JPP
Jurnal Pendidikan Progresif
e-ISSN: 2550-1313 | p-ISSN: 2087-9849
URL: https://jpp.fkip.unila.ac.id/index.php/jpp
Jounal's DOI: http://doi.org/10.23960/jpp

Vol. 16, No. 1, 2026
Article ID: 1333
Pages: 277-298

Beyond Curiosity: The Role of Inquisitiveness in Managing Epistemic Uncertainty and Problem-Solving Difficulties among Pre-Service Elementary Teachers

Fida Rahmantika Hadi[1,*], & Mulyadi[2]
[1]Elementary School Teacher Education, Universitas PGRI Madiun,Indonesia
[2]Mathematics Education, STKIP PGRI Pacitan, Indonesia

*Corresponding email: fida@unipma.ac.id

Received: 18 November 2025 *Accepted: 06 January 2026* *Published: 06 February 2026*

Abstract: This study investigates the relationship between inquisitiveness and problem-solving difficulties among pre-service elementary school teachers when solving mathematical problems containing contradictory information. The aim is to identify how different levels of inquisitiveness influence cognitive, metacognitive, and affective difficulties and to provide a deeper explanation of how these difficulties emerge during the reasoning process. A qualitative descriptive case study was conducted with 33 fifth-semester students in the Elementary Teacher Education program at Universitas PGRI Madiun. Data were collected through problem-solving tests, think-aloud, and interviews. Students were categorized into high, medium, and low inquisitiveness groups based on a questionnaire. Data analysis was carried out through coding, reduction, and triangulation across instruments, followed by cross-case comparison to ensure the consistency of themes and strengthen the interpretation of findings. The results showed that inquisitiveness strongly influenced the types and intensity of difficulties. Students with low inquisitiveness often experienced cognitive difficulties, such as reliance on formulas without verification, and affective difficulties, such as nervousness and frustration, which led them to stop. Students with medium inquisitiveness tended to experience metacognitive difficulties, recognizing contradictions but failing to regulate or adjust their strategies. High-inquisitiveness students demonstrated persistence and attempts at verification, although occasional metacognitive challenges still appeared. The study also found that inquisitiveness shaped students' emotional responses, with higher inquisitiveness associated with greater tolerance for confusion and a stronger willingness to re-evaluate conflicting information. Inquisitiveness plays a critical role in supporting conceptual verification, self-regulation, and emotional resilience when solving mathematical problems with contradictory information. These findings emphasize that inquisitiveness is not merely a cognitive trait but also an affective resource that helps students manage uncertainty. Strengthening this disposition may improve future teachers' reasoning and their ability to guide students through complex problem-solving situations.

Keywords: inquisitiveness, problem solving difficulties, contradictory information, pre-service elementary teachers.

Article's DOI: https://doi.org/10.23960/jpp.v16i1.pp277-298

INTRODUCTION

Inquisitiveness, defined as the disposition to question assumptions, seek deeper information, and verify accuracy, has emerged as a critical factor in mathematics education (Bardone & Secchi, 2017; Litman et al., 2017; Watson, 2015). Unlike procedural fluency, which focuses on recalling formulas or applying algorithms, inquisitiveness motivates learners to detect inconsistencies, explore alternative strategies, and persist in resolving contradictions (Kemmerle, 2013; Maharani et al., 2019; Syamsulrizal et al., 2025). In the context of mathematical problem solving, inquisitiveness is indispensable because it drives learners to evaluate the reliability of data, reflect on their reasoning, and pursue logical coherence (Fusaro & Smith, 2018). For pre-service teachers, inquisitiveness is not only essential for their own academic success but also for shaping classroom practices that foster curiosity, reflection, and resilience in their future students (Hurme et al., 2023). This view is consistent with Mehrad & Mehrad (2023), who emphasized that inquisitiveness in educational settings is strongly linked to creativity and sustainable innovation, enabling students to generate novel perspectives and approach complex tasks with flexibility.

Empirical studies have highlighted the importance of inquisitiveness in mathematics learning (Watson, 2019). Learners who exhibit inquisitiveness are more likely to notice contradictions and engage in reflective reasoning (Muis et al., 2015). Consistent with this, Yanarates (2022) reported that inquisitive thinking significantly predicted pre-service teachers' problem-solving skills, with motivation serving as a mediating factor. Umah et al. (2023) found that inquisitive questioning predicted students' comprehension of mathematical texts, demonstrating its role in supporting deeper understanding. Similarly, Hadi & Maharani (2022) found that prospective elementary teachers in Indonesia displayed limited inquisitiveness when confronted with non-routine problems, often leading to reliance on formulaic procedures. At a broader level, bibliometric evidence indicates that research on inquisitiveness has grown significantly over the last decade, reflecting its recognition as an emerging construct in education (Hadi & Mulyadi, 2025). These studies suggest that inquisitiveness plays a pivotal role in supporting higher-order thinking and meaningful problem solving.

Students' responses to mathematical problems containing contradictory information from a theoretical perspective can be understood as the interaction among cognitive, metacognitive, and affective processes. One relevant framework is the theory of epistemic emotions, which highlights emotions such as curiosity, confusion, and surprise as integral to knowledge construction (Pekrun et al., 2011; Vogl et al., 2019). In mathematical problem solving, contradictory information often triggers confusion, which may function either as a productive emotional state that encourages deeper inquiry and metacognitive monitoring or as a negative state that leads to disengagement and avoidance, depending on how learners regulate it.

Inquisitiveness is closely related to epistemic curiosity and plays a central role in shaping how learners respond to such emotional-cognitive challenges. Students with high inquisitiveness are more likely to interpret confusion as a signal to verify assumptions, explore alternative strategies, and persist in problem solving. In contrast, students with low inquisitiveness tend to perceive confusion as a sign of failure, triggering anxiety or premature task abandonment. This perspective aligns with self-regulated learning theories, which emphasize that metacognitive regulation is influenced not only by cognitive awareness but also by learners' emotional dispositions toward uncertainty (Oppong et al., 2018; Zheng et al., 2023).

Cognitive load theory also provides a complementary explanation for students' difficulties with contradictory information. Tasks that embed internally inconsistent data impose high intrinsic and extraneous cognitive load, which can overwhelm working memory and limit learners' capacity to monitor and revise their reasoning (Skulmowski & Xu, 2021). Under such conditions, learners often rely on familiar procedural routines rather than engaging in reflective evaluation. In this context, inquisitiveness may serve as a moderating disposition, encouraging learners to invest cognitive effort in sense-making and verification despite increased cognitive demands.

