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Analysis of MTs Students' Critical Thinking Skills in Solving Algebra Problems Based on Facione's Theory

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ABSTRACT

This study aims to analyze the critical thinking skills of eighth-grade Madrasah Tsanawiyah (MTs) students in solving algebraic problems based on Facione's critical thinking theory. Research methods employed a qualitative descriptive approach to explore students' cognitive processes in depth. The population consisted of eighth-grade students at an MTs in Kediri Regency, with a research sample of 25 students. Through purposive sampling, subjects were selected to represent high, medium, and low critical thinking ability categories. Data were collected via algebra problem-solving tests and in-depth interviews, both validated by experts. Data analysis techniques followed the Miles and Huberman model—comprising data reduction, data display, and conclusion drawing—with method triangulation used to ensure data validity. Research results indicate that only 8% of students (2 subjects) possess high critical thinking skills, while 60% (15 subjects) fall into the medium category, and 32% (8 subjects) are in the low category. The main conclusions reveal that while high-ability students fulfill all Facione indicators, students in the medium and low categories struggle significantly with analysis, evaluation, and inference. These findings suggest that students are unaccustomed to Higher-Order Thinking Skills (HOTS) in algebra, highlighting an urgent need for instructional strategies that consistently integrate critical thinking development in mathematics classrooms.

Keywords: algebra; critical thinking; Facione's theory; MTs students; problem solving

INTRODUCTION

Critical thinking is a fundamental 21st-century competency that enables students to analyze, evaluate, and make rational decisions when navigating complex, contextual mathematical problems (Halim, 2022). In mathematics education, this skill fosters the ability to evaluate arguments, formulate generalizations, and adapt knowledge to novel scenarios, transforming students into active thinkers (Monteleone et al., 2023).

Facione defines this process as a reflective, judgment-oriented endeavor categorized into six core cognitive skills: interpretation, analysis, evaluation, inference, explanation, and self-regulation (Facione, 2011). In the study of algebra, these skills are particularly vital as students must interpret abstract symbols, validate multi-step solution strategies, and draw logical conclusions from mathematical models (Khotimah & Yuliani, 2023).

Current literature suggests a direct correlation between critical thinking proficiency and problem-solving success, noting that students with high-level critical thinking skills—often associated with Higher-Order Thinking Skills (HOTS)—are more adept at strategy planning and error correction (Sinaga et al., 2023).

Despite its importance, the current state of the art reveals a significant performance gap; Paramitha (2024) identifies weaknesses in interpretation and analysis, noting that students often prioritize rote procedures over in-depth evaluation. This is echoed by Farulianyah (2025), who argues that the deficit is most pronounced in evaluation and inference during layered reasoning tasks, while Anastasia et al. (2024) found that students frequently fail to determine appropriate strategies due to failures in the analysis stage. Although Wahyu & Rudi (2024) demonstrate that contextual learning models can improve these outcomes, a specific mapping of how Madrasah Tsanawiyah (MTs) students transition through Facione's indicators in algebra remains under-explored.

The novelty of this research lies in its deep qualitative focus on the MTs demographic to identify the precise cognitive barriers students face. Consequently, this study aims to analyze and map the critical thinking skills of MTs students based on Facione's theory to provide a comprehensive description of the cognitive processes involved in solving algebraic problems.

RESEARCH METHODS

This study utilizes a qualitative descriptive research design to explore and understand students' thinking processes holistically. The research was conducted at a Madrasah Tsanawiyah (MTs) in Kediri Regency, focusing on a population of eighth-grade students. From this population, the research subjects were selected using a purposive sampling technique. Selection was based on three primary criteria: the results of an algebra problem-solving test, recommendations from mathematics teachers, and the students' communicative abilities. This approach ensured the representation of three distinct ability categories—high, medium, and low—as defined in the following classification:

Table 1. Categories of Mathematical Critical Thinking Abilities

Category	Value Interval
Tall	$66 < x < 100$
Currently	$33 < x < 66$
Low	$0 < x < 33$

The primary instruments used in this study include an algebraic problem-solving test and a semi-structured interview guide. Both instruments were developed based on Facione's critical thinking indicators and underwent a rigorous expert validation process by mathematics lecturers and practitioners to ensure content and construct validity. The specific indicators used to measure student performance are outlined below:

Table 2. Critical Thinking Ability Indicators

No	Aspect	Indicator
1	Interpretation	Students are able to write clearly and precisely what is known and asked in the question.
2	Analysis	Students are able to provide further explanations in a complete and precise manner regarding the main points of the problems that must be solved.
3	Evaluation	Students are able to use appropriate strategies to solve problems completely and correctly in carrying out calculations/explanations.

4	Inference	Students are able to make complete conclusions based on the questions asked.
5	Explanation	Students are able to explain the answers and conclusions drawn.
6	Self-Regulation	Students are able to review their own answers or write their own answers.

