

# Analysis of Introverted Students' Error Based on Newman in Solving Arithmetic Sequences and Series Problems

D Trapsilasiwi<sup>1</sup>, R P Murtikusuma<sup>1</sup>, Hobri<sup>1</sup>, E Oktavianingtyas<sup>1</sup>, I Wiliandani<sup>1</sup>, D M Widodo<sup>1,\*</sup>

<sup>1</sup> Faculty of Teacher Training and Education, Jember University  
[maharaniwidodo11@gmail.com](mailto:maharaniwidodo11@gmail.com)

## ABSTRACT

Mathematics is a universal field of science and has a very important role in human life. However, facts in the field show that students' reasoning power is still weak in the learning process of mathematics. It is because of one of the abstract characteristics of mathematics. This feature causes many students to experience errors in solving math problems. This study aims to analyze students' errors in solving arithmetic sequences and series material based on Newman's error analysis in grade VIII Junior High School 11 Jemberin terms of Jung's personality type. This research is qualitative descriptive research. The subjects in this study were 3 students with introverted personality types. The instrument used in this study was to collect data comprising an MBTI questionnaire, a test regarding the arithmetic sequence and series material, an interview guide and a validation sheet. Based on the research results, introverted students make mistakes in understanding, process skills, and perform mistakes in writing the final answer.

**Keywords:** *Newman error analysis, arithmetic sequences and sequences, introvert students.*

## 1. INTRODUCTION

Good schooling can accomplish strong academic success. Mathematics is one step towards achieving quality education [1]. Math is a universal field of science which plays a significant role in human life. The development in all fields, including economic, social, technological and so on is influenced by mathematics. Mathematics is the fundamental science that plays a key role in other sciences' development. But the facts on this field currently show that all students in mathematics learning could not improve their thinking capacity [2]. This is because of an abstract entity with one feature of mathematics. Many students have errors in solving mathematical problems because of this trait [3]. Math is one of two topics that offer students a significant chance of making mistakes [4].

The theory of error analysis used to determine the student errors is the Newman theory. According to Newman, there are 5 stages to analyze how students answer a problem in the question. These stages are reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors [5]. Several factors can cause these errors, one of which is

personality factors [6]. Personality is a unique behavior that exists in humans [7]. Personality refers to the psychological aspects of an individual that can determine adaptation to their environment [8]. Environmental factors and personality factors are two factors that influence individual creativity [9]. One of the personality types that exist in humans as proposed by Carl Gustav Jung, namely the personality type in the attitude of the human soul, one of which is introvert. Initially introvert is a child's reaction to something, but if the reaction is shown continuously, it can become a habit [10]. These habits can influence someone's behavior. Generally, someone who has an introverted personality prefers to process their thoughts in their head rather than talk about it [11]. Individuals who have an introverted personality will feel comfortable when they are in a calmer place [12]. The material used in this research is arithmetic sequence and series material. It is as a story problem which contains the possibility of errors in doing the problems according to Newman's theory. The subjects in this study were students of grade VIII F Junior High School 11 Jember.

## 2. METHODS

This research uses descriptive research with a qualitative approach. The preliminary stage carried out in this study is to determine the research area, determine the research schedule. Then the research instrument was made, comprising an MBTI questionnaire, test questions for material sequences and arithmetic series, and interview guidelines. The validity validated the instrument, namely two lecturers of the FKPI mathematics education study program, Jember University. After collecting data with the MBTI questionnaire and test questions, an interview was conducted to obtain information that was not obtained from the test questions. According to Huinker, interviewing is an assessment method that allows us to gain insight into students' conceptual knowledge and reasoning [13]. To get data validity, I carried method triangulation out by aligning the results of the arithmetic sequence and series material test results with the results of interviews with students selected as research subjects.

## 3. RESULTS AND DISSCUSSION

In analyzing students' errors in solving story problems, it is necessary to identify error indicators based on the NEA [14]. Based on research conducted at Junior High School 11 Jember grade VIII F, in total 30 students, data collection from the results of filling out the MBTI questionnaire, in the test, there are 11 illustrations with 2 answer choices, answer choice A show the extrovert personality type, the answer choice B shows the introvert personality type.