At the same time, research on students' difficulties in problem solving has revealed recurring challenges (Kim et al., 2018; Saygýlý, 2017; Yayuk & Husamah, 2020). Prior studies documented cognitive errors, such as misinterpreting information or applying formulas incorrectly, as well as metacognitive weaknesses in monitoring and evaluating strategies (Chew et al., 2019; Schoenfeld, 2016). Affective difficulties, such as anxiety, frustration, and loss of confidence, were also found to hinder persistence and reasoning in mathematical tasks (Hadi et al., 2018). However, while difficulties have been well documented, little is known about how inquisitiveness interacts with these difficulties (Peters et al., 2017; Reio, 2019). In particular, it remains unclear whether high inquisitiveness helps students regulate their reasoning and overcome affective barriers, or whether low inquisitiveness exacerbates their reliance on procedural strategies.

Despite these findings, existing research has largely examined cognitive, metacognitive, and affective difficulties as separate phenomena. Limited attention has been given to how these three dimensions interact dynamically during problem-solving, particularly in tasks that deliberately include contradictory information. Moreover, few studies have examined how dispositional factors, such as inquisitiveness, mediate learners' navigation of cognitive, metacognitive, and affective challenges. This lack of integrative analysis represents a significant gap in the literature, especially in the context of mathematics teacher education.

This gap is particularly urgent in the Indonesian context, where mathematics instruction in teacher education programs often emphasizes procedural fluency rather than conceptual understanding. Pre-service elementary school teachers are frequently trained to solve problems using formulas and algorithms, without being encouraged to verify data consistency or question underlying assumptions (Barham, 2020; Serin, 2019). As a result, when faced with problems containing contradictory information, they tend to struggle cognitively, fail to monitor their reasoning metacognitively, and experience negative affective responses (Hong et al., 2023; Potvin, 2023). This suggests that inquisitiveness may be a missing link in helping pre-service teachers manage these difficulties more effectively (Cansoy & Turkoglu, 2017; Karademir, 2019).

Empirical studies in Indonesia have shown that classroom practices often prioritize speed and correctness over justification and reflection, which may inadvertently discourage inquisitive behaviors (Herwin et al., 2023; Herwin & Nurhayati, 2021). In such instructional environments, numerical data presented in problems are typically assumed to be reliable, and questioning given information is rarely modeled or encouraged. Consequently, pre-service teachers may develop limited tolerance for uncertainty and confusion, reinforcing procedural habits while weakening metacognitive regulation and emotional resilience.

Therefore, the present study aims to examine the interplay between inquisitiveness and problem solving difficulties among pre-service elementary school teachers when solving mathematical problems with contradictory information. Specifically, the study investigates how different levels of inquisitiveness relate to the types of difficulties encountered, cognitive, metacognitive, and affective. The findings are expected to contribute theoretically by enriching the state of the art on inquisitiveness in mathematics education and practically by informing teacher education programs about the importance of cultivating inquisitiveness as a critical disposition for overcoming problem-solving challenges.

This study differs from previous work by examining how inquisitiveness specifically influences the interaction among cognitive, metacognitive, and affective difficulties in tasks involving contradictory information. This aspect has received little empirical attention in mathematics teacher education. The theoretical contribution of this study lies in positioning inquisitiveness not only as a cognitive disposition but also as an affective-regulatory mechanism that shapes how learners tolerate confusion, revise inconsistent data, and persist in the face of uncertainty. This contributes to a more comprehensive theoretical model of problem solving that integrates dispositional, emotional, and metacognitive processes.

Based on the identified research gap, this study is guided by the following research questions: 1) How do pre-service elementary teachers with different levels of inquisitiveness experience cognitive, metacognitive, and affective difficulties when solving mathematical problems containing contradictory information?, 2) What patterns of reasoning and emotional responses emerge across high, medium, and low inquisitiveness groups during the problem-solving process?, and 3) How does inquisitiveness contribute to the ways pre-service teachers verify information, regulate their thinking, and persist when facing contradictions in mathematical tasks?

METHOD

Research Design

This study employed a qualitative descriptive approach with a case study design to investigate how different levels of inquisitiveness influence the types of problem solving difficulties experienced by pre-service elementary teachers when working on mathematical tasks containing contradictory information. The case study approach enabled an in-depth exploration of students' reasoning processes when encountering contradictory information.

Participants

Participants were 33 fifth-semester pre-service elementary teachers enrolled in the Elementary Teacher Education program at Universitas PGRI Madiun, Indonesia. The sample was selected using purposive sampling because the participants had completed foundational mathematics courses relevant to the task. To obtain deeper insights into students' reasoning and affective processes, 10 participants were selected for semi-structured interviews using purposive sampling and the maximum variation principle. The selection criteria included completion of all stages of the problem-solving test, clarity and completeness of written reasoning, and the ability to articulate thinking during the think-aloud session. To ensure representation across inquisitiveness levels, the interview participants consisted of three students with high inquisitiveness, four with medium inquisitiveness, and three with low inquisitiveness. This distribution allowed for comparative analysis across categories and enhanced the transparency and replicability of the study.

Instruments

The instruments used in this research consisted of three types: (1) a problem solving test designed to measure students' ability to solve mathematical problems with contradictory information, (2) an inquisitiveness questionnaire adapted from previous studies, which contained items measuring the tendency to seek deeper information, verify accuracy, and question assumptions, and (3) semi-structured interview guidelines to explore further how inquisitiveness influenced the students' problem solving processes.

The problem-solving test consisted of a non-routine mathematical task that contained contradictory information. In this study, contradictory information refers to numerical data that are mathematically inconsistent when interpreted simultaneously within a single geometric structure. Specifically, the problem provided a total height of a composite solid (a cone attached to a hemisphere) that could not be coherently reconciled with the given radius and slant height if standard geometric relationships were applied correctly.

The contradiction did not arise from irrelevant or excessive information, but from internal mathematical inconsistency embedded in the given data. For example, when students attempted to calculate the cone's height using the Pythagorean theorem with the provided radius and slant height, the resulting value did not match the total height stated in the problem. This inconsistency required students to critically evaluate the validity of the given information, rather than directly applying formulas or assuming that all numerical data were reliable.

Such a task was intentionally designed to disrupt routine procedural reasoning and prompt verification, sense-making, and reflective judgment. Students were therefore expected not only to perform calculations but also to detect inconsistencies, evaluate assumptions, and decide how to respond to conflicting information. This design allowed the identification of cognitive difficulties (e.g., uncritical procedural application), metacognitive difficulties (e.g., failure to regulate or revise strategies after detecting contradictions), and affective difficulties (e.g., confusion, anxiety, or task abandonment).

The inquisitiveness questionnaire was adapted from the work of Litman et al. (2017) and Bardone and Secchi (2017), who conceptualize inquisitiveness as a disposition to seek deeper understanding, question assumptions, and verify the accuracy of information. The adapted questionnaire consisted of 20 Likert-scale items (1 = strongly disagree to 5 = strongly agree) measuring three dimensions: curiosity-driven information seeking, verification tendency, and critical questioning.

