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## **Analysis of Students Errors in Application Integrals Materials**

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**Abstracts:** This research aimed to analyze the students' mistakes based on Newman error analysis. Newman Error type consists of reading error, understanding the matter error, the transformation error, processing skills error, and writing down the answers errors. Qualitative research uses to descriptive describe the symptoms or the circumstances of the students in solving the matter on integral application. The research was conducted in the S-1 Study Program of Mathematics Education in 2017/2018 with the subject as many as 6 students who have low, medium and high competency respectively 2 students. The researcher gave two questions about the application integral to the students and then the results were analyzed and interviews were conducted to obtain information on students errors in solving problems. The analysis result shows that students with low competency experienced in reading error, comprehension error, transformation error, process skills error, and encoding error. This is because the students do not really understand the integral application materials. The students with medium competency in an underwent error in process skills and writing the final answers. While the high-competence students had an error in writing the final answer. Overall, most students experienced errors at the stage of understanding the problem. This happens because the students do not read and understand the questions carefully so the students are not able to understand the matter. In the end the students make mistakes of writing down the answers

**Keywords :** Integral Calculus, Applications integral, Newman Error Analysis

### **1. Introduction**

Integral calculus is a branch of Analysis field group and it's very important and useful, both in the course of multivariable calculus and other advanced subjects. Integral Calculus course descriptions, among others: the indefinite integral, definite integral, transsenden functions, integration techniques, improper integrals and integral applications. Material integral application consists of: spacious enclosed area, and the volume of turning object.

In the lecture the students often have difficulty in a strategy that will be used when solving problems. They still have difficulties and confusion to distinguish which strategies are appropriate. The ability of students in solving the integral application materials is very important to study further material related of integral. Based on the researcher's experience in teaching integral calculus courses, there are still many students not able to solve problems integral application problems. This is seen in the results of the test (quiz) in the integral application materials. To that end, there should be researches to analyze the errors of students in problem-solving related to the integral application.

Solving a problem by the students can be done in a way to understand the content of the question first, and then to take steps in solving the problems (Priyoko, et al, 2012). The student's thinking ability in solving mathematical problems mainly related to the integral application materials is still quite low. Students often have errors in understanding and choosing a way to use. This happens because students often memorize formulas rather than thinking of the steps to understand the problem to the matter solution. While the ability to learn not just memorizing formulas or specific material but students construct knowledge themselves (Subanji, 2013). To find out the students' error on integral application material, you need error analysis so the teachers understand the position of errors the students made to do the problems.

Researchers used Newman error analysis in conducting the research. Newman Error Analysis (NSA) was introduced by a mathematician from Australia named Anne Newman in 1977. In this model, there are five activities to find out errors that occur in the work of students when solving problems, namely: (1) reading error, (2) understanding the problem errors (comprehension error) (3) transformation error, (4) process skill error, and (5) encoding error (Rindyana et al, 2015; Parmjit, 2010; Suyitno, et al, 2015; Visitasari, et al 2012; and Sugesti et al, 2012). This research was conducted to determine the forms of student errors when solving the integral application materials. Thus a lecturer will find out and be able to choose a more efficient and effective strategy in improving the learning process in the classroom.

## 2. Methodology

The research is a qualitative research and using descriptive (Sugiyono, 2011). This descriptive research explains analysis students' work result error in solving problems of integral application. The researchers gave two questions related to the integral application. The test items cover the possibility of students making mistakes according to Newman error analysis level. Researchers also conducted interviews to determine the form of mistakes made by students in Newman problem solving stages: reading error, comprehension error, transformation error, process skills error, and the encoding error. The research was performed in the S-1 Study Program of Mathematics Education at the second semester students who took the classes Integral Calculus Academic Year 2017/2018 second semester, as many as 6 people with low, medium and high competency. The problem were done in 30 minutes and the students were supervised so that they solved the problem according to their own thoughts.

## 3. Result and Discussion

After the students finished working on two questions relating to the integral application then the researcher conducted an analysis the results of students answers. The problem consists of two indicators: 1) solving the problem relating to the area covered, 2) solving the problems related to the volume rotating objects. Problem is given as follows.

1. D area bounded by the graph of  $y = x^2$  and the line and the y-axis the first quadrant. Sketch of the area D and compute the area formed.  $y = \frac{3}{2}x + 1$
2. Unknown region D bounded by the graph of the function  $y = x - 1$ , The line  $x = 1 + 4y$ ,  $x = 2$  and  $x = 5$ . Determine the volume of which is formed when the area D is rotated around the line  $y = -1$

After the student worked on the problem, then their results were analyzed by the researcher. The students' work results were as early data, later this data identified the kinds of error made by students. Here are the types of mistakes each student at the time of solving the integral application which can be seen in Table 1.

