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Analysis of Students' Errors in Solving Open-Ended Problems Based on Personality Types: Feeling and Thinking

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Abstract

Solving open-ended problems requires students to think creatively and critically, and certain personality types may be more prone to making errors. This study aims to analyze students' errors in solving open-ended problems based on the Thinking and Feeling personality types. The errors were analyzed using Newman's Error Analysis procedure. This research employed a descriptive qualitative approach involving four students with Thinking and Feeling personality types selected through purposive sampling based on the MBTI personality test. The research instruments consisted of open-ended test questions, interviews, and observations. Method triangulation was used to ensure data validity, and the data were analyzed through data reduction, data presentation, and conclusion drawing. The results showed that students with the Feeling personality type made Comprehension Errors (CE) in 1 of 4 responses (25%), Process Skill Errors (PSE) in 3 of 4 responses (75%), and Encoding Errors (EE) in 2 of 4 responses (50%). Students with the Thinking personality type made Comprehension Errors (CE) in 3 of 4 responses (75%), Process Skill Errors (PSE) in 3 of 4 responses (75%), and Encoding Errors (EE) in 1 of 4 responses (25%). No Reading Errors (RE) or Transformation Errors (TE) were identified in either personality type. These findings indicate different error patterns between the two personality types, with Thinking students showing higher comprehension errors and Feeling students showing higher encoding errors. The implications of this study emphasize the importance of instructional strategies tailored to students' personality characteristics in order to improve their mathematical problem-solving abilities.

Keywords: Feeling Personality; Thinking Personality; Errors; Open Ended Problems

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INTRODUCTION

Mathematics is a discipline taught at all levels of education and plays a very important role in the learning process. As a foundation of various fields of knowledge, mathematics

continues to develop both theoretically and practically (Gufron & Junaedi, 2025). Mathematics contributes to shaping students' ways of thinking and helps them solve problems independently and responsibly, making it a crucial field of study (Fauzan & Anshari, 2024). This is in line with the views of Cynthia & Sihotang (2023) and Siagian et al. (2025) who emphasize the importance of mathematics in daily life and in the advancement of science and technology in the modern era. One of the essential abilities in mathematics learning is critical thinking and problem-solving skills (Rachmantika & Wardono, 2019; Rahmaini & Chandra, 2024).

Critical thinking and problem-solving skills are primary objectives in mathematics learning, particularly in open-ended problems (Kurniati & Astuti, 2016; Luritawaty et al., 2022; Afriansyah et al., 2023). Open-ended problems require students to develop and apply various strategies when dealing with complex and open questions (Febrianty et al., 2025; Wahyuni & Palupi, 2022). However, students often demonstrate different approaches in solving such problems (Hasanah & Abdussakir, 2024; Liliawati et al., 2022). An important factor influencing these differences is students' personality types (Damayanti et al., 2022). According to Miftahul (2018) and Sembiring & Mukhtar (2013) students with certain personality types tend to use more systematic and structured strategies, while others rely more on creative or intuitive approaches. Furthermore, Suwarma et al. (2024) and Irawati et al. (2025) emphasize that a deep understanding of students' personality types can help educators design more effective interventions to enhance students' critical thinking and mathematical problem-solving skills, particularly in open-ended problems.

Open-ended problems allow for various solution strategies and are considered a form of problem-based learning that begins by presenting a problem to students (A. N. P. Sari, 2024; Sinabang et al., 2023). Saironi and Sukestiyarno (2017) as well as Azizah et al. (2024) assert that open-ended problems involve tasks with more than one correct solution, providing students with opportunities to discover, recognize, and solve problems using diverse techniques and solutions. Nevertheless, students often experience difficulties when dealing with open-ended problems because they tend to apply methods that are exactly the same as the examples provided by the teacher (Wulandari, 2017; Nurfadilah & Afriansyah, 2022).

