The Students’ Errors in Answering Geometric Tests with Newman Procedures

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Abstract. This study aims to describe the kinds of the students’ errors and the factors causing the errors in answering math tests of geometry subject based on Newman procedures. The study used descriptive qualitative method. The research findings showed that the percentages of the students’ errors in answering math test of flat side space shape based on Newman procedures were: (a) the percentage of the students’ reading error was 17%, (b) the percentage of the students’ conceptual understanding error was 74%, (c) the percentage of the students’ transformation error was 83%, (d) percentage of the students’ process skill error was 87%, and (e) the percentage of the students’ errors in answer writing was 100%. The total percentage of the students’ errors was 72%. The factors that caused the students’ errors were that the students were not fluent in reading the tests and the students were lack of knowledge about signs in mathematic tests; the students did not have ability in writing what they knew and what was being asked in the tests correctly; the students did not master the subject of flat side space shape; the students were lack of practice in doing the exercises; the students only did the tests randomly; the students did not like math lesson; the students did not understand the method used in answering the tests correctly; the students did not understand the formula used; and the students were in hurry in doing the test.

1. Introduction

Education is conscious and planned effort to realize the learning atmosphere and teaching processes in order to make the students actively develop their self-potential to have spiritual-religious power, self control, intelligence, and the skills needed by themselves, society, nation, the state [1]. The effort in developing the students’ potential can be conducted through math learning processes, namely the learning that prioritizes the exact knowledge, right and straight to the target so that the discipline in thinking can be created and train the students to think simple, clear, precise, and fast. Therefore, math lesson should be taught to all students in every educational level to equip the students with logical, analytical, systematic, critical, and creative thinking as well as cooperation ability. Math lesson aims to make the students appreciate mathematic usefulness in life, such as having curiosity, attention, and interest in learning math, as well as tenacious attitude and confidence in solving the problem [2].

Mathematics is a lesson training students to develop and improve logical, critical, and creative thinking [3], and one of them is geometry. Geometry subject matter is a subject that discusses about the objects related to shapes and spaces, but as a matter of fact, there are still many students less master the geometry subject matter [4]. Mathematical thinking is an issue that has attracted many
mathematics educators [5]. There is a large body of varied literature including various conceptions of mathematical thinking, but there is a general agreement among researchers that the most important goal of mathematical education is to develop the ability to think correctly [6].

Based on the observation conducted by the researcher, it was found that the students’ learning achievement was still less satisfactory on geometry material. In MTs Muhammadiyah Tanetea of Jeneponto regency, especially class VIII, the students’ achievement in learning math of geometry material was still low. This is indicated from the documentation of daily test mean scores of geometry material of class VIII that is only 68 with Minimum Comprehension Criteria (MCC) of 75. It means that the mathematic learning achievement average is still far below MCC.

One way that can be used to determine the causes of the students’ low learning achievement is by analyzing the learning outcome errors in order to know the kinds of errors occurring commonly [7]. By analyzing the learning outcome errors, the teacher is expected can find the errors’ causes and the kinds of the students’ errors in doing the match tests especially related to geometry material. The information about the students’ errors in doing the mathematic tests is able to help the teacher in increasing the learning and teaching quality by emphasizing the matters that are not mastered by the students and are expected to avoid the same mistakes or errors [8].

Some methods usually used in analyzing the errors are like Newman Procedures, SOLO Taxonomy, and Polya, but in this research, the researcher used Newman Procedures to analyze the students’ errors or mistakes. The Newman Procedures make us easy to analyze the errors because it has five stages that should be passed by the students when solving the problem. Those five stages are reading stage, comprehension stage, transformation stage, process skill stage, and encoding stage. [9]

The Newman error analysis method was firstly introduced in 1977 by Anne Newman, a math teacher in Australia. As what Newman states that when the students try to answer a question in the form of story test, the students have passed series of obstacles and stages in answering the test, such as: reading the test, understanding and comprehending the test, test transformation, process skill, writing the answers (encoding) [10].

