NEWMAN ERROR ANALYSIS ON MISTAKES OF TADRIS MATHEMATICS STUDENTS UIN K.H. ABDURRAHMAN WAHID PEKALONGAN IN SOLVING COMPLEX ANALYSIS QUESTIONS

Wieke Nur Ilma[1], Irfanto Effendi[2], Zidni Ilma[3], Umi Mahmudah[4]
[1234]*UIN K.H Abdurrahman Wahid Pekalongan*
Email: [1]*wiekenurilma06@gmail.com,* [2]*ifantoeffendi670@gmail.com,*
[3]*zidni.ilma0805@gmail.com,* [4]*umimahmudah@uingusdur.ac.id*

ABSTRAK

Latar belakang penelitian ini menyoroti pentingnya pemahaman mahasiswa Tadris Matematika dalam menyelesaikan soal analisis kompleks, dimana konsepnya adalah matematika abtrak yang memerlukan pemahaman mendalam. Penelitian ini bertujuan untuk menganalisis kesalahan matematis mahasiswa tadris matematika UIN K.H. Abdurrahman Wahid Pekalongan pada penyelesaian soal analisis kompleks. Jenis penelitian adalah penelitian kualitatif dengan fokus deskriptif analisis. Adapun subjek dalam penelitian ini adalah 15 mahasiswa semester enam tadris matematika tahun akademik 2023/2024. Teknik pengumpulan datanya menggunakan lembar tes sejumlah 3 soal dan wawancara terbuka. Teknik keabsahan data menggunakan triangulasi dengan melalui penggabungan data dari berbagai sumber (triangulasi sumber), penggunaan beberapa metode pengumpulan data (triangulasi metode). Teknik analisis data menggunakan model interaktif Miles, Huberman, dan Saldana yang meliputi kondensasi data, display data, dan penarikan kesimpulan. *Newman error analysis* digunakan untuk menganalisis kesalahan siswa dalam menyelesaikan soal-soal analisis kompleks. Hasil penelitian ini menunjukkan bahwa tidak ada kesalahan yang dilakukan mahasiswa pada tipe indikator 1 (*reading error*), mahasiswa rata-rata melakukan kesalahan pada indikator 2 (*comprehension error*) sebesar 37,76%, rata-rata kesalahan pada indikator 3 (*transformation error*) sebesar 53,3%, rata-rata kesalahan pada indikator 4 (*process skills error*) sebesar 62,16% dan rata-rata kesalahan yang paling banyak dilakukan pada indikator 5 (*encoding error*) sebesar 66,63%. Penelitian ini memberikan pemetaan terhadap kesalahan matematis mahasiswa tadris matematika dalam menyelesaikan soal analisis kompleks. Penelitian ini memberikan kontribusi signifikan dalam peningkatan penyelesaian soal-soal konsep matematika abstrak.

Kata kunci: *Newman Error*, Penyelesaian Matematis, Analisis Kesalahan, Analisis Kompleks

ABSTRACT

The background of this research highlights the importance of Mathematics Education students' understanding in solving complex analysis problems, where the concept is abstract mathematics that requires deep comprehension. This study aims to analyze the mathematical errors of Mathematics Education students at UIN K.H. Abdurrahman Wahid Pekalongan in solving complex analysis problems. The research type is qualitative research with a descriptive analysis focus. The subjects in this study are 15 sixth-semester Mathematics Education students in the academic year 2023/2024. Data collection techniques use test sheets with 3 questions and open interviews. Data validity techniques use triangulation by combining data from various sources (source triangulation), using several data collection methods (method triangulation). Data analysis techniques use the interactive model of Miles, Huberman, and Saldana which includes data condensation, data display, and conclusion drawing. Newman error analysis is used to analyze student errors in solving complex analysis problems. The results of this study show that there are no errors made by students on indicator type 1 (reading error), students on average make errors on indicator 2 (comprehension error) by 37,76%, the average error on indicator 3 (transformation error) by 53,3%, the average error on indicator 4 (process skills error) by 62,16%, and the average error most commonly made on indicator 5 (encoding error) by 66,63%. This research provides mapping of mathematical errors of Mathematics Education students in solving complex analysis problems. This research contributes significantly to the improvement of solving problems in abstract mathematical concepts.

