject does not write the appropriate formula to work on the question, the subject immediately sums the whole and in the interview process the subject says that there is an appropriate formula to determine the slice of the set but do not remember the formula so that the subject experiences a transformation error of the problem. In question number 2 which is to determine the combined set, the subject does not write a formula to solve the problem, the subject immediately sums the whole and also reduces the number of all students to look for an x when it is not appropriate and at the time of the interview the subject has said that he did not write the formula because he forgot the formula to solve the problem so that the subject made a mistake in the transformation stage of the problem.

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Process Skill Errors

Problem number 1 is to insert the set slices, the subject can perform the number operations correctly and correctly and produce the right answers and in the interview process, the subject is convinced that the results of the operation he is working on are correct until the subject does not do the problem of process skills. Problem number 2 is to determine the combined set, the subject has made a mistake transformation problem, so also make mistakes at the stage of process skills even though the operation that has been launched is correct, but the answer obtained is not correct and does not match the answer of the question on the question so that the subject has made a mistake at the skill stage of the process.

Encoding Errors

In question number 1 which is to determine the slice of the set, the subject writes the conclusion of the question correctly so that the subject does not make mistakes when writing the final answer. While in question number 2 that is determining the combined set, the subject has mentioned the conclusion in accordance with the conclusion of the answer obtained from the work done, but not precise because the answer obtained when working on the question is also not correct so that the subject makes a mistake on the writing of the final answer.

Medium or Medium-Skill subjects

Reading Errors

In question number 1 which is to determine the slice of the set, the subject is able to write the main information of the question completely and precisely and in the interview process the subject has read the question correctly and read the complete information in the question so that it is said not to make mistakes at the reading stage. Problem number 2 is to determine the combined set, the subject has written important information on the question completely and precisely and at the time of interview the subject has read the question correctly and read the complete information in the question so that the subject does not make mistakes at the reading stage.

Comprehension Errors

Question number 1 is determining the slice of the set, the subject misunderstands the problem because at the time of writing the information asked, the subject writes it incompletely even though the subject has written the information that is known in full, and at the time of the interview the subject is able to reveal what is known, but is wrong in mentioning what is asked. The subject admits that he forgot to write down what was asked in full after rereading the question well. Similarly, question number 2 is determining the combined set, the subject also makes mistakes when understanding the problem. He does not write the information known correctly, the subject writes it in words and does not write it in the proper set symbol and in the interview process, the subject reveals that he did not write down the information asked in the set symbol because the subject forgot the symbol or in the set.

Transformation Errors

In question number 1 which is to determine the slice of the set, the subject writes the right formula based on the question and in the interview process the subject is confident that the formula that has been written is correct so that the subject does not make mistakes in the transformation of the problem. Problem number 2 is determining the combined set, the subject encounters an error in the transformation stage of the problem, because the subject uses a formula not precise to work on the problem. And in the interview process, the subject

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

said that he was not sure about the formula written on the answer sheet because the subject did not remember the right formula at the time of working on the question so the subject wrote down just what was remembered.

Process Skill Errors

In question number 1 which is to determine the slice of the set, the subject is able to operate the numbers correctly and precisely so that it is said to have made mistakes in the process skills. Problem number 2 is determining the combined set, the subject makes a process skill error because the results obtained at the time of solving the problem are not precisely related to the formula used inappropriately and in the interview process the subject says that he is not sure of the answer obtained because he believes that the formula written on the answer sheet is incorrect.

Encoding Errors

Question number 1 is determining the slice of the set, the subject made a mistake writing the final answer because the answer to the conclusion that has been written the subject is not precise this is due to the writing of the information asked the subject is incomplete so that the conclusion written is not complete and in the interview process the subject said that he forgot to write the conclusion completely and the subject has also admitted that the answer he has worked on is not correct. Similarly, in question number 2 which is to determine the combined set, the subject also makes a mistake in writing the final answer. The subject has written the conclusion according to the results he has obtained, but it is not correct because the answers obtained are also not correct. And in the interview process, the subject has admitted the mistake made is a wrong formula so that the results obtained at the conclusion are not correct.

Low-Categorized or Low-Ability Subjects

Reading Errors

Problem number 1 is determining the slice of the set, the subject has set the main information contained in the question correctly and has read the question correctly during the interview process so that it is said not to make mistakes in reading. Problem number 2 is to determine the combined set, the subject has written the main information based on the question correctly and is able to read the question correctly during the interview process so that the subject does not make mistakes at the reading stage.