Prior to data analysis, the questionnaire was examined for validity and reliability within the context of this study. Content validity was established through expert judgment by two mathematics education lecturers, who evaluated the clarity, relevance, and alignment of the items with the construct of inquisitiveness. Minor revisions were made based on their feedback. Reliability analysis using Cronbach's alpha yielded a coefficient of 0.87, indicating high internal consistency and confirming that the instrument was reliable for measuring inquisitiveness among pre-service elementary school teachers.

The semi-structured interview guide was developed to explore students' reasoning processes, verification strategies, and affective responses when dealing with contradictory information. Sample questions included prompts such as: "What information in the problem did you find confusing or contradictory?", "How did you decide whether the information provided in the problem was reliable?", "What strategies did you use when your calculations did not match the given information?", and "What emotions did you experience during the problem-solving process, and how did these emotions influence your decisions?" These guiding questions ensured consistency across interviews while allowing flexibility to probe participants' responses in greater depth.

Data Collection and Procedures

Data collection was conducted in three sequential stages, using multiple instruments to capture students' cognitive, metacognitive, and affective processes during problem-solving. First, all participants completed a problem-solving test consisting of mathematical tasks that contained contradictory information. The test was administered in a classroom setting under controlled examination conditions to ensure consistency across participants. Students' written responses served as primary data for identifying patterns of reasoning and types of difficulties encountered.

Following the problem solving test, an inquisitiveness questionnaire was administered to all participants to measure their levels of inquisitiveness. Based on the questionnaire results, students were categorized into three groups: high, medium, and low inquisitiveness. This classification was used to guide subsequent analysis and to select interview participants.

In the final stage, think-aloud and semi-structured interviews were conducted with ten selected students representing the three inquisitiveness categories. During the think-aloud sessions, students were asked to solve mathematical problems while verbalizing their thought processes in real time, and all verbalizations were audio-recorded. Semi-structured interviews were subsequently conducted to clarify students' reasoning steps, verification strategies, and affective responses, including confusion, anxiety, and persistence, when encountering contradictory information. The combination of tests, questionnaires, think-alouds, and interviews enabled data triangulation.

Data Analysis

Data were analyzed using a thematic approach following the framework of Miles et al. (2014), which includes data reduction, data display, and conclusion drawing. During data reduction, students' errors and challenges were coded into cognitive, metacognitive, and affective difficulty categories. The results were then organized according to students' inquisitiveness levels (high, medium, and low) to support comparative analysis. Two independent coders participated in the analysis, and inter-rater agreement reached 87%, indicating acceptable coding reliability. Triangulation across instruments and member checking with several participants were conducted to enhance the validity and trustworthiness of the interpretations.

■ RESULT AND DISCUSSION

Quantitative Overview of Inquisitiveness Levels and Types of Difficulties

Before presenting the in-depth qualitative findings, a quantitative overview was conducted to provide a statistical foundation for the observed patterns. Descriptive statistics of inquisitiveness scores indicated clear differentiation among the three groups. Students classified as having high inquisitiveness ($n = 10$) demonstrated the highest mean score ($M = 4.32$, $SD = 0.41$), followed by the medium inquisitiveness group ($n = 12$; $M = 3.51$, $SD = 0.38$), and the low inquisitiveness group ($n = 11$; $M = 2.74$, $SD = 0.46$).

To examine whether inquisitiveness scores differed significantly across the three groups, a Kruskal–Wallis test was conducted. The results revealed a statistically significant difference in inquisitiveness scores among the high, medium, and low groups, $H(2) = 18.27$, $p < .001$. This finding confirms that the three groups represent distinct levels of inquisitiveness and supports the categorization used in this study.

In addition, a Chi-Square Test of Independence was conducted to investigate whether the distribution of difficulty types (cognitive, metacognitive, and affective) was associated with students' levels of inquisitiveness. The analysis revealed a statistically significant association between inquisitiveness level and type of difficulty experienced, $\chi^2(4) = 13.86$, $p = .008$, indicating that the types of difficulties encountered by students were not independent of their inquisitiveness levels. The strength of this association was moderate (Cramér's $V = 0.46$).

Taken together, these quantitative results provide statistical support for the qualitative patterns identified in the subsequent analysis. The significant differences in inquisitiveness scores and the association between inquisitiveness level and difficulty type justify the in-depth qualitative exploration of students' reasoning processes presented in the following sections.

Based on this classification, each inquisitiveness group demonstrated distinct patterns of difficulties when solving the given problem. To facilitate visual comparison of the relative proportions of cognitive, metacognitive, and affective difficulties within each group, the distribution is illustrated in Figure 1.

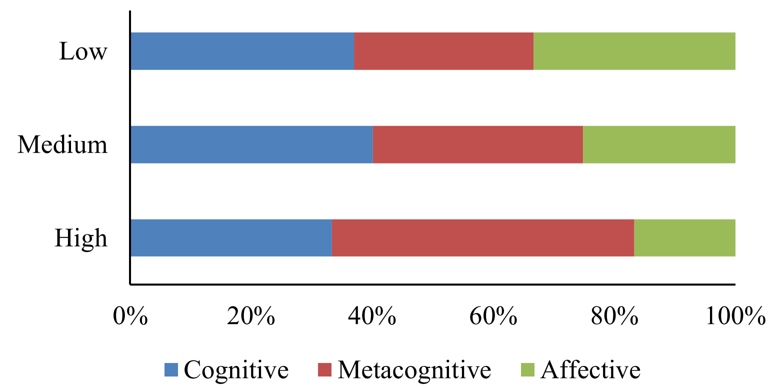

Figure 1. Proportion of cognitive, metacognitive, and affective difficulties across inquisitiveness levels (100% stacked bar chart)

Table 1 presents the distribution of cognitive, metacognitive, and affective difficulties across students with different levels of inquisitiveness. To facilitate visual comparison of the relative proportions of difficulties within each group, the data are further illustrated using a 100% stacked bar chart (Figure 1). As shown in Figure 1, students with high inquisitiveness predominantly experienced metacognitive difficulties, whereas affective difficulties accounted for the smallest proportion. Students with medium inquisitiveness demonstrated a more balanced distribution of cognitive, metacognitive, and affective difficulties. In contrast, students with low inquisitiveness exhibited a markedly different pattern, with affective difficulties representing the largest proportion of difficulties encountered. This visual pattern indicates a shift from primarily cognitive and metacognitive challenges toward affective barriers as inquisitiveness decreases. These findings suggest a clear trend: the higher the level of inquisitiveness, the lower the tendency to rely on superficial strategies and the greater the resilience in managing negative emotions. However, difficulties in self-regulation remained evident across all groups, even among students with high inquisitiveness.