Open-ended problems are defined as types of problems that have more than one correct answer (Nada et al., 2018; Berliana & Sholihah, 2022). As cited by Ayu et al. (2024) and Wiraharta et al. (2020), open-ended learning is defined as a process that begins with introducing open-ended problems to students, followed by the exploration of various possible answers, thereby providing opportunities to discover new ideas. Nurshalihah (2024) and Estevania & Fitriani (2025) identify several important characteristics of open-ended questions, namely that they must involve relevant mathematical information, generate diverse responses, require effective communication, be clearly stated, and utilize appropriate scoring rubrics.

According to Sakinah et al. (2024), errors are deviations from what is supposed to occur, depending on the context, such as miscalculations or other types of mistakes. This definition is consistent with Ananda et al. (2018), who state that errors are deviations from previously

established techniques. Vrasetya et al. (2024) and Marweli & Meiliasari (2024) further explain that errors are also related to feelings of fear and anxiety that arise in certain situations associated with mathematics. The success or failure of learning depends on how students are able to cope with difficulties in learning mathematics (Klorina & Juandi, 2022; Ijabah & Afriansyah, 2024). Several factors contribute to students' difficulties in solving mathematical problems, including incorrect interpretation and application of formulas, inability to understand prerequisite material, poor mastery of mathematical language, and calculation errors that lead to misconceptions (Sakinah et al., 2024).

The Myers-Briggs Type Indicator (MBTI) theory suggests that personality types can influence how students solve problems, particularly the Feeling and Thinking types. Students with a Feeling personality type tend to make decisions based on personal values and emotional impact, whereas students with a Thinking personality type tend to make decisions based on logic and objective analysis (Oktavia & Yulia, 2025). These differences affect how students understand and respond to open-ended problems. Students with a Feeling personality type often focus on emotional aspects, overlook technical details, and make decisions influenced by empathy, which can obscure logical reasoning (Lutfiananda & Rosyidi, 2014; Amarulloh et al., 2025). In contrast, students with a Thinking personality type often disregard emotional aspects, overemphasize logic, and neglect subjective values that may sometimes be important in solving open-ended problems (Susilawati, 2020; Firdaus, 2024; Kartika et al., 2025).

This study differs from previous research in terms of the specificity of personality types and subject matter. Sakinah et al. (2024) analyzed students' errors in solving open-ended problems on systems of linear equations in two variables (SPLDV) based on Kastolan's stages, and found that students still made conceptual, procedural, and technical errors, such as incorrect concept application, inappropriate steps, and incorrect formulas, resulting in less accurate answers. Similarly, Hidayah (2016) analyzed students' errors in solving SPLDV word problems based on Polya's problem-solving steps and found that Grade X science students at SMA Negeri 3 Jember made four types of errors: understanding the problem (5.00%), planning (21.50%), carrying out the plan (22.88%), and checking the solution (18.00%) (Pratami et al., 2022). Therefore, the novelty of this study lies in its focus on Feeling and Thinking personality types, as no previous research has specifically examined the relationship between solving open-ended problems and these personality types.

This study has significant novelty by linking students' Feeling and Thinking personality types with the errors they make in solving open-ended problems and by exploring how emotional and logical approaches influence mathematical problem solving. Previous studies have largely focused on cognitive aspects or technical abilities in mathematics without considering personality differences in the problem-solving process, particularly in the context of open-ended problems that require higher-order thinking. This study also makes an important contribution by demonstrating how an understanding of personality differences can be used to design more personalized and effective teaching strategies that take into account individual learning styles based on students' personality types. Thus, this research offers new insights that

have not been widely explored in previous literature, particularly regarding the influence of personality on students' errors in mathematics.

METHODS

This study employs a descriptive qualitative approach aimed at deeply analyzing students' errors in solving open-ended problems and their relationship with Thinking and Feeling personality types. The research subjects were students from one of the senior high schools in Sungai Penuh City, selected using purposive sampling. The selection criteria were students who had been identified as having Thinking or Feeling personality types through the MBTI questionnaire and who had experience in solving open-ended mathematics problems. This approach was used to understand students' thinking processes and the characteristics of errors that emerge comprehensively.