Keywords*: Newman Error, Mathematical Problem-Solving, Error Analysis, Complex Analysis*

INTRODUCTION

Mathematics is a basic science that is taught at all levels of education starting from elementary school to university. There is a very strong connection between one concept and other concepts in mathematics which allows students to use it as a basis for thinking in solving problems (Yolanda & Sthephani, 2021).

Complex analysis is a branch of mathematics that studies complex functions, namely functions that depend on complex numbers. Due to its abstract nature, complex analysis is often considered one of the most challenging branches of mathematics. This is due to the complexity of the mathematical structures involved and the conceptual level required to understand them thoroughly (Halikin & Ubaidillah, 2019).

Complex functions have some unique properties, such as analyticality, that allow us to perform differentiation and integration operations in a consistent and sustainable way. This provided the basis for the development of important theorems in complex analysis, such as Cauchy's theorem, the residue theorem, and the complex integral theorem.

Despite the challenges faced in studying complex analysis, a deep understanding of it has invaluable value in the development of modern science and technology. With its ability to provide deep insight into complex natural phenomena and its wide use in practical applications, complex analysis remains a very important subject in mathematics education and scientific research (Sthephani & Yolanda, 2021).

Mathematics is a basic science that is taught at all levels of education starting from elementary school to university. There is a very strong connection between one concept and other concepts in mathematics which allows students to use it as a basis for thinking in solving problems (Daut Siagian, 2017).

Students in the Mathematics Tadris Study program at the Faculty of Tarbiyah and Teacher Training (FTIK) UIN K.H. Abdurrahman Wahid Pekalongan are prospective teachers who are being equipped with in-depth knowledge. They are required to become educators who are able to inspire students in the future.

With their role as bearers of knowledge and carriers of information, mathematics education students must have superior qualities in order to be able to convey lesson material effectively to students. (Sthephani & Yolanda, 2021).

Students need to prepare themselves from the start of college, starting from the first semester, by preparing a strong foundation. They must understand, be able to solve, and apply mathematical concepts in problem solving. This is necessary so that mathematics learning objectives can be achieved well (Jana, 2018).

However, in reality, students often make several mistakes when solving mathematics problems given by lecturers. This situation can affect student achievement, especially in complex analysis courses (Sthephani & Yolanda, 2021).

Several previous studies have examined students' mathematical errors in solving abstract mathematics problems, such as research conducted by (Aida Sari, 2019; Anggoro, 2023; Junaedi, 2012; Setiawan et al., 2021; Widiastuti & Suwito, 2023) found that there are several factors that cause student errors in solving abstract mathematics problems. First, weak understanding of concepts is the main cause, where students do not yet understand in depth the concepts that are the basis for complex analysis. Second, students often experience difficulty in applying relevant formulas in the context of the questions given. This shows that they have not gained a strong enough understanding in applying mathematical concepts in practical situations.

Apart from that, carelessness in solving questions is also a significant factor. Students often make mistakes due to lack of concentration or lack of thoroughness in the process of solving questions, resulting in unnecessary errors. Lastly, lack of practice also plays a role in increasing error rates. Students who rarely practice working on mathematical problems tend to be less skilled in facing the various challenges that arise in complex analysis.

According to Newman in Junaedi (2012) states that student errors in solving abstract mathematics problems can be analyzed using Newman Error Analysis. Newman Error Analysis is a method used to identify and categorize types of mathematical errors made by students. In the same source it is also explained that Newman Error Analysis (NEA) is a framework with simple diagnostic procedures, which include (1) decoding, (2) comprehension, (3) transformation, (4) process

skills, and (5) encoding. The diagnostic method developed by Newman is used to identify error categories in answers to a description test.