Comprehension Errors

Question number 1 is determining the slice of the set, the subject has written what is known and what is asked on the question correctly and with the right set symbol and in the interview process the subject has presented all the information on the question, what is known, what is asked and understands what is asked on the question and understands the symbol of the set well so that the subject does not misunderstand the problem. In question number 2 which specifies the combined set, the subject has written the known information on the question completely and accordingly the symbol of the set appropriately. The subject also writes the information in question appropriately using the correct set symbol. In the interview process, the subject is able to explain all the information known to the question correctly. When explaining the information asked, the subject mentions it correctly, but after being asked the meaning of the written symbol, the subject does not know clearly the meaning of the symbol, he writes the symbol because it is the only symbol that is remembered without knowing the meaning of the symbol. It causes the subject to misunderstand the problem.

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Transformation Errors

Problem number 1 is determining the slice of the set, the subject encounters an error in the transformation of the problem. This is because the subject does not include a formula for determining the slice of the set. The subject instantly sums the whole based on the information in the venn diagram that has been drawn. And in the interview process the subject says confidently that there is the right formula to solve it, but he does not know the formula so he does not write it down. Similarly, in question number 2 which is to determine the combined set, the subject also experiences a transformation error. This happens because the subject directly works on the solution without writing the formula of the problem solving and, in the interview, process the subject says that there is no other known way to resolve the question.

Process Skill Errors

Problem number 1 is determining the slice of the set, the subject makes a mistake in performing the calculated operation, he is wrong in getting the calculation results and in the interview process, the subject says that he is rightly wrong in performing the calculated operation because the subject has recalculated so that it is said to have made a mistake of process skills. Problem number 2 is determining the combined set, the subject also experiences a process skill error because in the process of transformation the subject problem does not write the correct formula so that the result of the answer operation obtained is incorrect and does not correspond to what is asked on the question.

Encoding Errors

Question number 1 is determining the slice of the set, the subject has written the conclusion well but not precisely because the answer obtained from the settlement is also not correct and in the interview process the subject said that what he did was wrong and has mentioned the answer that should have made the subject make a mistake when writing the final answer. Similarly, in question number 2 which is determining the combined set, the subject has made a mistake at the stage of writing the final answer because the result of the answer written is incorrect and in the interview process the subject also mentions the results of the conclusions worked and it is not appropriate because the results of the answer are not correct.

Students' mistakes in answering set material narrative questions were found to be 14.71 percent when they did not grasp the issue, 43.38 percent when they did not transform the issue, and 1.47 percent when they did not use process skills to solve the problems. Flagg (2014) stage, the reasons that create student mistakes while working on set narrative questions are as follows: a) Errors in Understanding the Problem (Comprehension Mistake), the elements that create this mistake are not being able to change to set notation and not writing what is being asked. b) Errors in Understanding the Problem (Comprehension Error), the elements that create this error are not being able to change to set notation and not writing what is being requested. b) Errors in Transforming Problems (Transformation Errors), the reasons that produce these errors are the inability to develop a solution to the given issue and the inability to write formulae correctly. While it comes to process skills errors (Process Skill Error), the element that contributes to this is the inability to recall that he made a mistake when doing calculations (Stamatis, 2003).

According to the findings of the research, the proportion of mistakes made by students ranged from the biggest to the smallest, with the biggest being the mistake in comprehending the issue (65.39 percent), the second being the transformation mistake (50 percent), the third being the mistake in drawing conclusions (40 percent), and the fourth being the reading

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

mistake (20.77 percent) (Kleijn, 2018). Question number 2 has the greatest proportion of student errors, with 90 percent of students making mistakes. As a result, students' ability to comprehend each phrase in the question as well as their counting abilities are required in order to complete question number 2.