The instruments used in this study included a Thinking-Feeling personality questionnaire adapted from the MBTI framework, an open-ended mathematics test, and interview guidelines. The personality questionnaire consisted of 20 items. Scoring was carried out by calculating the dominant responses to classify students into Thinking or Feeling categories. Although the MBTI is widely used in educational research, it has also been criticized in terms of reliability and validity. Therefore, in this study, the MBTI was not used as a full personality typology consisting of four dimensions, but was limited only to the Thinking-Feeling dimension.

This study focuses solely on the Thinking–Feeling dimension because it is directly related to decision-making tendencies and approaches to problem-solving. Students with a Thinking tendency prioritize logical and analytical reasoning, whereas students with a Feeling tendency place greater emphasis on personal values and subjective considerations. Therefore, this dimension is considered the most relevant to the purpose of this study, which focuses on analyzing students' errors in solving open-ended mathematics problems. Meanwhile, the other MBTI dimensions, Extraversion-Introversion, Sensing-Intuition and Judging-Perceivingwere not analyzed as they fall outside the scope of this research.

The open-ended test consisted of two mathematics problems designed to explore students' problem-solving processes. Interviews were conducted after the test to gain deeper insight into students' thinking processes and the factors that lead to errors. The interviews were semi-structured, allowing for follow-up questions to be developed based on participants' responses.

Students' error analysis was conducted using Newman's Error Analysis (NEA), which consists of five categories: Reading Error (RE), Comprehension Error (CE), Transformation Error (TE), Process Skill Error (PSE), and Encoding Error (EE). Error identification was carried out through the analysis of students' written answers and interview results based on the indicators of each category. Reading Error refers to mistakes in reading symbols, terms, or information in the problem; Comprehension Error refers to mistakes in understanding the given and required information; Transformation Error occurs when students fail to convert problem

information into an appropriate mathematical model; Process Skill Error relates to procedural or computational mistakes; and Encoding Error refers to errors in writing mathematical notation, units, or conclusions. The results showed that no Reading Error (RE) or Transformation Error (TE) was found among all research subjects. Therefore, the discussion is focused on Comprehension Error (CE), Process Skill Error (PSE), and Encoding Error (EE).

RESULTS AND DISCUSSION

Results

Before analysing students' errors in solving open-ended problems, the research subjects were first classified based on their personality types using the Myers-Briggs Type Indicator (MBTI) test. The MBTI test was administered to all prospective research subjects to identify students' personality tendencies. Based on the results of the test, two personality types became the focus of this study, namely Feeling (F) and Thinking (T). The results of the MBTI test showed that there were two students with the Feeling personality type and two students with the Thinking personality type. These MBTI results were used to determine the research subjects and served as the basis for analysing students' errors in solving open-ended problems.

In this study, differences were found in the types of errors made by students with Feeling and Thinking personality types when solving open-ended problems. Students with the Feeling personality type tend to prioritize emotional values and personal perspectives when answering questions, which often leads to errors such as subjective arguments, a lack of emphasis on logical analysis, and ignoring instructions that require an objective approach. In contrast, students with the Thinking personality type focus more on rational analysis and logic; however, they are often trapped in overly structured approaches, overlook problem contexts that require more creative or applicative thinking, and show less flexibility in providing solutions that accommodate various perspectives. These errors indicate how personality types influence the way students respond to open-ended problems, which needs to be understood in order to improve the effectiveness of teaching and support the development of students' problem-solving abilities.