**Table 1. Results of Error Analysis Student Work**

Problem Number	Error type	Student Code					
		M1	M2	M3	M4	M5	M6
1	1	X	V	V	V	V	V
	2	X	X	V	V	V	V
	3	X	X	V	V	V	V
	4	X	X	V	V	V	V
	5	X	X	X	X	X	X
2	1	V	V	V	V	V	V
	2	V	X	V	V	V	V
	3	X	X	X	V	V	V
	4	X	X	X	X	X	V
	5	X	X	X	X	X	X

**Information:**

1. Reading, 2. comprehension, 3. Transformation, 4.Process Skills 5.Encoding  
 Subjects M1 = 1, M2 = Subject 2 Subject 3 = M3, M4 = Subject 4, M5 = Subject 5, M6 = Subject 6.

**Reading Error**

Reading error is that students are able to read that there is a problem in matter but did not pay attention to other known element, so they made mistakes to sketch D area. It can be seen from the results of students' work in Figure-1 below.

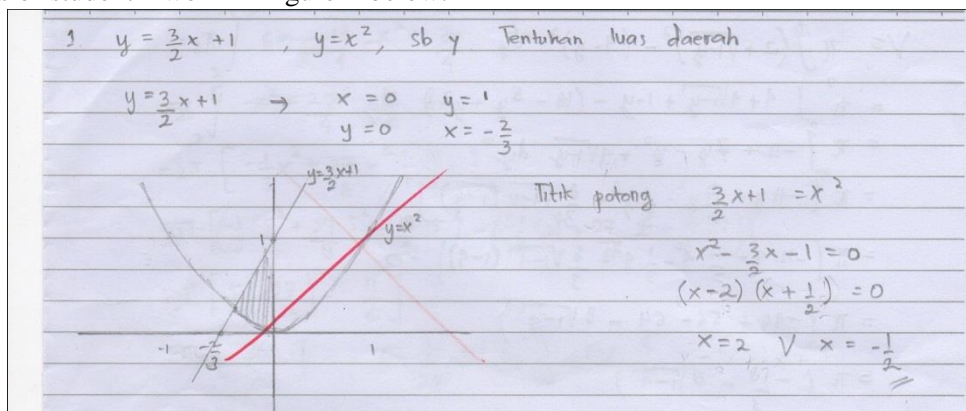


Figure-1 Work M1 for Problem 1

The Students had an error in reading. They did not notice that the area D was located in the first quadrant, so that students experience an error in the final answer, According to Firdaus, et al (2016) reading error occurs if the symbols or written words are not understood by a student, causing difficulties to get answers on the matter. Meanwhile, to reading error occurs when students are not able to recognize objects in a matter or misunderstood word in a sentence on a matter (Iman, et al :2016). This reading error occurred because the students did not read carefully, downplayed a question and were too hasty in reading.

**ComprehensionError**

Comprehension error occurs when students do not understand what is being asked, and what necessary information of a problem to avoid mistakes in solving problems. It can be seen from the answers of students as in Figure 2 below.

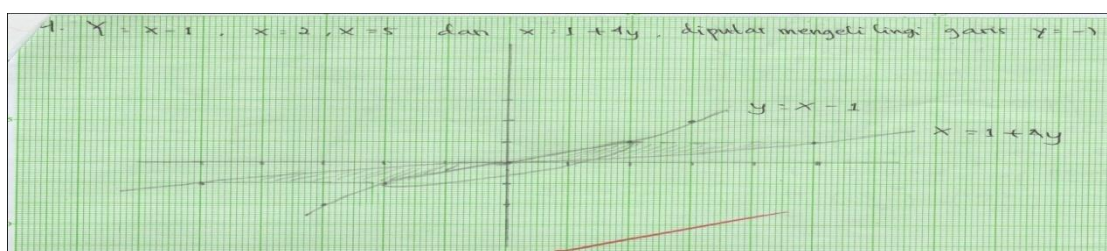


Figure 2 Work M2 for about 2

Students misunderstood what was being asked about. Although the students knew what the problem was. In this matter the students did not notice that the D area is rotated to the y axis. This suits the Rindyana’s research, et al (2015) which states that the mistakes that many students experienced in doing a problem is at the stage of comprehension error so the students made wrong answers. Meanwhile, misunderstanding the problem when students can read the question correctly but fail to understand what has been read, so he did not know what to do. (Parmjit, 2010) According to the researcher problem comprehension error occurs when the students are not able to construct comprehension perfectly. The cause of the comprehension error is students do not read the questions carefully so they do not understand the questions well

**Transformation error**

In this research, the students undergo transformation error. When a student is able to understand the questions well, however they make a mistake in giving the limits of integration. It can be seen from the answers of students as in Figure 3 below.