This research shows a significant difference from previous research because it focuses on the analysis of errors made by Tadris Mathematics students at UIN K.H Abdurrahman Wahid Pekalongan when solving complex analysis questions, by applying the Newman Error Analysis method. The uniqueness of this approach differentiates this research from previous research that has been conducted. It is hoped that through this approach, the patterns of errors that often occur and the factors that influence them will be more clearly depicted in the context of Tadris Mathematics students. Apart from that, this research is also expected to provide a more detailed picture of students' understanding of abstract mathematical concepts contained in complex analysis.

It is hoped that this research can make a significant contribution in the context of increasing students' understanding and ability in solving problems related to abstract mathematical concepts, especially in complex analysis. By mapping the errors made by students, this research can become the basis for developing more effective learning strategies, which can overcome the obstacles faced by students in understanding and applying abstract mathematical concepts in real contexts. Thus, this research has the potential to have a positive impact in improving the quality of mathematics learning in the academic environment.

Based on the background above, the research title focuses on the mistakes of mathematics education students at UIN K.H. Abdurrahman Wahid Pekalongan on completing complex analysis. Meanwhile, the aim is to analyze the mistakes of mathematics education students at FTIK UIN K.H. Abdurrahman Wahid Pekalongan on completing complex analysis.

The type of research used is qualitative research with a descriptive analysis focus. The focus of this descriptive analysis aims to describe the mistakes that are often made by mathematics education study program students in solving complex analysis problems, by referring to the Newman Error Analysis (NEA) framework. The NEA indicators that are the focus of this research include:

Table 1. Newman Error Analysis Type Indicator

Error Type	Indicator
Reading Error	Mistakes are often made by students when reading information, whether in the form of words or symbols that are already known and requested in a question.
Comprehension Error	The mistake that students often make is that after they read the question information carefully, they fail to understand the content and meaning of the words and symbols contained in the question.
Transformation Error	A mistake that often occurs among students is when they understand the problem well but have difficulty determining the formula, properties or steps needed to solve the problem.
Process Skills Error	A mistake often made by students is when they succeed in determining the formula, properties, or steps needed to solve a problem correctly, but they fail to carry out the procedure correctly.
Encoding Error	Mistakes made by students after successfully carrying out the procedure correctly but failing to conclude the answer correctly.

Source: (Ningsi et al., 2022)

This research involved 15 sixth semester students in the Tadris Mathematics study program in the 2023/2024 academic year. The data collection technique used consisted of a test sheet containing three questions and an open interview. To ensure the validity of the data, triangulation was carried out by combining data from various sources (source triangulation) and using several data collection methods (method triangulation). The data analysis process refers to the Miles, Huberman, and Saldana interactive model which includes a data condensation stage to simplify the collected data, data display to display relevant information visually, and conclusion drawing to draw findings from the data that has been analyzed.

At the analysis stage, the Newman Error Analysis method is used to identify and analyze errors made by students in solving complex analysis questions. This method was chosen because of its ability to provide in-depth insight into various types of errors that often occur, as well as the factors that influence them. By using this approach, it is hoped that a more comprehensive understanding of the

difficulties faced by students in understanding complex analytical material can be obtained.

DISCUSSION

The questions about complex analysis presented to research subjects consisted of three questions. In question number one, students are asked to calculate complex number operations, in question number two, students are asked to create the polar form of a complex number, and in question number three, students are asked to analyze the real and imaginary parts of multi-operations based on two known complex numbers. The questions can be seen from the following picture: :

1. Berapa hasil dari $(3 + 2i) + (-2 + 7i)$?
2. Buatlah bentuk polar dari z = -6 + 6i !
3. Diket : $Z_1 = 5 + 6i$ dan $Z_2 = -2 - i$

   Tentukan nilai $R(Z)$ dan $I(Z)$ dari $\frac{3Z_1}{2Z_2} - 3Z_1Z_2$!