Revealing the mistakes or errors made by the students means that an effort has been made to find a way out to increase the students’ achievement. It encourages the researcher to examine and discuss about the condition with the aim to find out the kinds of mistakes or errors made by the students and the causes of the students’ errors in answering math test of Geometry subject matter based on Newman procedures.

2. Method
The study used descriptive qualitative research method. The study was described to collect the information about error analysis based on Newman procedures in answering the geometric tests. The research subject in this study was the second grade students of MTs Muhammadiyah Tanetea of Jeneponto Regency which consisted of 37 students. The students’ answers was then corrected and assessed. Then the researcher randomly took 5 students as the research subject from the students who got the lowest scores. The criteria of selecting those five students were based on the students doing 5 errors of Newman procedures as well as representing all the errors from 37 students. Furthermore, the researcher interviewed those five students to find out the factors causing the errors in answering geometric test. The data collecting technique in this study was through test distributed to the students to get the data from the students’ answers as well as conducting in-depth interview to know the factors causing the errors. The data validity used triangulation method technique. In this case, the researcher compared between the students’ answer and the interview result, and then the researcher examined the document suitability in the form of the students’ scores when doing the test.
3. Findings and Discussion

3.1 The data of the test result

3.1.1 The error made by the students. The following is the example of the error made by 4 students in answering 2 try-out tests of flat side space shape subject matter.

Based on the data analysis of the students’ answers on the test number 1, it was found that the S7 student had misunderstanding (comprehension error), transformation error, and the error in determining the last answer or encoding error. Based on figure 1, the S7 student did not determine what was known and what was questioned by the test (comprehension error). S7 student made mistake in determining the formula to be used, in which the correct formula to find the surface area of the cube (5 sides) is $5s^2$, but the student used formula $6s^2$ (transformation error). S7 also made mistake in determining the last answer. It caused by the error in transformation process, while S29 student was able to determine what was known and what was questioned on the test, so that S29 student only did transformation error and error in determining the last answer because S29 student was wrong in determining the formula to be used, so it caused the error in determining the last answer.

Based on the data analysis of the students’ answers on the test number 3, it was found that S13 student had reading error, comprehension error, transformation error, process error, and decoding error (error in determining the answer). It could be seen on Figure 2 that S13 student wrote down $AB = 3$ cm while it was written on the test that it was known $AB = 6$. It showed that the students were wrong in reading the test or were wrong in taking necessary information from the test. S25 student was also wrong in reading the test and could not take necessary information, it could be seen from the figure above that the students wrote down $r = 6$ cm, $s = 10$ cm, $t = 5$ cm, while the correct answer $AB = 6$ cm, $BC = 10$cm, $AE = 5$ cm and $FB = 3$ cm. due to being wrong in reading process, both students did the errors in comprehension process in which the students were not able to write was known and what was questioned by the test. Both students were unable to do the next process; it was because at the beginning, both students were unable to read and understand the test well. It could be seen from the S13 student’s answer which was unclear in writing the formula, and even S25 student did not write the completion process.

3.2 In-depth interview

3.2.1 In-depth interview with S17 student. Based on the interview conducted to S17 student, it was found that the student could understand the test well but he did not understand the test content. The student could not show the formula of the cube side on the picture and was wrong in identifying the picture consisting of any space shapes on the test number 17. On the test number 2, the student did not write down what was known and what was questioned on the test. When he was asked about the causes, the student admitted that it was because the student did not use to write what was known and what was questioned on the test, and the student rarely did the exercises about flat side space shape. It was caused by student’s lack of material mastery being assessed through the test. The student admitted that the given test number 5 was very difficult to do, so that the student only did 2 test item even the answer was taken from cheating on his friend answer.