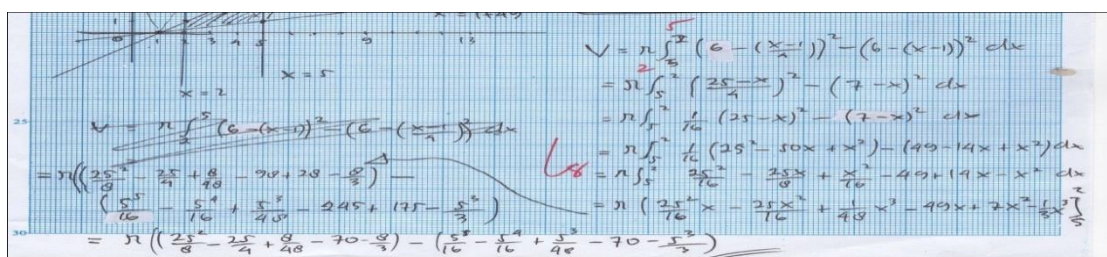


Figure 3 Deliverables M3 for about 2

The students use wrong finishing method. Students have difficulty in transforming graphs sketch into integral form. Transformation error occurs when students are able to understand the question, but can not identify the appropriate mathematical models or sequence of operations in order to successfully get a solution to the problem, according to Firdaus, et al (2016). Meanwhile, transformation error occurs when students are not able to create a mathematical model of the information obtained, do not know the strategies to be used to solve problems and do not know arithmetic operations that will be used to solve the matter, according to White (in Sughesti et al, 2016). Transformation error is an error in which a student cannot change the shape of the image into a mathematical form.

**Process Skill Errors**

The process skill errors is that the students do not use the correct procedure and lead to calculation errors resulting in incorrect answers. It can be seen from the answers of students as in Figure 4 below.

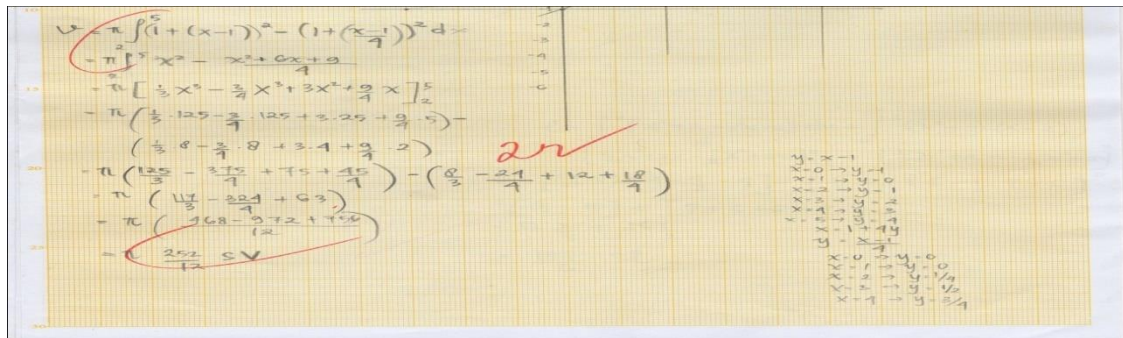


Figure 4 Work M4 about 2

Errors in this process the students experienced an error in the calculation. This happens because students are too hasty in doing so lead to errors in the calculation. the process skill error occurs when a student can not perform the procedure correctly, even though the operation (or sequence of operations) to be used to solve problems is right and correct, according Purwanta, et al (2016) . Meanwhile, Sughesti, et al (2016) “errors Skills Process occurred when students do not know or understand the procedures or measures that will be used to solve problems appropriately and correctly”. According to investigators error occurs when a process specific to the skills the students experienced an error in operation or procedure in solving mathematical problems.

**Encoding Error**

Encoding error is that the students cannot write according to context matter, give no answers and no conclusions answers. None of the six students who meticulously wrote down the answers with the words "so wide area D is" or "so the volume of the rotating object occurs is". It can be seen from the answers of students who experienced errors in reading, comprehension, transformation and process skills certainly experienced an error in encoding. According to Jha (in Sughesti, 2016) Encoding Errors occur when students are not able to find the answers or the outcome of a matter under the procedures or steps that have been mastered, can not provide the final answer of completion questions correctly and can not write final answer in accordance with the conclusions.

The results of researches and interviews with students obtained several factors that cause students to make mistakes in working on the problems are:

1. Reading errors phase are as follows: a) students are too hasty to work on the problems, b) students do not read given problem with full attention.
2. Comprehension errors phase are as follows. a). Not reading the questions carefully. b). Not understanding the questions well.
3. Transformation errors phase is as follows. a). wrong in determining the formula. b). Unable to plan solutions to solve the matter. c). Wrong in using mathematical operations like addition, subtraction, multiplication, and division or other mathematical operations.
4. Process skills errors phase are as follows. a). Cannot perform arithmetic operations correctly. b). Unaware of making mistakes in arithmetic operations being performed.
5. The cause of encoding errors occurred when students experience reading, comprehension, transformation or skills errors.

#### 4. Conclusion

The results showed all students could not show the correct final answer. The mistakes made by students of low ability in working on the integral application included comprehension, transformation, process skills, and encoding errors. This is because the students do not understand the integral application materials. Students of medium ability experienced difficulties in process skills and encoding. While the high-ability students experienced in encoding error. The highest error percentage of students occurred at the stage of understanding the problem, at this stage the students failed to understand so the students could not solve the problem of the integral application well. As for the causes is they are not able to figure out the problems expressed in the matter, a lack of understanding about the concept of the material for solution, lack of exercises and meticulous work on the problems. The lecturers who administer the courses in the first year should give the matter especially integral application materials by observing the probably mistakes done by the students. Lecturers need to make students understand the concept primarily a prerequisite for the subsequent material. There should be further research on learning process that can improve students' ability in solving problems.

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