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Critical Thinking Skills in Solving Mathematical Problems Based on Thinking and Feeling Personality Types of Grade 8 Students

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ABSTRACT

Critical thinking skills are essential competencies in mathematics learning, but learning practices often emphasize final results rather than students' thinking processes. These differences in thinking processes are inseparable from personality characteristics, particularly the Thinking and Feeling types. This study aims to describe and compare students' critical thinking skills in solving mathematical problems based on the Thinking and Feeling personality types. This study uses a descriptive qualitative approach with two subjects, eighth-grade students at Unismuh Makassar Junior High School, each representing the Thinking and Feeling personality types. Data were obtained through the MBTI personality test, critical thinking ability tests in the form of essay questions, semi-structured interviews, and documentation, then analyzed using the Miles, Huberman, and Saldaña model with time triangulation to ensure data validity. The results showed that both personality types were able to fulfill the six indicators of critical thinking, namely interpretation, analysis, inference, evaluation, explanation, and self-regulation, but through different thinking processes. Students with the Thinking type showed a more logical, systematic, and efficient thinking pattern from the early stages, while students with the Feeling type displayed a more gradual, contextual, and reflective thinking process. These findings confirm that critical thinking in mathematics is multidimensional and influenced by personality. This study contributes to enriching the study of mathematical critical thinking and provides practical implications for teachers to design adaptive learning according to students' thinking characteristics.

Keywords
Critical Thinking
Mathematics Education
MBTI
Problem Solving
Thinking Personality Type

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Introduction

Mathematics is a discipline that not only serves as a tool for performing calculations but also as a means of developing higher-order thinking skills. Ideally, mathematics education in schools should not only emphasize procedural mastery, but also encourage students to develop logical, analytical, critical, and creative thinking skills [1–2]. These skills are in line with the demands of the 21st century, which emphasize the importance of critical thinking, communication, collaboration, and problem-solving skills, so that students can adapt and compete in global life [3–4]. Therefore, mathematics has a strategic role in shaping students' thinking in a way that goes beyond memorization to reasoning and meaningful problem solving.

Critical thinking skills occupy an important position in mathematics learning because they enable students to identify relevant information, design solution strategies, evaluate solutions, and reflect on possible mistakes [5–6]. Critical thinking emphasizes that the quality of problem-solving is not only determined by the final answer, but also by the accuracy and logic of the underlying thought process. [7] states that a problem only truly becomes a problem when the solution is not immediately available, thus requiring students to activate their critical thinking skills. Although the importance of critical thinking has been widely recognized, various studies show that students' critical thinking skills in mathematics are still not optimally developed, especially when students are faced with non-routine problems that require high-level reasoning [8–10].

A preliminary study conducted at Unismuh Makassar Junior High School shows that most students are not yet able to fully demonstrate critical thinking processes in solving mathematical problems. Many students tend to rely on procedures from textbooks or examples obtained from social media without understanding the mathematical reasoning behind the solution steps. Errors in symbolic representation are also often found, even in students who are able to obtain the correct final answer. These findings indicate that the correctness of the answer does not always reflect the quality of students' critical thinking, so a more in-depth exploration of their thinking processes is needed.

Differences in students' thinking processes in solving mathematical problems are inseparable from individual characteristics, one of which is personality type. The Myers-Briggs Type Indicator (MBTI) classifies personality types based on how individuals process

information and make decisions, including the Thinking and Feeling personality types [11]. Students with the Thinking type tend to make decisions based on logic, objective analysis, and consistency of thinking, while students with the Feeling type consider values, feelings, and personal meaning more when making decisions. These differences in characteristics have the potential to influence how students interpret problems, choose strategies, and evaluate solutions in mathematical problem solving.

Several previous studies have shown a correlation between personality type and higher-order thinking skills. [12] found that students with a Thinking personality type tend to demonstrate a more systematic and logical thinking process in solving mathematical problems. [13] also reported that students with Thinking and Feeling types were able to solve mathematical problems, but through different lines of thinking. Meanwhile, other studies have examined critical thinking skills based on general categories such as ability level or gender differences [14–15]. However, in-depth studies that describe and compare students' critical thinking processes based on Thinking and Feeling personality types, particularly at the junior high school level and in the context of mathematical problem solving, are still very limited.