3.2.2 The Interview Result of S25 Student. Based on the interview result, it was found that the student did some errors in reading the test given. The student was wrong in recognizing the sign $=$, symbol $/$, and unit of cm. the student even got difficulty when being asked to write $1 + 1$, the student was wrong in recognizing sign $+$ (plus sign), and $=$ (equitation mark). It was because the student rarely read match tests; moreover the student was not very fluent in reading and writing it. The student was wrong in determining what was known and what was questioned by the test item number 1 and 3, the student even did not do the test item number 4 and 5. It was because the student understood nothing on the flat side space shape subject matter; the student was difficult in understanding and comprehending the test; and the student was hesitate in finding out or deepening the math lesson. It was seen that the student had less interest in math lesson.
3.3 Data analysis result

The result of percentage calculating of the errors experienced by the student in answering the test on flat side space shape based on the student’s try-out test result viewed from each error type according to Newman procedures.

Table 1. The error percentage and error type category done by the student

| Test Item Number | Type of Error | 1 | 2 | 3 | 4 | 5 |
|------------------|--------------|---|---|---|---|---|
| 1                |              | 1 | 22| 37| 37| 37|
| 2                |              | 9 | 30| 18| 20| 37|
| 3                |              | 13| 22| 37| 30| 37|
| 4                |              | 3 | 32| 24| 37| 37|
| 5                |              | 5 | 31| 37| 37| 37|
| **Total**        |              | 31| 137|153|161|185|
| **Percentage**   |              | 17%|74%|83%|87%|100%|

3.4 The errors experienced by the students

Based on the description of the test and interview result conducted on the students, it was found that the errors done by the students in answering geometric test of the flat side space shape are as follows:

Reading Error, it occurs when the student is unable to read the words or symbol in the test. The errors done by the students in this aspect such as, the student was wrong in reading what the symbol p, l, t, and cm meant. Even, the student was unable to read the sign \(-\) (minus), \(+\) (plus) and \(=\) (equal) correctly. The error level done by the student on the error type of reading obtained from the error level percentage calculation is 17%.

Comprehension Error, it is seen from the student who did not write what is known and what is questioned by the test or only wrote one of them on the answer sheet. In addition, most of students wrote down what was known and what was questioned by the test, but they were wrong in taking the information contained in the test so that the student could not solve the problem on the test correctly and accurately. The error level done by the student in this type of error (comprehension error) obtained from the calculation result of the error level percentage is 74%.

Transformation error, it is seen from the students who are unable to select the formula, or was wrong in using formula to solve the problem on the test. For example, the students use width formula of bar surface. Besides that, most of students have determined the initial formula correctly to find out the bar volume. In addition, most of students are correct in determining the initial formula used, but they do not write the next formula to solve the problem or answer the question thoroughly. The error level done by the students on this type of transformation error obtained from the error level percentage calculation is 83%.

Process skill error: in this case, there are some errors done by students regarding this type of error, regardless of the previous error (transformation error), for example, the students are unable to operate multiplication and summation correctly. The error level done by the students on this type of process skill error obtained from the calculation result of error level percentage is 87%.
Error in determining the last answer (encoding): it is caused by the previous errors done by the students. The error level done by students on this type of encoding error obtained from the calculation result of the error level percentage is 100%.

Based on the percentage calculation of every error type, it is found that the biggest error done by the students is the error in determining the last answer (decoding). From the percentage calculation result, it is found that the type of reading error category is low, and the types of other error categories are very high. In addition, it is also found the total error percentage is generally 72%.

3.5 The factors causing the students’ errors
Based on the interview result obtained from 5 students, it is seen that all the research subjects do the errors on the tests given. The discussion on the errors done by the students and the factors causing them is as follows:

Reading error: the research subject of S25 did reading error on the test item number 2, 3, and 4. It was known by the time of interview session, the research subject of S25 was wrong in mentioning some symbols on the test. The factors causing the students did the reading error type are: (1) not fluent in reading, and (2) unaccustomed to reading math test.