Students are required to choose one of the answers by means of a cross mark on the available column according to the reflection of each student's personality. Furthermore, the answers from each student were analyzed to determine the personality type of each student and obtained 27 students with the extrovert personality type and 3 students with the introvert personality type. Students have had experienced errors when making mistakes at least 1 indicator. The following is a table of error analysis for introverted students in solving questions on Arithmetic Sequences and Series, illustrate in the following table 2.

The next data collection was giving test questions and interviews. The test questions given are as story questions about arithmetic sequences and series.

**Table 1.** Error indicators according to Newman

Error Type Analysis	Indicator
Reading error	Students cannot read units, or symbols correctly.
Comprehension error	<ol style="list-style-type: none"> <li>1. What students know about the questions are not written down by the students.</li> <li>2. Students write down what is understood but not as asked for.</li> <li>3. What the questions asked were not written by the students.</li> <li>4. Students write down what has been asked, but not the question request.</li> </ol>
Transformation error	<ol style="list-style-type: none"> <li>1. Students are not able to make a mathematical model from the information obtained.</li> <li>2. Students are wrong in choosing the formula or method used in solving the problem.</li> </ol>
Process skill error	<ol style="list-style-type: none"> <li>1. Students miscalculated.</li> <li>2. Students do not proceed to the completion stage.</li> <li>3. Students do not write down the calculation phases in sequence</li> </ol>
Encoding error	<ol style="list-style-type: none"> <li>1. Students do not write conclusions.</li> <li>2. Students write conclusions but they are incorrect.</li> <li>3. Students write wrong units from the final answer</li> </ol>

**Table 2.** Analysis of introvert student errors

Student Code	Type 1	Type 2				Type 3		Type 4			Type 5		
	Indicators-	Indicators-				Indicators -		Indicators			Indicators -		
	1	1	2	3	4	1	2	1	2	3	1	2	3
SI1	-	√	-	√	-	-	-	√	√	-	√	-	-
SI2	-	-	-	-	-	-	-	-	-	-	√	-	-
SI3	-	-	-	-	-	-	-	-	-	-	√	-	√

**Information:**

Type 1 = Reading error  
 Type 2 = Error understanding the problem  
 Type 3 = Problem transformation error  
 - = Error Free

Type 4 = Process skill error  
 Type 5 = Encoding Error  
 √ = Making error

Based on table 2, the percentage of errors made by 3 introverted students in solving the arithmetic sequence and series material test questions were: reading error 0%, error understanding 33.33%, question transformation

error 0%, processing skill error 33.33%, encoding error 100%. Based on the results, the percentage of introverted students was more dominant in making mistakes in writing the final answer.

**Table 3.** Types and Forms of Student Errors

Personality type	Type of Error	Form of Error
Introvert	Reading Error	-
	Comprehension Error	<ul style="list-style-type: none"> <li>• Do not write what is known and asked in the questions</li> <li>• It is incorrect to write what is known and asked in the questions</li> </ul>
	Transformation Error	-
	Process Skill Error	Unable to identify the result of the questions based on the procedures or steps that have been used
	Encoding Error	<ul style="list-style-type: none"> <li>• Wrong in writing symbols in tonnes</li> <li>• Do not write conclusions after finding the final result</li> </ul>

Table 3 illustrate the most common types of errors that occur in introverted students are writing errors in the final answer, while the least error is reading errors and problem transformation errors. It relates to the Tiyas research that found that the lowest error was to reading errors [15]. And under research conducted by Singh which concluded that students' mistakes in doing math problems mostly occurred at the stage of writing the final answer [16]. Introverted students also experience misunderstanding problems. The reason is that students cannot absorb information well, students are not used to writing what is known and what is asked in the questions. This is in line with research conducted by Santoso, namely the students' weak ability to understand and solve story problems [17]. This is also in line with research conducted by Prakitipong and Nakamura which concluded that students' mistakes in working on structured questions were at the understanding stage. [18].

Based on the results of the problem-solving test in table 2, students of SI1, SI2 and SI3 describe the types of errors that were made.

1) Reading Error

From the questions the subject does not experience an error at this stage. The subject can read the questions clearly and correctly. Reading errors are the least mistakes to make.

2) Comprehension Error

Comprehension error occurred in SI1 students. SI1 students do not write what they know and are asked about the questions. The result in SI1 students making mistakes in process skills. This error occurs because students cannot identify the information in the questions.