Data collection was carried out through the administration of a written algebra test followed by in-depth interviews with the selected subjects. The gathered data were then analyzed using the Miles and Huberman model, which consists of three concurrent flows of activity. First, the data reduction phase involved identifying, focusing, and abstracting the raw data obtained from both the test results and interview transcripts. This was followed by data display, where the information was organized into narrative text and matrices to facilitate the process of drawing conclusions. Finally, the conclusion drawing and verification phase focused on interpreting the emergent patterns of student thinking. To ensure the validity of the research findings, method triangulation was employed by matching the written solutions from the test with the verbal explanations provided during the interviews, thereby creating a consistent and credible description of the students' critical thinking skills.

RESULTS AND DISCUSSION

The research was conducted on November 11, 2025 in class VIII consisting of 25 students. The results of the student tests have been scored and the results can be seen in Table 3 below.

Table 3. Summary of Student Scores

Category	Number of Students	Percentage
Tall	2	8%
Currently	15	60%
Low	8	32%
Amount	25	

Table 3 shows the results of students' critical thinking tests. The results showed that 2 students fell into the high-level category, 15 students into the medium-level category, and 8 students into the low-level category. Next, an analysis will be conducted based on student responses using Facione's critical thinking indicators. The following describes Subject SA's responses with high-level abilities, as seen in Figure 1.

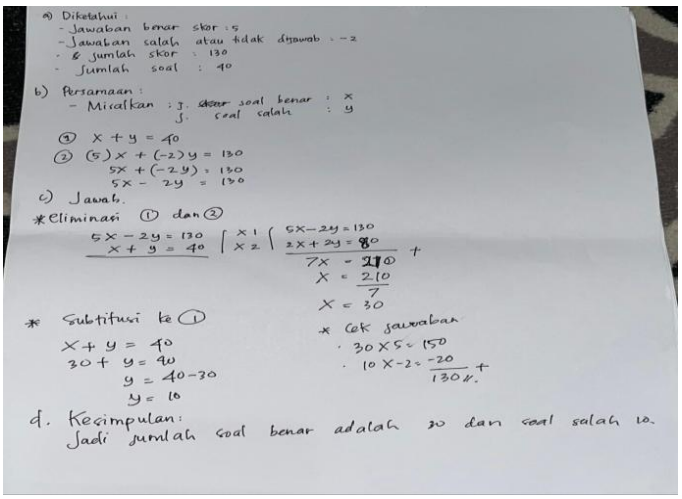

Figure 1. Answers of SA Subjects with High Category Ability

Based on the test results, students with high ability were able to produce correct answers and meet all indicators of critical thinking skills. In the Interpretation indicator, students were able to clearly and accurately write down what was known in the problem. In the analysis stage, as seen in the work and in the interview process, SA was able to provide complete and precise further explanations regarding the main points of the problem to be solved. SA was able to analyze well how to transform the sentences in the problem into correct mathematical sentences or equations. Then, in the evaluation stage, SA used the elimination and substitution methods completely and correctly. In the next stage, inference, students wrote conclusions based on their answers . In the explanation stage, which was confirmed during the interview, SA was able to explain their answers and conclusions in depth. The final stage, self-regulation, saw students review their answers by substituting them into the written equations.

Next, we will explain the answers of ANF subjects with moderate category abilities, which can be seen in Figure 2.

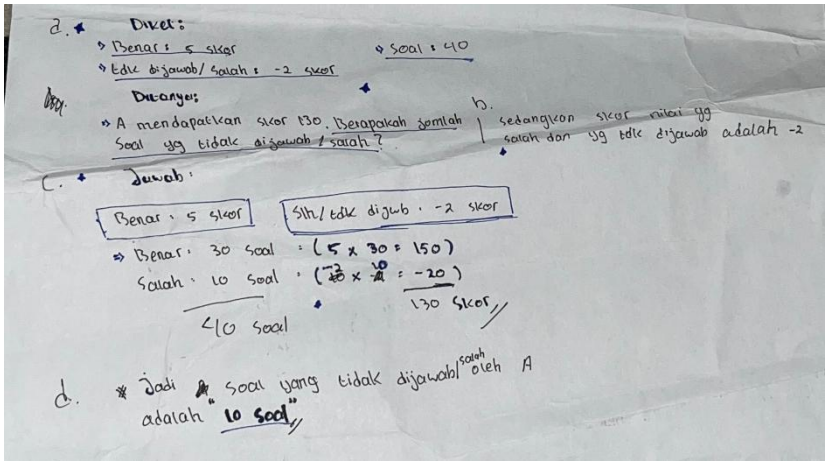

Figure 2. ANF Subject Answers with Moderate Ability Category

Based on the test results and interviews with ANF subjects who are included in the moderate category. Students with moderate critical thinking skills are students who have not been able to change verbal sentences in the problem into mathematical sentences so that the subject ANF did not write the equation obtained when solving the problem. In addition, the subject ANF also had difficulty using mathematical methods or strategies, however , he had good reasoning and used trial and error methods. So on the answer sheet, ANF immediately wrote the number 30 correct questions and 10 incorrect questions, after being confirmed ANF revealed that he tried several values so that he could get a total score of 130 as stated in the problem. In this section, the subject ANF was able to fulfill the aspects of inference, explanation and self-regulation.