Figure 1. Complex Analysis Question

Of the 15 students who took the test, the following results were obtained according to the Newman Error Analysis category :

Table 2. Newman Error Analysis Results

	Question 1	Question 2	Question 3
Reading Error	0 Student	0 Student	0 Student
Comprehension Error	5 Students	6 Students	6 Students
Transformation Error	6 Students	8 Students	10 Students
Process Skills Error	7 Students	10 Students	11 Students
Encoding Error	7 Students	11 Students	12 Students

The percentage of student errors based on Newman Error Analysis is as follows:

Table 3. Newman Error Analysis Percentage

	Question 1	Question 2	Question 3	Average
Reading Error	0%	0%	0%	0%

	Question 1	Question 2	Question 3	Average
Comprehension Error	33,3%	40%	40%	37,76%
Transformation Error	40%	53,3%	66,6%	53,3%
Process Skills Error	46,6%	66,6%	73,3%	62,16%
Encoding Error	46,6%	73,3%	80%	66,63%

Based on the two tables above, it is known that there were no students who made reading errors; as many as 37.76% made comprehension errors; as many as 53.3%\ made transformation errors; as many as 62.16% made process skills errors; and as many as 66.63% made encoding errors. The following is a description of the errors made in solving the questions given:

1. *Reading Error*

   In the first stage of error analysis according to the Newman category, reading errors can occur when students fail to read information, whether in the form of words or symbols that are already known and requested in a question. In the three questions given, no errors of this type were found.

2. *Comprehension Error*

   Comprehension error occurs when students cannot understand the content and meaning of the words and symbols contained in the question. Even though there were no students who made mistakes in reading errors, there were students who made mistakes, namely in question 1 as many as 5 students, in questions two and three as many as 6 students.

3. *Transformation Error*

   This type of error occurs when students understand the problem well but have difficulty determining the formula, properties or steps needed to solve the problem. Based on question one, out of 10 students who were correct in

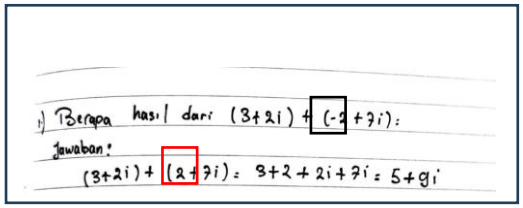

Figure 1. Example of type 2 error

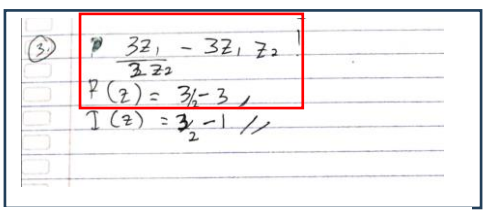

Figure 2. Example of type 3 error

understanding the content and meaning of the words and symbols contained in the question, there was 1 student who was wrong at this stage, so the number of errors increased to 6 students. Based on question two, of the 9 students who correctly understood the content and meaning of the words and symbols contained in the question, there were 2 students who were wrong in this type, so the number of errors increased to 8 students. Based on question three, of the 9 students who correctly understood the content and meaning of the words and symbols contained in the question, there were 4 students who were wrong in the transformation error stage, so the number of errors increased to 10 students.

4. *Process Skills Error*

   This type of error occurs when students have succeeded in determining the formula, properties, or steps needed to solve a problem correctly, but they fail to carry out the procedure correctly. Based on question one, of the 9 students who were correct in determining the formula, properties, or steps needed to solve the problem contained in the question, there was 1 student who was wrong at this stage, so the number of errors increased to 7 students. Based on question two, of the 7 students who were correct in determining the formula, properties, or steps needed to solve the problem contained in the question, there were 2 students who were wrong in this type, so the number of errors increased to 10 students. Based on question three, of the 5 students who were correct in determining the formula, properties, or steps needed to solve the problem contained in the question, there was 1 student who was wrong in the Process Skills Error stage, so the number of errors increased to 11 students.