Table 1. Result of Error Analysis in Students' Written Responses Based on Feeling and Thinking Personality Types

Personality	Question No.	*RE*	*CE*	*TE*	*PSE*	*EE*
***Feeling* 1**	1	0	0	0	✓	0
	2	0	0	0	0	✓
***Feeling* 2**	1	0	✓	0	✓	0
	2	0	0	0	✓	✓
Total		0	1	0	3	2
Percentage		0%	25%	0%	75%	50%
***Thinking* 1**	1	0	✓	0	✓	0
	2	0	✓	0	✓	✓
***Thinking* 2**	1	0	✓	0	✓	0
	2	0	0	0	0	0
Total		0	3	0	3	1

Personality	Question No.	*RE*	*CE*	*TE*	*PSE*	*EE*
Percentage		0%	75%	0%	75%	25%

The results of the error analysis in written responses for the Feeling personality type show that students frequently experience errors in process skill errors (75%) and encoding errors (50%). This indicates that students with the Feeling personality type face significant challenges in applying the correct procedural steps and in writing or adjusting their answers to the appropriate context. In addition, the percentage of comprehension errors (25%) suggests that there are still difficulties in understanding the information provided in the problem. With an average error percentage of 35%, the main focus for improvement should be on strengthening procedural skills and writing accuracy. In contrast, students with the Thinking personality type show high levels of errors in comprehension errors (75%) and process skill errors (75%), indicating difficulties in understanding the given information and correctly applying solution procedures. Although the percentage of encoding errors is lower (25%), there are still challenges related to writing or contextualizing answers. The same average error percentage of 35% for both personality types highlights the need for adapted instructional approaches to address the specific error areas associated with each personality type.

Discussion

Errors of Students with the Feeling Personality Type in Solving Open-Ended Problems

a. Comprehension Error

In the indicator of understanding the problem, students with the Feeling personality type were not fully able to interpret the purpose of the question. The students only wrote part of the known information without explicitly stating what was being asked, so the answers provided did not directly address the objective of the problem.

Figure 1. Answer of Student F2 on Problem 1

These findings indicate that students' understanding of the problem context is still incomplete. Comprehension errors occur because students are less careful in identifying keywords and the objectives of the problem (Arafan & Khotimah, 2018). The characteristics of the Feeling personality type, which tend to rely on intuition, cause the analysis of the problem structure to be less thorough (Rihyanti, 2023). These results are consistent with the findings of Novitasari & Masriyah (2020) and Hartiningrum et al. (2020), which state that students with the Feeling personality type tend not to fulfill all indicators of critical thinking when solving open-ended problems.

b. Process Skill Error

In the process skill indicator, subjects with the Feeling personality type showed errors in performing calculations and applying solution procedures. Although the students had selected relevant strategies, there were inaccuracies in numerical manipulation and inconsistencies in using the initial data.

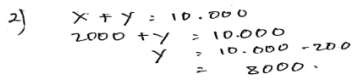

Figure 2. Answer of Student F1 on Problem 2

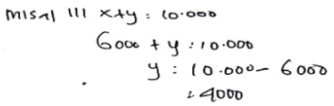

Figure 3. Answer of Students F2 on Problem 3

Figure 4. Answer of Student F2 on Problem 2

Based on Figures 2-4, the errors made by students include the use of irrelevant values, mistakes in arithmetic operations, and assumptions of variables that are not consistent with the initial information. This indicates that students rely more on intuitive understanding rather than systematically checking the procedures used. These findings are consistent with Ekadayanti et al. (2024), who state that students with the Feeling personality type tend to experience errors in transforming information when working on open-ended and HOTS problems. Aryanto et al. (2019) also revealed that a lack of accuracy in following solution steps is a major factor causing process errors among students with the Feeling personality type. Therefore, the characteristics of the Feeling personality type influence the accuracy of the problem-solving process in mathematics.

c. Encoding Error

In the writing or notation indicator, students with the Feeling personality type made errors in writing mathematical symbols and notations, such as inconsistencies in format and the use of inappropriate notation.