Comprehension error, on the test item number 1, the comprehension error was did by 4 research subjects (students), namely, the research subjects of S17, S19, S25, and S36. On the test item number 2, 3, 4, and 5, the comprehension errors were done by all research subjects. The factors causing the subjects did comprehension error type are: (1) they did not thoroughly find the matter being known on the test, (2) they did not understand the signs on the test, (3) they did not understand the picture on the test, (4) they did not know what was known what was questioned on the test, (5) they did not know the problem on the test, (6) they did not write what was questioned on the test, (7) they were confused with what should be written for what was known and what was questioned on the test, and (8) they did not use to write what was known and what was questioned on the test.

The transformation error: on the test item number 1, 2, 3, 4, and 5, the transformation error did by those five research subjects. The factors causing the research subject did transformation error type are: (1) they did not know the formula to be used, (2) they did not understand the completion method to be used, (3) they did not know the steps in answering the test, (4) they could not input what was known into the math formula, (5) they did not understand the surface width definition of space shape volume, (6) they did not understand the flat side space shape subject matter, (7) they rarely read the tests related to math tests, (8) they rarely did the tests related to the flat side space shape subject matter, (9) they did not have sufficient mastery on the material, (10) they did not like math lesson, (11) they did not have interest on math lesson, and (12) low cognitive ability.

The process skill error: on the test item number 1, 2, 3, 4, and 5, the process skill error was done by those five research subjects. The factors causing the students did the process skill error are: (1) they did not master the sum operation, (2) they did not master multiplication operation, (3) they did the calculation process carelessly, (4) they wrote the answer as they will, (5) they rushed in writing the answers, (6) they did not like operating too large number of, and (7) the effect of the previous errors. It is due to the low numerical ability, because the numerical ability affects the mathematics learning outcomes [11].

The error in writing the last answer (encoding): on the test item number 1, 2, 3, 4, and 5, the encoding error was done by those five research subjects. The factors causing the subject did the encoding error are: (1) the effect of the previous errors, (2) they did not understand about what is questioned on the test, and (3) they were still influent in writing.

4. Conclusion
Based on the research findings and discussion previously, it can be concluded that:
1. The types of errors done by the students are, reading error, comprehension error, transformation error, process skill error, and encoding error. The biggest error done on writing the last answer (encoding error) is 100%, while the smallest error done on reading stage is 17%. The error
percentage calculation done by students in answering the math test related to the flat side space shape subject matter is the reading error percentage done by students as many as 17%. The comprehension process percentage is 74%. The transformation error percentage is 83%. The process skill error percentage is 87%. The error in writing the last answer percentage (encoding error) is 100%. In addition, the total error percentage is 72%.

2. The factors causing the students did the errors in answering the test of flat side space shape based on Newman procedures are: (1) the factors causing the reading error are the students were not fluent in reading and the students were lack of knowledge about the symbols usually used in math test, (2) the factors causing the comprehension error are the students were difficult in finding out what was known and what was questioned on the test, the students did not understand about what was known and what was questioned on the test, the students were careless in finding what was known on the test, the students forgot writing what was known and what was questioned on the test, and the students rarely read the tests related to the flat side space shape subject matter, (3) the factors causing the transformation error are the students did not understand the completion process used, the students were confused in using the appropriate formula, the students did not know which method should be used, the students did not focus on completing the test, the students, the students did not understand the flat side space shape subject matter, the students did not like math lesson, the students rarely did the exercises related to the flat side space shape subject matter, and the students had low cognitive ability, (4) the factors causing the process skill error are the students had not mastered the addition and multiplication operation, the students were careless in doing calculation process, the students were lazy in doing the addition and multiplication operation with too large number, the students did not understand the calculation used, and (5) the factors causing the encoding error are the effect of the previous errors and the students did not understand about what was questioned on the test.

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