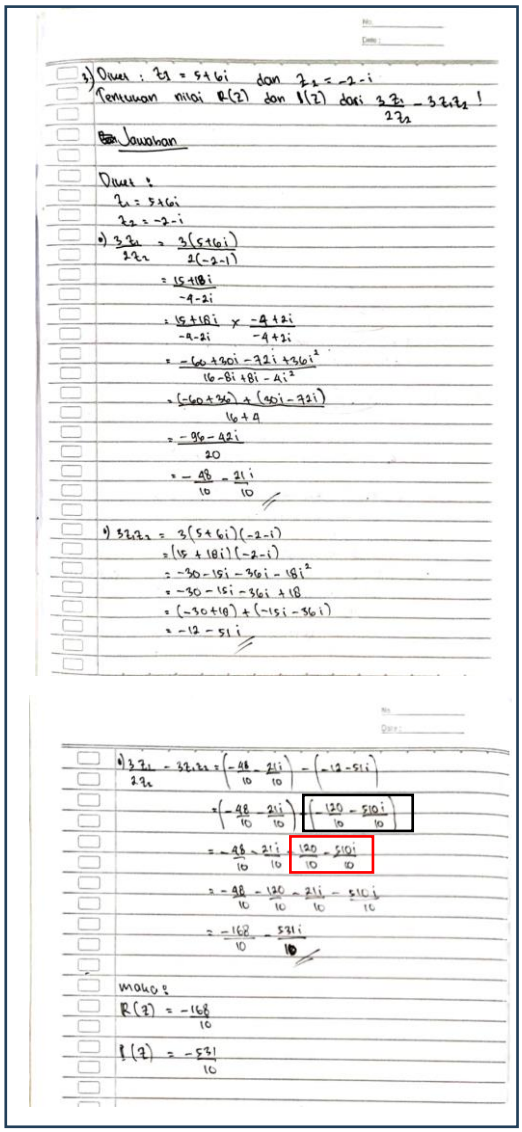

Figure 2. Example of type 4 error

5. *Encoding Error*

This type of error occurs when students have succeeded in carrying out the procedure correctly but failed to conclude the answer correctly. Based on question one, of the 8 students who were correct in carrying out the procedure to solve the problem contained in the question, there were no students who were wrong at this stage, so the number of errors remained at 7 students. Based on question two, of the 5 students who were correct in carrying out the procedure to solve the problem contained in the question, there was 1 student who was wrong in this type, so the number of errors increased to 11 students. Based on question three, of the 4 students who were correct in carrying out the procedure

to solve the problem contained in the question, there was 1 student who was wrong in the Encoding Error stage, so the number of errors increased to 12 students.

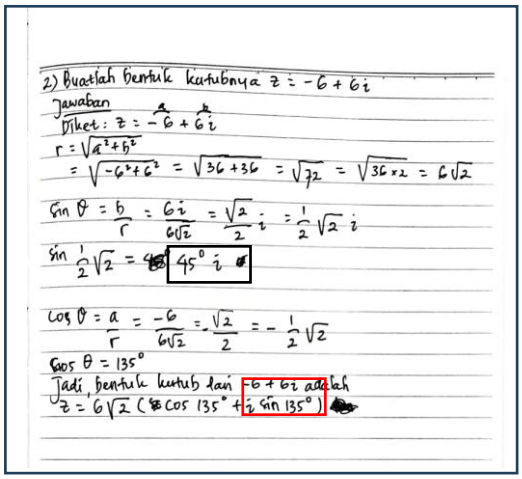

Figure 3. Example of type 5 error

Next, the author used an open interview method to find out the reasons behind the mistakes made by students. Based on the results of the interview, in type two errors (Comprehension Error) it was discovered that they forgot the material that had been taught so they could not understand the meaning of the question being asked. In type three errors (Transformation Error) it is known that they are confused about determining the formula and how to do the problem because they don't understand the material. In type four error (Process Skills Error) when students have determined the formula, they are not careful in working on the formula which results in errors in calculations. In type five error (Encoding Error) students were also found to be less careful when drawing conclusions after the calculation was completed.