3) Transformation Error

Based on the results of the Arithmetic Sequence and Series test results, students of SI1, SI2, SI3 did not experience any problem transformation errors. SI1, SI2, SI3 students can make mathematical models from the information obtained and students can choose the formula or method used to solve the questions.

4) Process Skill Error

Based on the test results, S11 students cannot find the final result of the questions based on the procedures or steps that have been used. The results of the S11 student test are presented in Figure 1 below.

$$\begin{aligned}
 S_n &= \frac{n}{2}(2a + (n-1) \cdot b) \\
 &= \frac{4}{2}(2 \cdot 17 + (3) \cdot 27) \\
 &= 2 \cdot 34 + 81 \\
 &= 68 + 81 \\
 &= 149
 \end{aligned}$$

Figure 1. Process Skill Error S11

Based on the test results in Figure 1, it shows that S11 students cannot find the final result. The following is an excerpt from an interview with S11 students.

- P : What formula did you use to solve the problem?  
 S11 : Arithmetic sequences and sequences ma'am. That I substituted  $a = 17$ ,  $n = 3$ ,  $b = 27$  into the formula Bu.  
 P : Where did you get grades  $a$  and  $b$  from?  
 S11 : I'm careless ma'am. I only know the formula.

If a student seeks to solve a problem, challenges will occur if he or she cannot identify the knowledge required in the problem [19]. According to Rudnitsky et.al the teacher's interpretation of what students do not know is extracted from the teacher's conversation with students [20].

Based on the test results and the interview quotation above, it can be inferred that the final answer of the question cannot be identified by students with the S11 code. This is because students do not understand mathematical concepts and students do not have a practice to work on arithmetic sequences and arithmetic series such that S11 students make process skills errors.

5) Encoding Error

The following are examples of encoding error by S13 students. The results of the S13 student tests and interviews are presented in Figure 2 and the following interview excerpt.

$$\begin{aligned}
 U_4 &= a + 3b = 17 \\
 S_4 &= \frac{n}{2}(a + U_4) \\
 44 &= 2(a + 17) \\
 S_{12} &= \frac{n}{2}(2a + (n-1)b) \\
 &= \frac{12}{2}(2a + 11b) \\
 &= 6(10 + 44) \\
 &= 6(54) = 324 \text{ T}
 \end{aligned}
 \quad \left| \begin{aligned}
 22 + 17 &= 2 \\
 a &= 5 \\
 17 &= a + 3b \\
 17 &= 5 + 3b \\
 12 &= 3b \\
 4 &= b
 \end{aligned} \right.$$

Figure 2. Encoding Error student S1

- P : What units did you use in the final answer?  
 S13 : Ton, ma'am.  
 P : Does the tons symbol use the symbol T?  
 S13 : Is it wrong ma'am?  
 P : Yes, it should use the symbol t. Next, what is the conclusion of this answer?  
 S13 : So, the total production during 2019 is 324 tons  
 P : Why don't you write a conclusion on your answer sheet?  
 S13 : I'm not used to writing conclusions ma'am. after all the time is running out, I thought about it for a while because it was too crowded

Based on test results and interview quotes from S13 students, S13 students write the unit symbol in the final answer and do not write the results of the answers that have been collected. This is because S13 students do not understand the writing of symbols, are not accustomed to writing conclusions, and introvert students are more relaxed focusing on questions in a quiet environment. Thus, it can be inferred that the students of S13 faced errors in writing in the final answer.

4. CONCLUSION

Based on the results and discussion, the percentage of 3 introverts of class VIII F SMPN 11 Jember in solving Arithmetic Sequences and Series questions based on Newman's theory got reading errors of 0%, errors in understanding questions 33.33%, errors in transforming questions 0%, errors in skills process 33.33%, 100% encoding error. Introverted students experience an error in writing the final answer (encoding error), which is an error in writing the unit symbol and not writing a conclusion. This error occurs because students do not understand the writing of symbols in mathematics and introverted students tend to be disturbed by a class environment that was too crowded, resulting in introvert students losing concentration. Misunderstanding occurs because students cannot identify the information in the questions, resulting the students experiencing processing skills errors.

## AUTHORS' CONTRIBUTIONS

All authors contributed in collecting and analysing data

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