The urgency of this study lies in the need to understand how students with Thinking and Feeling personality types construct critical thinking processes in solving mathematical problems. This understanding is important so that teachers do not apply uniform learning strategies, but are able to design adaptive learning according to students' thinking characteristics. Therefore, this study aims to describe students' critical thinking abilities in solving mathematical problems based on the Thinking and Feeling personality types. The results of this study are expected to contribute theoretically to the study of critical thinking and personality, as well as practically to teachers in designing mathematics learning that is more responsive to individual differences among students.

Material and Methods

This study uses a qualitative approach with a descriptive research type. A qualitative approach was chosen because this study aims to explore in depth the critical thinking process of students in solving mathematical problems, not to generalize the research results. The main focus of this study is to describe how critical thinking indicators appear in the problem-solving process in students with Thinking and Feeling personality types.

The research was conducted at Unismuh Makassar Junior High School in the even semester of the 2024/2025 academic year. The research subjects were selected using purposive sampling techniques, considering two main criteria, namely personality type and mathematical ability. Personality types were determined using the Myers-Briggs Type Indicator (MBTI) test adapted from PsikologiLa.ID, while mathematical ability was determined

based on students' mathematics scores on previous material. Based on the results of this grouping, two research subjects were selected, namely one student with a Thinking personality type and one student with a Feeling personality type, both of whom had high mathematical ability. The selection of subjects with high mathematical ability was intended to ensure that differences in critical thinking processes were influenced more by personality characteristics rather than limitations in mastery of the material.

The research instruments consisted of main instruments and supporting instruments. The main instrument in this study was the researcher himself, who acted as the planner, data collector, data analyst, and conclusion drawer. The supporting instruments included: (1) the MBTI personality test to identify students' personality types, (2) a critical thinking ability test in the form of essay questions on rectangular material that had been validated by experts, and (3) semi-structured interview guidelines used to explore students' thinking processes in solving mathematical problems in greater depth.

Data collection was carried out using four techniques, namely: (1) personality tests to determine students' personality types, (2) critical thinking tests to obtain written data in the form of problem-solving steps, (3) semi-structured interviews to deepen information related to students' reasons, strategies, and considerations in solving problems, and (4) documentation in the form of students' work results and interview recordings. The interviews were conducted after the students completed the written test so that the researchers could confirm and clarify the thinking processes shown in the written answers.

Data analysis was conducted using the interactive analysis model of [16], which consists of three stages: data condensation, data presentation, and conclusion drawing. Data condensation was carried out by selecting, focusing, and simplifying data relevant to the research objectives. Data presentation was arranged in the form of descriptive narratives that described students' critical thinking processes based on [8] indicators, namely interpretation, analysis, inference, evaluation, explanation, and self-regulation. Conclusions were drawn by linking the research findings to critical thinking theory and the characteristics of the Thinking and Feeling personality types.

Data validity is maintained through time triangulation techniques by comparing the consistency of test and interview data collected at different times. This triangulation aims to ensure that the data obtained truly represent students' critical thinking processes in solving mathematical problems and to enhance the credibility of the research findings.

Results and Discussions

The results of the study indicate that students with Thinking and Feeling personality types are equally capable of fulfilling the six indicators of critical thinking skills according to [8], namely interpretation, analysis, inference, evaluation, explanation, and self-regulation.

However, there are differences in characteristics and thinking patterns in the way these two personality types construct the process of solving mathematical problems. The analysis was conducted based on the results of written tests, interviews, and time triangulation through the first and second interviews for each subject.