CONCLUSION

Based on the results of the analysis of the two tables presented, it can be concluded that the majority of student errors in answering exam questions are in type three (Transformation Error), followed by type five (Encoding Error of 66.63%), type four (Process Skills Error of 62 .16%), and type two (Comprehension Error of 37.76%). This shows that the majority of students experience difficulty in applying the formulas and concepts taught, and are less careful in their work and

drawing conclusions after the calculations are complete. The interview results also revealed that the Comprehension error type error was caused by students' lack of understanding of the material that had been taught, while the Transformation error type error was caused by students' confusion in determining the formula and how to do the questions correctly due to a lack of understanding. Process Skills errors are caused by a lack of accuracy in working on formulas, and Encoding errors occur due to a lack of vigilance in drawing conclusions after calculations.

Thus, further efforts are needed to improve understanding and application of concepts, increase accuracy in work, and increase vigilance in drawing conclusions after calculations. This can be done through various active learning strategies and involving students directly in the learning process.

REFERENCES

Aida Sari, F. (2019). Analisis Kesalahan Mahasiswa Dalam Menyelesaikan Soal Geometri Pada Mata Kuliah Matematika Terapan. In *Journal JOSCE* (Vol. 01, Issue 02).

Anggoro, A. Y. (2023). Mathematics Education Students' Error Analysis On Solving Integral Calculus Problems. *Jurnal Kependidikan Matematika*, *131*(2), 131–140.

Daut Siagian, M. (2017). Pembelajaran Matematika Dalam Persfektif Konstruktivisme. *Jurnal Pendidikan Islam Dan Teknologi Pendidikan*, *VII*(2).

Halikin, I., & Ubaidillah, F. (2019). *Analisis Kompleks*. Digital Repository Universitas Jember.

Jana, P. (2018). Analisis Kesalahan Mahasiswa Dalam Menyelesaikan Soal Matematika Pada Pokok Bahasan Vektor. *Jurnal Mercumatika : Jurnal Penelitian Matematika Dan Pendidikan Matematika*, *2*(2), 8. https://doi.org/10.26486/jm.v2i2.398

Junaedi, I. (2012). Tipe Kesalahan Mahasiswa dalam Menyelesaikan Soal-Soal Geometri Analitik Berdasar Newman's Error Analysis (NEA). *Jurusan Matematika FMIPA UNNES*, *3*(2).

Ningsi, G. P., Nendi, F., Jehadus, E., Sugiarti, L., & Kurnila, V. S. (2022). Analisis Kesalahan Mahasiswa dalam Menyelesaikan Soal Kalkulus Integral

Berdasarkan Newman's Error Analysis dan Upaya Pemberian Scaffolding. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(3), 2698–2712. https://doi.org/10.31004/cendekia.v6i3.1469

Setiawan, E., Jusniani, N., Sutandi, A., & Suryakancana, U. (2021). *Analisis Kesalahan Mahasiswa dalam Menyelesaikan Soal Interpolasi Berdasarkan Analisis Kesalahan Newman* (Vol. 10, Issue 2). https://jurnal.unsur.ac.id/prisma

Sthephani, A., & Yolanda, F. (2021). Analisis Pada Penyeleisaian Analisis Kompleks: Curiosity Attitude Mahasiswa. *Anargya: Jurnal Ilmiah Pendidikan Matematika*, *4*(1), 11–16. https://doi.org/10.24176/anargya.v4i1.6007

Widiastuti, A., & Suwito, A. (2023). Griya Journal of Mathematics Education and Application Analisis Kesalahan Mahasiswa dalam Pembuktian Geometri Analitik Materi Segitiga. *Journal of Mathematics Education and Application*, *3*, 25–36. https://mathjournal.unram.ac.id/index.php/Griya/indexGriya

Yolanda, F., & Sthephani, A. (2021). Analisis Kesalahan Mahasiswa Pendidikan Matematika UIR pada Penyelesaian Analisis Kompleks. *SJME (Supremum Journal of Mathematics Education)*, *5*(1). https://doi.org/10.35706/sjme.v5i1.4393