To explore these patterns in more depth, the following sections provide detailed descriptions of each type of difficulty. The discussion incorporates examples of students' written work, excerpts from interviews, and theoretical perspectives to illustrate how inquisitiveness shaped their problem-solving approaches. The results are organized into three subthemes: Cognitive Difficulties and Inquisitiveness, Metacognitive Difficulties and Inquisitiveness, and Affective Difficulties and Inquisitiveness.

These findings provide a foundation for deeper exploration into how inquisitiveness interacts with the specific types of problem-solving difficulties. The following sections elaborate on each difficulty category, integrating cognitive, metacognitive, and affective dimensions with students' levels of inquisitiveness.

Cognitive Difficulties and Inquisitiveness

Figure 2 illustrates the work of a student who determined the cone's height by directly subtracting the hemisphere's radius (4 m) from the total height (10 m), resulting in $h = 10 - 4 = 6$ m. This approach demonstrates a clear cognitive difficulty: the student applied direct subtraction without evaluating whether the reasoning was mathematically valid. Instead of employing the Pythagorean theorem to calculate the cone's true height, the student assumed that the difference between the total height and the hemisphere's radius represented the cone's height.

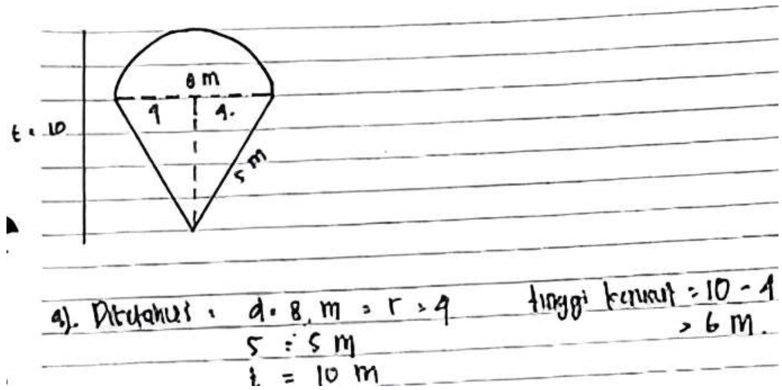

Figure 2. Cognitive error in determining cone height

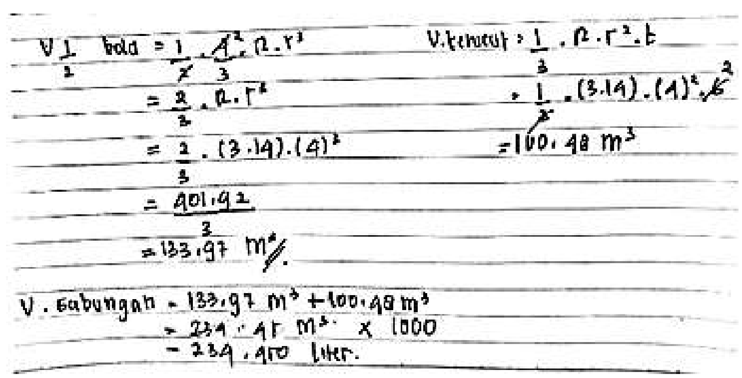

Figure 3. Consequences of the initial error in subsequent calculations

Figure 3 continues the same student's solution. The incorrect height (h = 6 m) was subsequently used in formulas for surface area and volume. Although the student completed the procedural steps in an orderly and systematic manner, the solution remained conceptually flawed. This pattern demonstrates how an initial cognitive error, left unexamined, can propagate throughout the problem-solving process and yield results that appear numerically coherent but are mathematically invalid.

Interview data provide further insight into the reasoning underlying this cognitive difficulty. One student explained how procedural habits shaped the decision-making process:

"I thought that if the problem already gave the total height, then subtracting the radius was the easiest way to find the cone's height. I did not really think about whether the shape required a different approach. I assumed the numbers in the problem were correct and that following the formula step by step would yield the correct answer. I focused more on completing the calculation than on checking whether my reasoning made sense."

Another student expressed a similar tendency to rely on given numerical information without verification:

"When I see numbers in a problem, I usually just use them directly. I did not feel the need to check whether the information was consistent, because in most exercises we do in class, the numbers are always reliable. I thought that questioning the data was unnecessary, so I just applied the formula I remembered."

These narratives indicate that cognitive difficulties were closely related to students' habitual reliance on procedural routines and unquestioned trust in given information. In the context of Indonesian teacher education, where mathematics instruction often emphasizes correct procedures and final answers over conceptual verification, such habits are likely reinforced through repeated exposure to routine exercises. As a result, students with low inquisitiveness tended to prioritize procedural completion rather than reflective evaluation, making them particularly vulnerable when confronted with problems containing contradictory information.

A closer examination of students' written responses and interview narratives indicates that cognitive difficulties in this study can be further classified into specific sub-categories. The most dominant form of cognitive difficulty among students with low inquisitiveness was procedural error, characterized by the uncritical application of familiar formulas without evaluating their appropriateness in the given context. Students relied on surface-level cues, such as the availability of numerical values, and applied subtraction or memorized formulas without considering underlying geometric relationships.

A second sub-category involved conceptual misinterpretation, in which students misunderstood the structural relationship between the cone and the hemisphere, leading them to treat the total height as a simple arithmetic combination rather than a geometrically constrained value. These errors were often compounded by data acceptance bias, in which students assumed that all numerical information provided was inherently correct and did not require verification. Such patterns were particularly evident among students with low inquisitiveness, who tended to prioritize procedural completion over conceptual sense making.

This finding is consistent with Lithner (2017), who distinguishes between imitative reasoning, in which students reproduce memorized procedures without reflection, and creative reasoning, which requires evaluating the appropriateness of strategies in unfamiliar situations. Similarly, Hadi & Maharani (2022) found that Indonesian pre-service teachers often prioritize procedural fluency over conceptual understanding, leaving them vulnerable when confronted with non-routine or contradictory problems. Moreover, Hardy et al. (2017) demonstrated that inquisitive thinking significantly predicts problem-solving performance, highlighting the role of curiosity in prompting learners to verify assumptions and explore alternative strategies.

In the Indonesian context, this tendency toward procedural reasoning can be understood as a product of long-standing instructional practices that emphasize algorithmic mastery and speed of completion over conceptual justification. Pre-service elementary teachers are often socialized into classroom environments where mathematics is framed as a set of fixed procedures with single correct answers, and questioning given information is rarely encouraged. As a result, students may internalize the belief that numerical data presented in a problem is inherently valid and should not be challenged. This educational culture helps explain why students with low inquisitiveness in this study readily accepted contradictory information and relied on procedural shortcuts, even when such strategies led to conceptually flawed solutions.