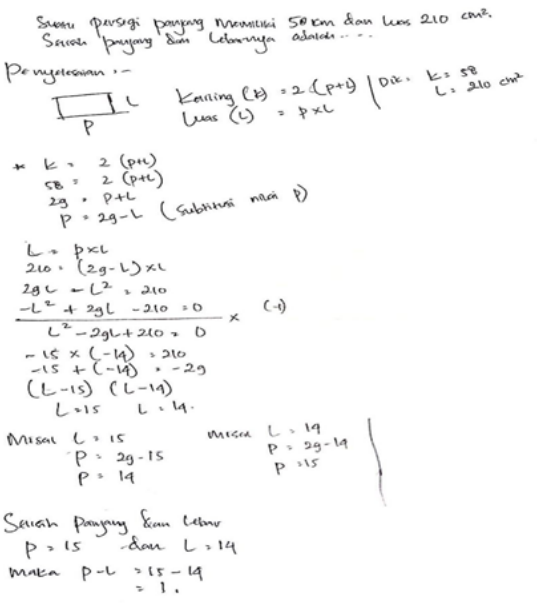


Fig. 1. Student Work Results: Thinking Personality Type

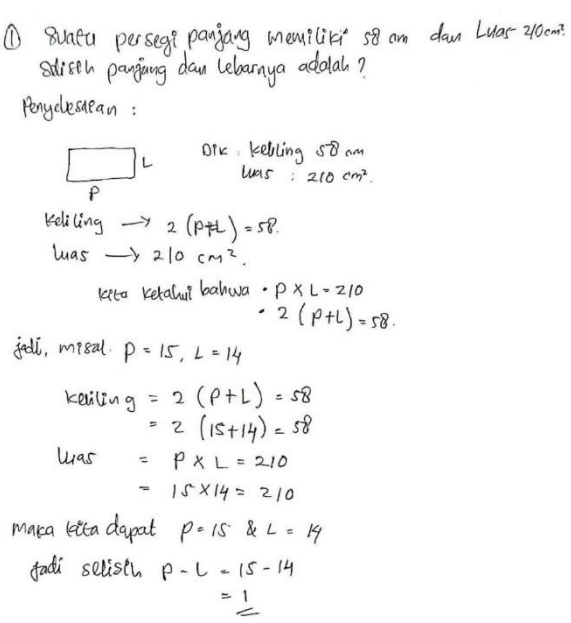


Fig. 2. Student Work Results: Feeling Personality Type

A. Critical Thinking Skills of Thinking Type Students

Students with a Thinking personality type demonstrate logical, systematic, and consistent critical thinking patterns from the early stages of problem solving. In terms of interpretation, students are able to clearly identify important information in the question and directly relate it to the objective being asked. This ability shows that students have built a strong initial understanding of the problem context, in line with [17], who emphasize the importance of interpretation as the foundation of conceptual understanding.

In the analysis indicator, Thinking-type students are able to separate relevant information, connect it with appropriate mathematical concepts, and construct formal mathematical models. This pattern supports [18] finding that Thinking-type individuals tend to prioritize logical order in constructing problem-solving structures.

The inference indicator is evident in students' ability to draw logical conclusions based on the mathematical models they have constructed. The selection of efficient solution strategies, such as factorization, demonstrates mature inference skills. This finding is in line with [19], who states that Thinking-type students excel at drawing accurate mathematical conclusions.

In the evaluation indicator, students recheck the results obtained by substituting the values back into the initial model. This is in line with [8] view that evaluation is at the core of reflective critical thinking.

The explanation indicator is evident in the students' ability to convey the logical reasons for each step of the solution using formal mathematical language, although not yet fully consistent. This finding supports [20], who state that the quality of the explanation reflects the depth of conceptual understanding.

Furthermore, indicators of self-regulation were evident when students realized the possibility of calculation errors and compared alternative methods of solution. This is in line with [21], who assert that self-regulation is a characteristic of mature critical thinkers.

B. Critical Thinking Skills of Feeling Type Students

Unlike thinking type students, Feeling type students exhibit a more intuitive, contextual, and emotionally reflective pattern of critical thinking. In terms of interpretation, Feeling type students are able to understand problems well, but tend to start by reading the questions repeatedly to ensure they understand the context. This pattern shows that problem understanding is built through a meaning-based approach, rather than directly on formal structure.

On the analysis indicator, feeling-type students are able to connect the information in the question with relevant mathematical concepts, even though the process is not always systematic from the start. The analysis develops gradually as confidence in the chosen steps increases. These findings are in line with [22], who state that feeling-type students need more time in the analysis stage but show significant progress after receiving feedback.