According to the findings of the research, the following kinds of mistakes were made by students: First, there were reading mistakes in subjects with medium and low categories for all number of questions, which occurred because the subject did not write down the essential information of each question. Second, there were mistakes in subjects with high categories for all number of questions, which occurred in subjects with medium and low categories for all number of questions. Individuals in the medium and low categories have mistaken in comprehending the issue (Comprehension errors), and mistakes in comprehending the issue are observed in subjects in both the medium and low categories. While answering question number 1, low-ability subjects made mistakes, and when answering question number 2, subjects were divided into two categories: medium and low ability. The topics with high, medium, and low categories are discovered to have transformation mistakes, which are mistakes in the transformation of issues Individuals with high and low abilities made mistakes on question number 1, and there were subjects in the high, medium, and low categories make mistakes on question number 2. Fourth, mistakes in process skills were discovered in individuals who fell into the moderate-level categorization: Only individuals in the moderate group were affected by the mistakes in questions number 1 and number 2. (5) Mistakes in writing the final response (Encoding mistakes), errors in writing the final response to the transformation of the issue are discovered in individuals with high, medium, and low categories of difficulty in writing the final response with regard to question number 1, mistakes were encountered by individuals with high, medium, or low abilities, and with regard to question number 2, there were mistakes encountered by individuals from the same groups as question number 1.

In this study there are limitations of research that is due to the current condition that does not support to take data directly in school because students are not allowed to gather too much so this research is done virtually at the time of conducting early math skills tests.

Conclusion

Subjects in the High or High Ability Category make mistakes in their reading and comprehension skills. A transformation mistake is also encountered at the issue solution step of the issue solving process. During the interview, the subject must clarify all of the facts on the topic and ensure that he or she understands what is being asked of them or requested of them. He does not properly write the information that he knows and instead puts it in words, failing to utilize the appropriate set symbol in the process. During the interview process, the subject admits that he did not write down the information requested in the set symbol because he had forgotten what the symbol was or that the setting was in the wrong place.

References

Ahmad, A., Tarmizi, R. A., & Nawawi, M. (2010). Visual representations in mathematical word problem solving among form four students in Malacca. *Procedia-Social and Behavioral Sciences, 8,* 356-361.

Arafahanisa, R., Suhendra, S., & Nurjanah, N. (2020). Analysis of the Difficulties of Student's Problem Solving Skill in Pythagorean Theorems. *PROCEEDINGS STEMEIF*.

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)

Ball, D. L., Hill, H. C., & Bass, H. (2005). Knowing mathematics for teaching: Who knows mathematics well enough to teach third grade, and how can we decide?

Baumeister, R. F., & Newman, L. S. (1994). How stories make sense of personal experiences: Motives that shape autobiographical narratives. *Personality and Social Psychology Bulletin*, *20*(6), 676-690.

Flagg, V. L. (2014). *Newman's Error Analysis and mathematical language: Diagnosing mathematical errors on word problems made my 4th graders who attend a low SES school*. Mercer University.

Hwang, W. Y., Chen, N. S., Dung, J. J., & Yang, Y. L. (2007). Multiple representation skills and creativity effects on mathematical problem solving using a multimedia whiteboard system. *Journal of Educational Technology & Society*, *10*(2), 191-212.

Jonassen, D. H. (2010). *Learning to solve problems: A handbook for designing problem-solving learning environments*. Routledge.

Jupp, J. C. (2013). *Becoming teachers of inner-city students: Life histories and teacher stories of committed White teachers*. Springer Science & Business Media.

Kleijn, S. (2018). *Clozing in on readability: How linguistic features affect and predict text comprehension and on-line processing*. LOT.

Nurkaeti, N. (2018). Polya's strategy: an analysis of mathematical problem solving difficulty in 5th grade elementary school. *Edu Humanities| Journal of Basic Education Cibiru Campus*, *10*(2), 140.

Oldford, R. W., & Cherry, W. H. (2006). Picturing probability: The poverty of Venn diagrams, the richness of eikosograms. *Unpublished manuscript*.

Priliawati, E., Slamet, I., & Sujadi, I. (2019, October). Analysis of junior high school students' errors in solving HOTS geometry problems based on Newman's error analysis. In *Journal of Physics: Conference Series* (Vol. 1321, No. 3, p. 032131). IOP Publishing.

Rushton, S. J. (2018). Teaching and learning mathematics through error analysis. *Fields Mathematics Education Journal*, *3*(1), 1-12.

Smith, F. (2012). *Understanding reading: A psycholinguistic analysis of reading and learning to read*. Routledge.

Stamatis, D. H. (2003). *Failure mode and effect analysis: FMEA from theory to execution*. Quality Press.

Yunus, J., Zaura, B., & Yuhasriati, Y. (2019). Analysis of Students Error According to Newman in Solving Mathematics Problems of Algebra in The Form of Story in Second Grade of SMPN 1 Banda Aceh. *Jurnal Geuthèë: Penelitian Multidisiplin*, *2*(2), 308-313.

ISSN 2721-0979 (Print), ISSN 2721-1258 (Online)