Taken together, these results suggest that inquisitiveness functions as a cognitive regulator that encourages verification, sense-making, and error detection. Students with higher levels of inquisitiveness were more likely to question the reliability of given data and reconsider their reasoning when inconsistencies emerged. Conversely, students with lower inquisitiveness tended to accept surface-level solutions without reflection, increasing the likelihood of persistent cognitive errors. Therefore, fostering inquisitiveness through tasks that emphasize justification, explanation, and verification may help pre-service teachers develop more flexible and accurate problem solving approaches. These findings suggest that inquisitiveness functions as a cognitive regulator that prompts verification and error detection. Students with greater inquisitiveness tend to revisit their reasoning when encountering inconsistencies, aligning with findings by Tee et al. (2018), who found that inquisitive thinking mediates the relationship between motivation and mathematical problem-solving. Therefore, strengthening inquisitiveness through reflective questioning may directly enhance cognitive flexibility and accuracy.

Metacognitive Difficulties and Inquisitiveness

Figure 4 shows the work of a student who attempted to verify the cone's height using the

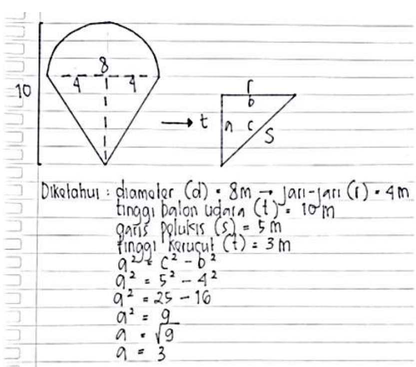

Figure 4. S-2 Attempt to check cone height using Pythagoras

Pythagorean theorem. The student calculated "$(5^2 - 4^2)$ = "9 = 3 and subsequently treated this value as the cone's height. This response indicates an initial awareness of the need to verify the given information rather than relying solely on direct subtraction. However, the student failed to evaluate whether the obtained result was consistent with the overall structure of the solid, which had a total height of 10 m. Instead of questioning this inconsistency or revisiting the assumptions underlying the calculation, the student proceeded as if the value were valid.

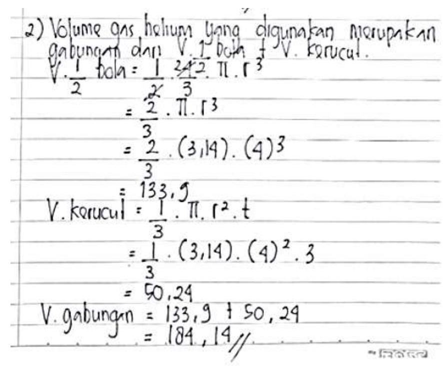

Figure 5: S-2 Continuation of the misapplied result in surface area and volume calculations

Figure 5 presents the continuation of the same student's solution, where the incorrect height (h = 3 m) was directly used in subsequent surface area and volume calculations. Although the procedural steps were carried out systematically, the fundamental inconsistency remained unresolved throughout the solution. This pattern reflects metacognitive difficulties: students recognize a contradiction but lack the regulatory skills to monitor, evaluate, and revise their strategies effectively.

Interview excerpts further confirm this tendency and provide deeper insight into students' metacognitive struggles. One student described the internal conflict experienced after recognizing an inconsistency:

"I realized that the height I calculated did not match the total height given in the problem. At that moment, I felt something was wrong, but I was not sure which step to change. I kept thinking the formula might be correct, but I also doubted the numbers in the problem. I tried to reconsider my steps, but I did not know how to fix the problem. Because I was afraid of making more mistakes, I decided to continue with what I had, even though I was not confident."

Another student expressed a similar struggle between curiosity-driven checking and uncertainty in regulation:

"I checked the calculation because I was curious whether the subtraction was correct. After using Pythagoras, I got a different answer, which confused me. I was afraid of making more mistakes if I changed my steps, so I just used one result and finished the problem."

These narratives illustrate that inquisitiveness encouraged students to notice inconsistencies and initiate verification; however, this awareness did not consistently translate into effective self-regulation. Even among students with high inquisitiveness, metacognitive control remained fragile. Although students were able to detect that "something was wrong," they lacked the strategic knowledge and confidence to decide when and how to revise their reasoning. This finding helps explain why a substantial proportion of students with high inquisitiveness (60%) continued to experience metacognitive difficulties.

A closer inspection of the metacognitive difficulties experienced by highly inquisitive students reveals that they were not rooted in a lack of awareness, but rather in what can be described as decisional paralysis following contradiction detection. Although these students successfully identified inconsistencies and initiated verification attempts, they struggled to make strategic decisions about how to proceed. In several cases, students hesitated between competing results, uncertain whether to trust the given information, revise assumptions, or abandon an initial strategy altogether. This indicates that their difficulty lay primarily in strategic metacognitive knowledge, knowing which corrective action to take, rather than in failure to recognize the problem itself.

This finding supports the view that metacognitive regulation is a distinct competence that does not automatically develop from dispositional traits such as inquisitiveness. While inquisitiveness appears to activate metacognitive awareness by prompting students to question and verify information, it does not necessarily equip them with the procedural knowledge or confidence required to revise strategies effectively. As noted by Hoth et al. (2022) and Kingsdorf & Krawec (2014), students may recognize errors but remain unable to act on them without explicit training in planning, monitoring, and decision-making. In this sense, inquisitiveness functions as a catalyst for reflection, whereas metacognitive regulation operates as the mechanism that translates reflection into adaptive action.

Within the context of Indonesian teacher education, this pattern may be related to limited opportunities for explicit metacognitive training. While students are often encouraged to obtain correct answers efficiently, they are rarely guided to reflect on alternative strategies or to justify revisions to their reasoning. Consequently, inquisitiveness primarily served as a trigger for awareness rather than a mechanism for sustained regulation, supporting Recht et al.'s (2025) view that metacognitive skills must be deliberately cultivated rather than assumed to emerge from curiosity alone.

An important and noteworthy finding of this study is that a substantial proportion of students with high inquisitiveness (60%) still experienced metacognitive difficulties. This suggests that inquisitiveness alone is insufficient to ensure successful problem solving when tasks involve contradictory information. One possible explanation lies in the problem's design, which required students not only to question the given data but also to integrate multiple pieces of information and evaluate their coherence. Such tasks demand advanced metacognitive skills, including planning alternative strategies, monitoring intermediate results, and making deliberate decisions about when and how to revise an approach.

Further analysis reveals that metacognitive difficulties manifested in several specific forms.

The most prominent subcategory was monitoring failure, in which students became aware of inconsistencies but did not systematically evaluate their implications for subsequent steps. Closely related to this was regulation failure, in which students lacked strategies to revise or abandon an initial approach even after recognizing its inadequacy.