The inference indicator in Feeling-type students appears when students draw conclusions based on calculation results and understanding of the problem context. The conclusions obtained are generally correct, even though the process of reaching these conclusions involves more intuitive considerations than formal logic.

In the evaluation indicator, Feeling-type students check their results by comparing their answers to the context of the question, not solely to the mathematical model. This shows that evaluation is carried out by considering the appropriateness of meaning, in line with the characteristics of Feeling, which emphasizes subjective and contextual aspects [23].

The explanation indicator is seen in the students' ability to explain the steps of the solution narratively and communicatively, even though the use of formal mathematical terms is not yet consistent. This finding supports the view of [24] that coherent verbal explanations still reflect conceptual understanding.

On the self-regulation indicator, Feeling-type students showed reflection on errors after receiving encouragement or confirmation, rather than spontaneously. This is in line with [25],

who stated that self-regulation in Feeling-type students develops more strongly after external interaction and reflection.

Table 1. Triangulation of Time Critical Thinking Ability of Thinking and Feeling Type Students

Indicators	Thinking (W1–W2)	Feeling (W1–W2)	Conclusion
Interpretation	Consistent and direct	Consistent, more contextual	Consistent
Analysis	Systematic from the start	Gradual and evolving	Consistent
Inference	Logical and efficient	Intuitive yet precise	Consistent
Evaluation	Mathematical verification	Contextual verification	Consistent
Explanation	Formal and concise	Narrative and communicative	Consistent
Self- Regulation	Independent and reflective	Developing after reflection	Consistent

Table 1 shows that both personality types are capable of fulfilling all critical thinking indicators, but with different process characteristics. The Thinking type excels in formal logic and systematics, while the Feeling type excels in contextual meaning and gradual reflection.

Table 2. Differences in Subjects' Critical Thinking Ability Indicator Achievement in Solving Mathematical Problems

Indicators Critical Thinking	Thinking Type	Feeling Type
Interpretation	Able to quickly identify important information and connect it directly to relevant mathematical concepts	Able to understand key information in natural language, focus on the correctness of results, and gradually connect it to mathematical concepts
Analysis	Able to form formal mathematical models from the outset, construct equations, and use structured solution strategies.	Able to use trial and error methods at the beginning, developing into a more systematic approach in the second interview by considering the concepts of number of sides and multiplication.
Inference	Able to draw logical conclusions from mathematical models and choose the most efficient method (factoring or quadratic formula).	Able to determine the answer based on the initial match, then reinforce it with arguments of exclusivity.
Evaluation	Able to check results with formal mathematical proofs and ensure the accuracy of several methods.	Able to check results with simple recalculations, then progress to evaluations that consider other factors.
Explanation	Able to provide reasons based on formal logic and relevant mathematical concepts.	Be able to provide reasons based on comfort and personal beliefs, then begin comparing methods in the second interview.
Self- Regulation	Recognizing the possibility of errors from the outset, comparing various methods, and selecting the most efficient one.	Be willing to try again if you make a mistake, then start considering alternative methods, even if you still choose the familiar one.

Table 2 shows that students with Thinking and Feeling personality types are equally capable of achieving all critical thinking ability indicators according to [8], but through fundamentally different cognitive pathways. These findings confirm that critical thinking is not merely a result, but rather a process that is influenced by personality disposition.

In terms of interpretation, Thinking-type students show a tendency to immediately identify important information and relate it to relevant mathematical concepts. This pattern reflects an objective, logically structured cognitive approach. In contrast, Feeling-type students understand key information gradually and contextually, focusing initially on the meaning of the question before moving on to mathematical concepts. This difference reinforces [8] the view that interpretation can be built through conceptual or contextual pathways, depending on individual thinking tendencies. This finding is also in line with [11], who states that individuals of the Thinking type process information through rational analysis, while those of the Feeling type prioritize personal meaning-making in situations.

In the analysis indicator, Thinking-type students were able to construct formal mathematical models from the outset, systematically arrange equations, and choose structured solution strategies. This shows the dominance of deductive reasoning and logical consistency, as emphasized by [18], that Thinking-type individuals tend to prioritize order and efficiency in constructing problem-solving structures. Conversely, Feeling-type students show a gradual development of the analysis process, where systematicity emerges after reflection and consideration of the meaning of concepts. These findings support the results of research by [22], which states that Feeling-type students take longer to organize information but are able to achieve equivalent understanding through strategy adjustment.