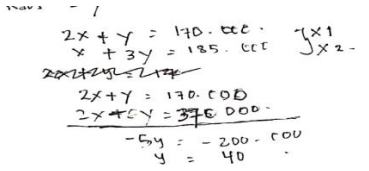

Figure 5. Answer of Student F1 on Problem 2

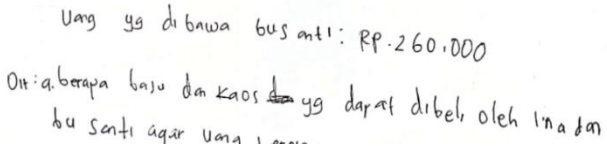

Figure 6. Answer of Student F2 on Problem 2

These writing errors indicate that students have not been fully careful in representing their ideas mathematically. Hanim (2022) states that students with the Feeling personality type tend to rely more on intuition rather than strictly following standard writing rules. This finding is consistent with Piaget's constructivist theory, which states that understanding is built from previous experiences, as well as Vygotsky's theory regarding the importance of guidance

within the Zone of Proximal Development (Arafah et al., 2023; Zebua et al., 2024). Therefore, students with the Feeling personality type require structured practice and consistent feedback in order to write solutions more systematically and accurately.

Errors of Students with the Thinking Personality Type in Solving Open-Ended Problems

a. Comprehension Error

Comprehension errors in students with the Thinking personality type are indicated by inconsistencies in using the initial information from the problem when forming a mathematical model. In Problem 2, the student used the value Rp2.000 as a variable, even though the problem stated that the price of a ruler was Rp4.000 and a pencil was Rp6.000. The use of a value that does not originate from the given data indicates that the student has not fully connected the context of the problem with the process of mathematical modeling.

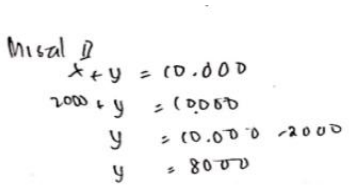

Figure 7. Answer of Student T1 on Problem 1

Although students with the Thinking personality type tend to use a logical approach, the interview results show that the subject did not write down what was being asked because they felt they had already understood the intention of the problem. This attitude reflects an assumptive tendency in understanding the problem, which can potentially lead to conceptual errors. In the context of open-ended problems, an understanding that is not written explicitly can cause inconsistencies between the objectives of the problem and the steps taken in the solution process.

Comprehension errors are also evident in the elimination process of the system of equations. Although the method chosen was appropriate, the student made an error in the subtraction operation, resulting in an equation that does not follow algebraic rules (Figure 8). A similar finding is shown in Figure 9, where the student again used variable values that were inconsistent with the initial information provided in the problem.

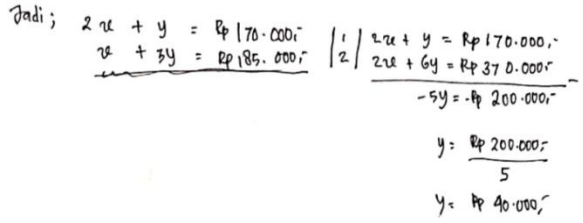

Figure 8. Answer of Student T1 on Problem 2

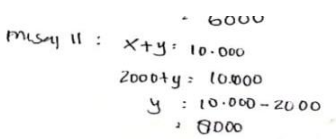

Figure 9. Answer of Student T2 on Problem 1

In general, comprehension errors among students with the Thinking personality type indicate that analytical ability is not always accompanied by careful interpretation of the initial information. This finding is consistent with Sari (2023) and Safitri et al. (2025), who state that students with the Thinking personality type are able to design solution strategies but remain prone to errors if they do not conduct systematic initial checks. From the perspective of Cognitive Load Theory (Sweller, 1988), the high cognitive load present in open-ended problems can hinder the processing of relationships between variables, even when the thinking approach used is logical.

b. Process Skill Error (PSE)

Process skill errors among students with the Thinking personality type mainly occurred during the stages of substitution and elimination of variables. In Problem 2, the student used variable values that were not consistent with the initial data, causing the calculation process to produce results that contradicted the context of the problem. This error indicates that the solution procedure was carried out without first ensuring the appropriateness of the values being substituted.