Another recurring pattern involved strategy fixation, particularly among students with medium inquisitiveness. These students attempted verification but remained attached to their original procedures, continuing calculations despite unresolved inconsistencies. This indicates that inquisitiveness facilitated awareness but did not automatically translate into adaptive regulation. Such findings suggest that metacognitive difficulties in this context are less about the absence of awareness and more about insufficient strategic control when confronted conflicting information.

The persistence of metacognitive difficulties among highly inquisitive students may be partly explained by the limited emphasis on metacognitive training in Indonesian teacher education programs. While students are encouraged to master content knowledge and instructional procedures, explicit instruction on planning, monitoring, and evaluating problem-solving strategies is often minimal. Consequently, even when students exhibit inquisitiveness and attempt to verify information, they may lack practical experience in deciding how to revise their strategies or reconcile conflicting results. This suggests that inquisitiveness in the Indonesian context tends to develop as a dispositional curiosity rather than as a fully integrated self-regulatory competence. Without systematic exposure to reflective problem-solving practices, inquisitive students may become aware of contradictions but remain uncertain about how to respond effectively.

Another contributing factor may be participants' educational backgrounds. As pre-service elementary school teachers, many students had been exposed primarily to instructional practices emphasizing procedural fluency and correct final answers rather than reflective monitoring and justification. Consequently, even highly inquisitive students may have lacked sufficient experience in systematically regulating their problem-solving processes. This finding supports Schoenfeld's argument that metacognitive regulation is a distinct competence that must be explicitly developed, rather than assumed to emerge naturally from curiosity or motivation. Similarly, Medina et al. (2017) emphasized that awareness of errors does not automatically lead to strategy revision without targeted metacognitive training. Similar to Kilis & Yýldýrým's (2018) findings, inquisitiveness in this study appeared to activate metacognitive awareness but not full self-regulation. Students realized inconsistencies but lacked strategies to evaluate alternative solutions. This supports the argument by Abdelghani et al. (2023) that curiosity alone must be coupled with metacognitive training to sustain engagement and regulation in problem-solving.

Affective Difficulties and Inquisitiveness

Figure 6 illustrates the work of a student who discontinued the problem-solving process

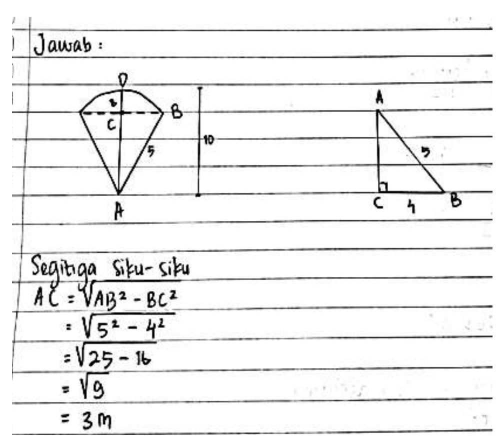

Figure 6. S-3 example of unfinished solution due to confusion

after realizing that the calculated cone height did not match the total height provided in the problem. Although the student initially applied the Pythagorean theorem and obtained a numerical result (3 m), the inconsistency between this value and the total height (10 m) led to hesitation and ultimately to task abandonment. Instead of attempting alternative strategies or re-evaluating the assumptions underlying the calculation, the student stopped working and left the solution incomplete. This behavior exemplifies affective difficulties, in which emotional responses such as confusion and anxiety interfere with sustained cognitive engagement.

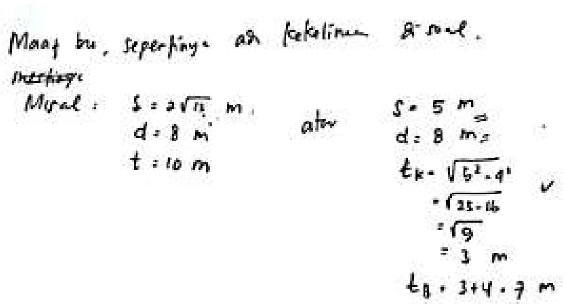

Figure 7. S-3 Arbitrary choice under emotional pressure

Figure 7 shows another student's response, where two inconsistent values of the cone's height (6 m from subtraction and 3 m from the Pythagorean theorem) were obtained. Feeling confused, the student chose to proceed with 3 m, noting that it "seemed safer," even though it was inconsistent with the problem's total height. This indicates that the decision was not based on logical verification but on the affective need to finish the task quickly.

Interview data further illuminate the role of affective responses in shaping students' engagement with contradictory information. One student described how emotional reactions influenced the decision to stop working on the problem:

"When I saw that the numbers didn't match, I immediately felt nervous and started to doubt myself. I thought I might have made a serious mistake. The more I tried to think about it, the more confused I became. I was afraid that if I kept trying different methods, I would only get more confused, so in the end I decided to stop and leave the solution unfinished."

Another student reported a similar emotional experience that led to a premature decision:

"I felt very frustrated because I believed that I had followed the correct steps, but the result was strange and did not make sense. That made me lose confidence in my ability. At that point, I just wanted to finish the task quickly, even though I was not sure my answer was correct, because I felt tired and overwhelmed."

These narratives indicate that students with low inquisitiveness were particularly vulnerable to affective difficulties when confronted with contradictory information. Rather than interpreting contradictions as opportunities for deeper inquiry, they perceived them as indicators of personal failure. This perception triggered negative emotions such as anxiety, frustration, and loss of confidence, which in turn reduced persistence and willingness to explore alternative strategies. In contrast, students with high inquisitiveness were more likely to tolerate uncertainty and continue working despite confusion, treating inconsistencies as challenges to investigate rather than as obstacles to avoid.

In the context of Indonesian teacher education, this pattern may be linked to learning environments that prioritize correctness and speed over exploration and reflection. When students are accustomed to viewing errors as signs of failure rather than as part of the learning process, emotional responses can quickly dominate cognitive and metacognitive processes. In this study, inquisitiveness appeared to serve as an affective buffer, enabling some students to reinterpret confusion as a manageable, even productive, emotional state rather than a threat to their self-confidence.

Affective difficulties observed in this study can be further categorized into distinct response patterns. One dominant sub-category was anxiety-induced task avoidance, in which students discontinued problem-solving upon encountering contradictions, perceiving confusion as a sign of failure. Another common pattern was emotion-driven decision-making, in which students selected arbitrary values or incomplete solutions to reduce emotional discomfort rather than to achieve conceptual coherence.

These affective responses were most pronounced among students with low inquisitiveness, who tended to interpret contradictions as threats to self-efficacy. In contrast, students with higher inquisitiveness exhibited greater emotional tolerance, allowing them to remain engaged despite uncertainty. This differentiation highlights how inquisitiveness functions not only as a cognitive disposition but also as an affective regulator that influences persistence and emotional resilience in problem solving.