Then below are the results of the answers from subject IA who are included in the low critical thinking category. The results of the students' answers can be seen in Figure 3.

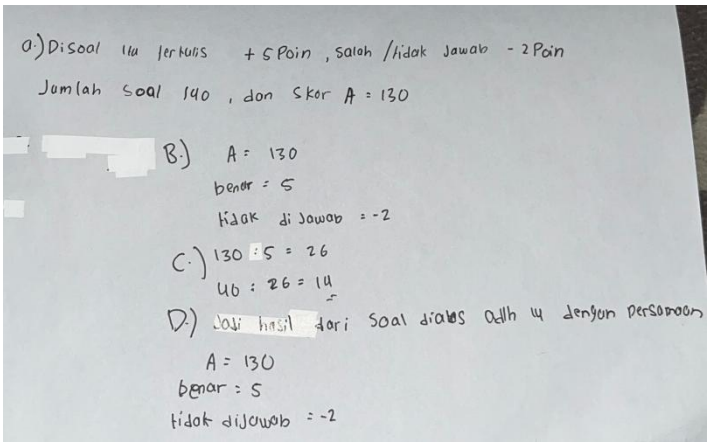

Figure 3. Results of IA Subjects with Low Category Ability

Based on the test results and interviews with subject IA, subject IA is included in the low category. Students with low critical thinking skills are defined by their test scores below 33. Subject IA only managed to meet the interpretation aspect, namely being able to accurately write down what is known and asked in the problem. Meanwhile, in other aspects, subject IA failed to meet the analysis, evaluation, inference, explanation, and self-regulation aspects. During the interview, IA admitted that he couldn't understand the meaning of the questions or solve them. As a result, he could only write down the information contained in the questions, including the scores for correct answers, incorrect or unanswered answers, and the total score for the questions.

The findings of this study reveal that the majority of students (92%) fall within the medium and low categories of critical thinking, with a significant deficit in the analysis, evaluation, and self-regulation aspects of Facione's theory.

The struggle of medium-category students like ANF to transition from verbal sentences to mathematical equations suggests a lack of symbolic literacy. While these students possess the logical reasoning to solve problems through trial and error—fulfilling the inference indicator—they fail the analysis and evaluation stages because they cannot formalize their logic into algebraic models. This aligns with research by Khotimah & Yuliani (2023), which notes that students often perceive algebra as a series of disconnected procedures rather than a language for modeling contextual problems.

For students in the low category, the failure to move beyond interpretation indicates a breakdown in conceptual scaffolding. This mirrors the findings of Anastasia et al. (2024), where students' inability to determine appropriate strategies was rooted in a failure to grasp the relational meaning between variables.

The results support the notion that critical thinking is not an inherent trait but a skill that must be explicitly trained. The high performance of only 8% of the sample suggests that Higher-Order Thinking Skills (HOTS) are not yet integrated into the daily pedagogical experience. According to Facione (2011), critical thinking requires both the "skill" and the "disposition." The subjects in the medium category showed the disposition (willingness to try values) but lacked the formal skills (algebraic methods) to reach an expert level of evaluation.

Similar to Paramitha (2024), this study confirms that students tend to focus on simple procedural steps. However, this research adds a new dimension by showing that

even when students reach the correct answer (as ANF did), they may still be "critical thinking deficient" in the self-regulation and explanation phases if they cannot mathematically justify their steps. This confirms Farulianyah's (2025) assertion that the gap in evaluation skills is the primary hurdle in MTs mathematics education.

This research is limited by its small sample size (25 students) at a single institution, which prevents broad generalization across all Madrasahs. Additionally, the study focused on a single algebraic topic; results might vary in other mathematical domains such as geometry or statistics. Future research should consider longitudinal interventions using contextual learning models, as suggested by Wahyu & Rudi (2024), to track the development of these indicators over time.

CONCLUSION

The results of the algebra problem-solving test reveal that only a small minority of students possess high-level critical thinking skills, while the vast majority fall into the medium and low categories. This disparity is largely attributed to a profound lack of familiarity with Higher-Order Thinking Skills (HOTS) questions. Students reported that they rarely encounter practice materials of this complexity, which leaves them unprepared for the rigorous analysis required in such assessments. This situation stems from a pedagogical cycle where teachers hesitate to introduce challenging tasks due to a perceived lack of foundational abilities among the students. Consequently, because these advanced problem-solving strategies are seldom taught or practiced, students continue to struggle with high-level reasoning. Ultimately, this gap in critical thinking proficiency is a result of multiple intersecting influences, ranging from internal cognitive readiness to external factors within the classroom environment and instructional habits.

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