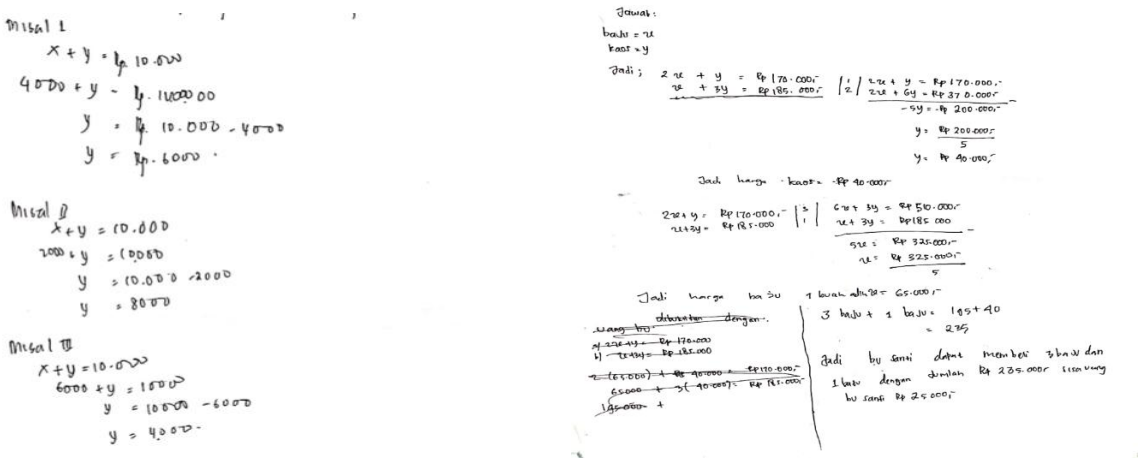

Figure 10. (a) Answer of Student T1 on Problem 2 (b). Answer of Student T1 on Problem 2

In addition, process errors are also evident in the inaccuracy of elimination operations and the calculation of final results. Students tend to focus on applying procedural steps without ensuring the meaning of each operation. This finding is consistent with Riyadi & Supriatna (2025), who state that students with an analytical thinking tendency may still make procedural errors when their conceptual understanding is not yet strong.

In Problem 1, the process skill error is shown through an incorrect substitution of variable values, resulting in a final answer that does not match the initial information given in the problem. This indicates a lack of reflection and rechecking of the solution steps (Figure 11).

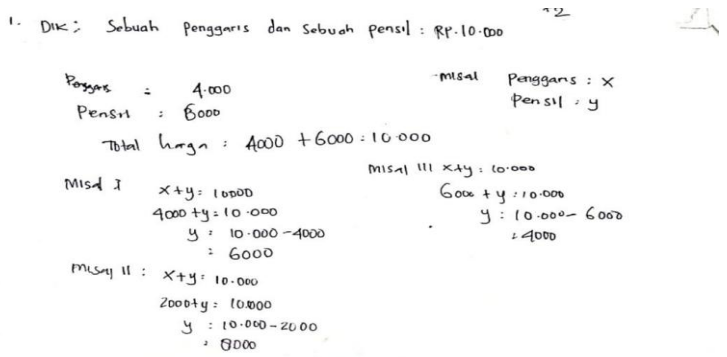

Figure 11. Answer of Student T2 on Problem 1

Overall, although students with the Thinking personality type are able to select appropriate methods, the lack of verification and reflection still leads to procedural errors. This finding supports Cognitive Load Theory (Sweller, 1988), which states that a high cognitive load in open-ended problems can reduce accuracy in processing numerical information.

c. Encoding Error

Encoding errors among students with the Thinking personality type were found in the form of inaccuracies in writing numbers, operation signs, and a lack of verification of the final results. Although the students had obtained the values of the variables, they did not recheck whether the results were consistent with the initial conditions of the problem. This error indicates that the students' focus was more on the analytical solution process rather than on the accuracy of presenting the final answer.