Affective difficulties observed among low-inquisitiveness students can also be interpreted within the broader socio-educational context of Indonesian mathematics classrooms, where errors are often associated with failure rather than learning opportunities. Many pre-service teachers have experienced evaluative environments that prioritize correct answers and penalize mistakes, which may heighten anxiety when unexpected contradictions arise. In such contexts, contradictory information is perceived not as an invitation for inquiry but as a threat to performance. This may explain why some students in this study chose to abandon the task or arbitrarily select an answer, prioritizing task completion over conceptual coherence. Conversely, students with higher inquisitiveness appeared better equipped to reinterpret confusion as a manageable challenge, suggesting that inquisitiveness functions as a protective factor against negative emotional responses during problem-solving.

This pattern is consistent with Muis et al. (2018), who emphasized that epistemic emotions such as confusion and frustration can either support or hinder learning, depending on how they are regulated. Similarly, Hannula (2015) emphasized that negative emotions often reduce persistence in mathematical problem solving. In this study, inquisitiveness appeared to buffer affective difficulties: students with higher inquisitiveness were less likely to abandon the task and more likely to persevere despite uncertainty.

From an educational perspective, these findings suggest that cultivating inquisitiveness may contribute not only to cognitive and metacognitive development but also to affective resilience in problem solving. By framing contradictory information as a meaningful and authentic challenge rather than an error, teacher educators can help pre-service teachers reinterpret confusion as a productive emotional state (Hourani, 2013). This aligns with Jirout & Matthews (2022) concept of curiosity-driven emotional stability, in which inquisitive attitudes allow learners to manage uncertainty more constructively. Consequently, integrating tasks that explicitly normalize confusion and encourage emotional reflection may strengthen students' persistence and confidence when facing complex mathematical problems.

Despite the contributions of this study, several limitations should be acknowledged. The participants were drawn from a single class within a teacher education program at a single university, limiting the diversity of institutional contexts and learning experiences represented. Consequently, the findings should be interpreted with caution and cannot be generalized to all pre-service elementary school teachers in Indonesia. The patterns of cognitive, metacognitive, and affective difficulties identified in this study may be influenced by contextual factors such as curriculum emphasis, instructional practices, and assessment culture specific to the participants' institution. Nevertheless, the in-depth qualitative analysis provides valuable insights into the mechanisms through which inquisitiveness interacts with problem-solving difficulties. Future research is encouraged to involve participants from multiple institutions or regions and to adopt comparative or mixed-method approaches to enhance the generalizability and transferability of the findings.

Cross-Case Analysis of Reasoning Processes Across Inquisitiveness Levels

To further illuminate the qualitative patterns identified in this study, a cross-case analysis was conducted by comparing representative cases from the low, medium, and high inquisitiveness groups. This approach highlights how students' reasoning trajectories diverged at critical moments, including in the detection of contradictions, emotional responses, and strategic decision-making.

Case 1: Low Inquisitiveness (Procedural Acceptance and Early Disengagement). A student from the low inquisitiveness group began the task by directly applying familiar procedures, subtracting the hemisphere's radius from the total height without questioning the validity of this operation. The student did not detect any inconsistency between the obtained value and the problem conditions. When later calculations produced confusing results, the student exhibited anxiety and discontinued the solution. This case illustrates how limited inquisitiveness led to uncritical procedural reasoning, minimal metacognitive monitoring, and affective withdrawal.

Case 2: Medium Inquisitiveness (Detection Without Effective Regulation). In contrast, a student with medium inquisitiveness noticed that the calculated cone height did not align with the total height provided. This prompted an attempt to verify the result using the Pythagorean theorem. However, upon obtaining a conflicting value, the student experienced confusion and uncertainty about which strategy to trust. Although the student was aware of the contradiction, they lacked the confidence and regulatory strategies needed to revise the solution, ultimately proceeding with an unresolved inconsistency. This case exemplifies partial inquisitiveness, where detection occurs without sustained metacognitive control.

Case 3: High Inquisitiveness (Persistent Verification with Regulatory Constraints). A representative student from the high-inquisitiveness group actively questioned the data's reliability and attempted multiple verification steps. The student recognized the contradiction and expressed curiosity-driven engagement with the problem. However, despite this persistence, the student struggled to decide how to reconcile conflicting results and hesitated to abandon initial assumptions. This case demonstrates that even high inquisitiveness does not automatically ensure successful metacognitive regulation, particularly when strategic knowledge is limited.

Across cases, the key divergence occurred not at the point of calculation but at moments requiring evaluation, emotional regulation, and strategic decision-making. Low inquisitiveness was associated with procedural acceptance and affective avoidance, medium inquisitiveness with awareness but indecision, and high inquisitiveness with persistent engagement constrained by regulatory limitations. These cross-case comparisons reinforce the conclusion that inquisitiveness shapes how students navigate cognitive, metacognitive, and affective challenges, but must be supported by explicit metacognitive instruction to produce adaptive problem-solving outcomes.

Integrative Model of Students' Reasoning Based on Inquisitiveness Levels

To synthesize the qualitative findings across cognitive, metacognitive, and affective dimensions, this study proposes an integrative process model illustrating students' reasoning pathways when solving mathematical problems with contradictory information. The following flowcharts illustrate how students with varying levels of inquisitiveness interpret information, encounter inconsistencies, and respond cognitively and affectively. These models highlight critical divergence points in students' reasoning processes and illustrate how varying levels of inquisitiveness shape persistence, verification behavior, and problem-solving outcomes.