Clear differences are also evident in the inference indicator. Thinking-type students conclude directly from mathematical models and choose the most efficient methods, such as factorization or quadratic formulas. This pattern demonstrates formal logic-based inference abilities, in line with the findings of [19] and [12], who stated that Thinking-type students excel in rational mathematical decision-making. Conversely, Feeling-type students determine answers through matching results with the problem context, then reinforce them with intuitive arguments. This shows that inference does not always originate from formal logic but can also be built from assessments of meaning and belief in the results.

On the evaluation indicator, Thinking-type students conduct evaluations through formal mathematical proofs and comparisons of several methods, demonstrating a strong reflective attitude from the outset. This is in line with [26], who place evaluation at the core of reflective critical thinking. Meanwhile, Feeling-type students conduct evaluations gradually, starting with rechecking simple calculations, then progressing to evaluations that consider the reasonableness of the results. These findings support the view of [27] that evaluations in individuals with developed self-regulation often emerge after experience and repetition.

The explanation indicator shows significant differences in mathematical communication styles. Thinking-type students provide explanations based on formal logic and relevant mathematical concepts, but tend to be concise and get straight to the point. In contrast, Feeling-

type students provide more narrative explanations based on beliefs and experiences, and compare the methods used in the interview stage. These findings reinforce the results of [28] research, which states that the quality of explanations is not only determined by the formality of language but also by the coherence and meaningful connections constructed by students.

The most notable difference was seen in the self-regulation indicator. Thinking-type students showed awareness of the possibility of mistakes from the outset, comparing various methods and choosing the strategy they considered most efficient. This reflects mature and independent self-regulation. In contrast, Feeling-type students were willing to try again when mistakes occurred, but tended to stick with familiar methods even after considering alternatives. These findings are in line with [25], who states that self-regulation in Feeling-type students develops gradually and is greatly influenced by a sense of security and personal confidence.

Overall, both personality types are equally critical, but with different characteristics. Thinking-type students excel in logical consistency, systematicity, and strategy efficiency, while Feeling-type students excel in contextual meaning, gradual reflection, and emotional flexibility. These findings make an important contribution to the literature on critical thinking in mathematics learning by showing that critical thinking is not homogeneous but is influenced by personality disposition.

The practical implication of these findings is the need for mathematics teachers to design adaptive learning strategies. Logical discussion and formal modeling approaches will be more effective for Thinking-type students, while contextual, reflective, and dialogue-based approaches will better support the critical thinking development of Feeling-type students. Thus, this study not only enriches the theoretical study of critical thinking and personality but also provides an empirical basis for more inclusive and equitable mathematics learning practices.

Conclusion

This study reveals that students with Thinking and Feeling personality types are equally capable of fulfilling the six indicators of critical thinking according to Facione, namely interpretation, analysis, inference, evaluation, explanation, and self-regulation, but through different thinking processes. This finding closes the gap in previous studies, which tended to assess critical thinking only from cognitive achievements, without considering students' personality dispositions. Students with a Thinking type exhibit logical, systematic, and efficient critical thinking patterns from the early stages of problem solving, with an emphasis on formal mathematical models, the selection of rationality-based strategies, and reflective self-evaluation and regulation. In contrast, Feeling-type students achieve critical thinking

indicators through a more gradual and contextual process, with strengths in problem interpretation, reflection, and strategy flexibility. These findings show that critical thinking is not singular in nature but can be manifested through both logical and reflective approaches.

The contribution of this study lies in reinforcing the perspective that critical thinking in mathematics is influenced by personality characteristics, so its development needs to be tailored to students' ways of thinking. Practically, the results of this study provide a basis for teachers to design adaptive and equitable learning. The limitations of this study lie in the number of subjects and the limited context of the material, so further research is recommended to involve more diverse subjects and contexts in order to deepen the understanding of the relationship between personality and critical thinking in mathematics learning.

Conflict of Interest

The author declares that there is no conflict of interest in the conduct of the research or the writing of this article.

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