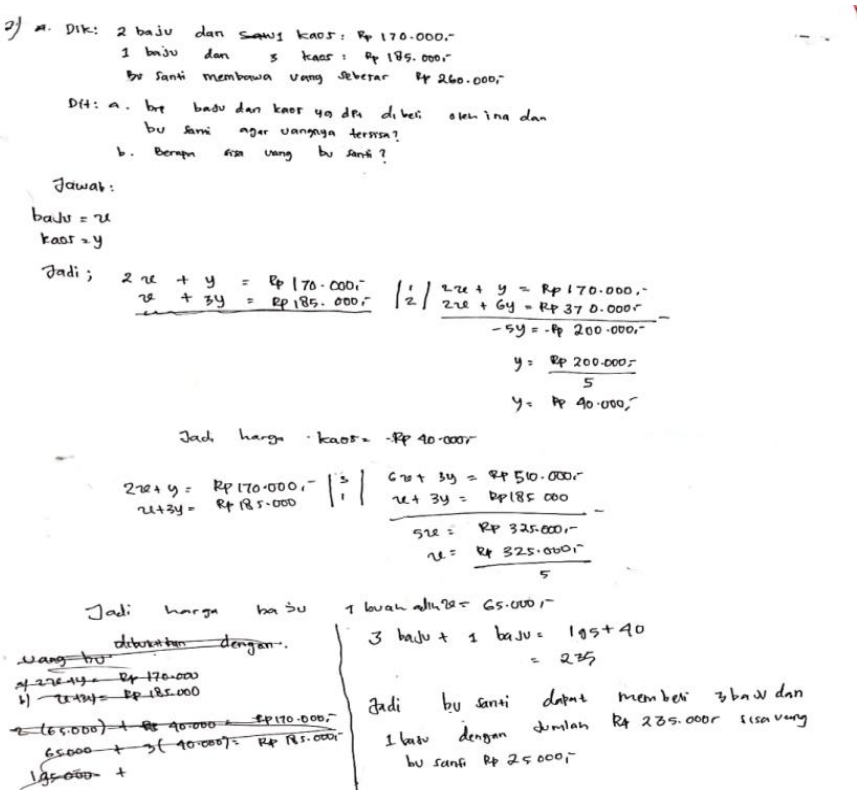

Figure 12. Answer of Student T2 on Problem 2

These findings are consistent with Ilmiyana et al. (2018), who state that students with a Rational or Thinking personality type tend to think systematically but still have the potential to make notation errors if they are not accustomed to performing final checks. Other studies also show that encoding errors often occur in open-ended problems because students tend to emphasize the thinking process rather than the accuracy of written answers (Aritonang et al., 2024; Pebriyani & Pahlevi, 2020). Therefore, the learning process needs to emphasize the importance of result verification and accuracy in writing as integral parts of mathematical problem-solving.

CONCLUSION

Based on the results and discussion, it can be concluded that students with Feeling and Thinking personality types exhibit different patterns of errors in solving open-ended mathematical problems. Students with the Feeling personality type predominantly made Process Skill Errors (75%) and Encoding Errors (50%), indicating difficulties in carrying out solution procedures accurately and expressing answers using appropriate mathematical notation. In contrast, students with the Thinking personality type predominantly made Comprehension Errors (75%) and Process Skill Errors (75%), indicating difficulties in interpreting problem information and applying solution procedures consistently. Although both personality types showed a high proportion of Process Skill Errors, students with the Thinking personality type demonstrated a higher frequency of Comprehension Errors (75% compared to 25%), whereas students with the Feeling personality type demonstrated a higher frequency of Encoding Errors (50% compared to 25%). These findings suggest that personality characteristics influence the types of errors students make when solving open-ended problems. Therefore, instructional approaches should be adapted to address the specific error patterns associated with each personality type, particularly by strengthening problem comprehension among Thinking students and improving mathematical representation and notation skills among Feeling students.

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