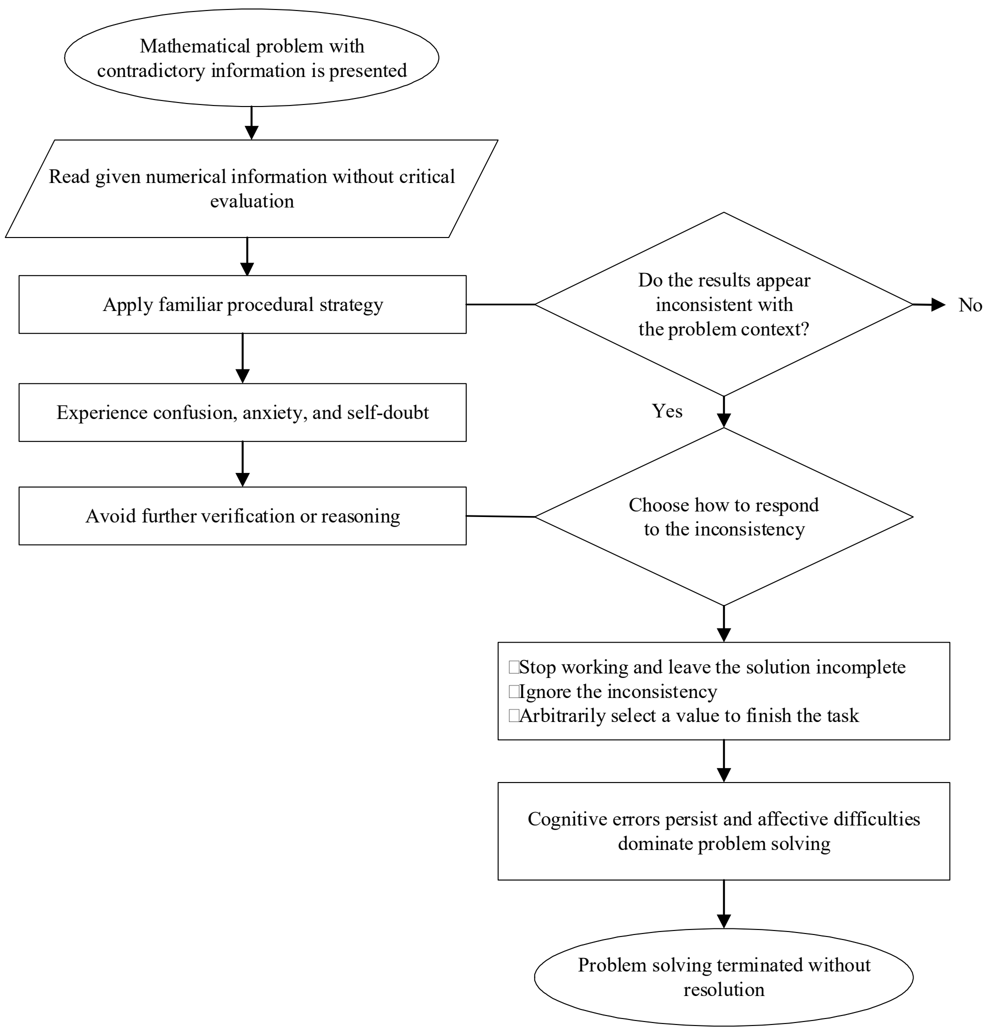

Figure 8. Reasoning process of students with low inquisitiveness

Figure 8 illustrates the reasoning pathway of students with low inquisitiveness. This model emphasizes a predominantly procedural approach, in which students tend to accept given information without critical evaluation and respond to emerging inconsistencies by avoiding or prematurely terminating problem-solving. Affective reactions, such as confusion and self-doubt, play a dominant role in shaping their decisions.

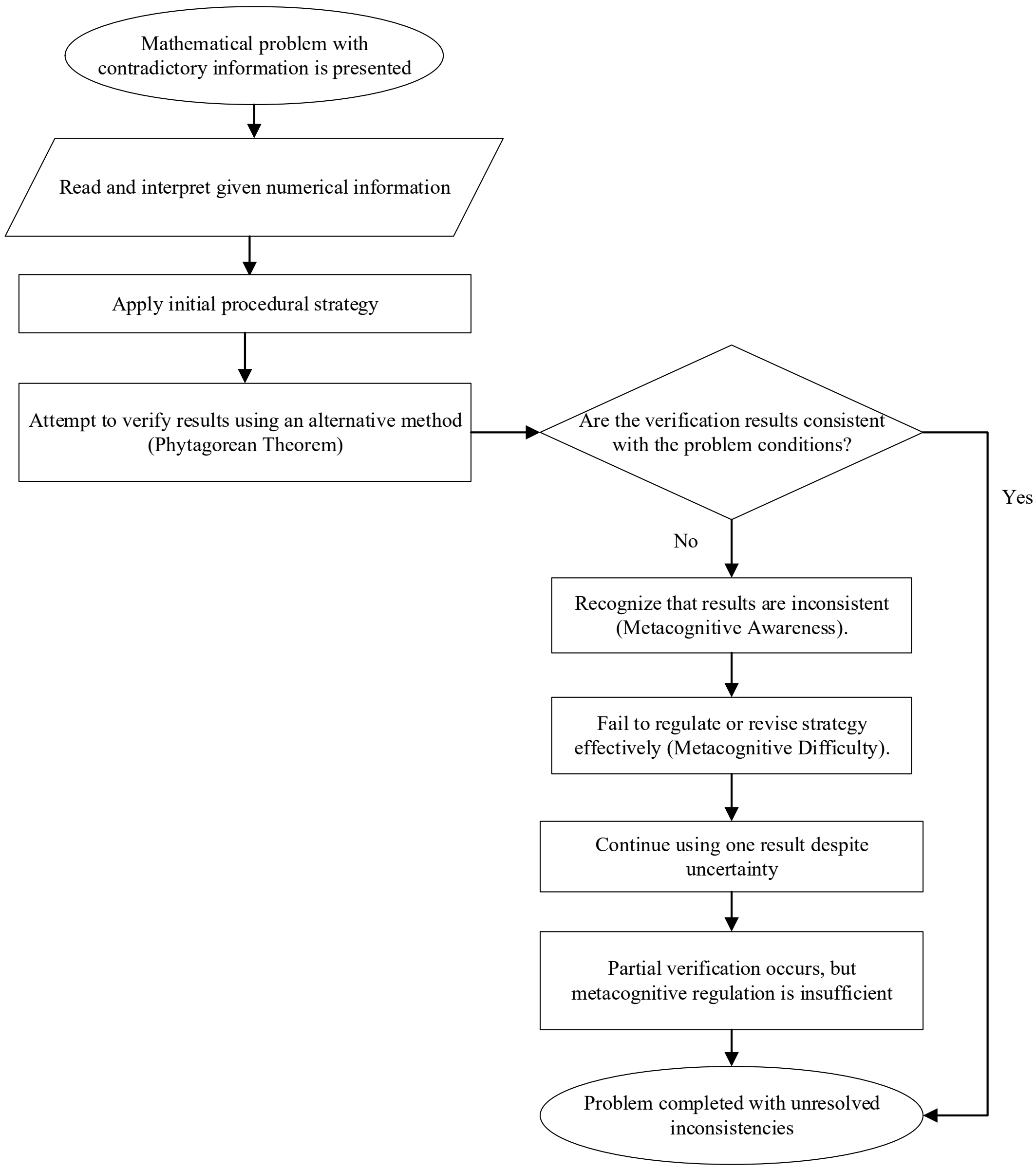

Figure 9. Reasoning process of students with medium inquisitiveness

Figure 9 presents the reasoning process of students with medium inquisitiveness. Unlike the low-inquisitiveness group, these students demonstrate initial awareness of inconsistencies and attempt partial verification. However, the model highlights a critical breakdown at the regulation stage, where students recognize contradictions but remain uncertain about how to revise their strategies effectively.

Figure 10 depicts the reasoning process of students with high inquisitiveness. This model is characterized by sustained engagement, iterative verification, and greater tolerance for uncertainty. Although cognitive and metacognitive challenges may still arise, students in this group are more likely to regulate their strategies and persist until achieving a coherent resolution.

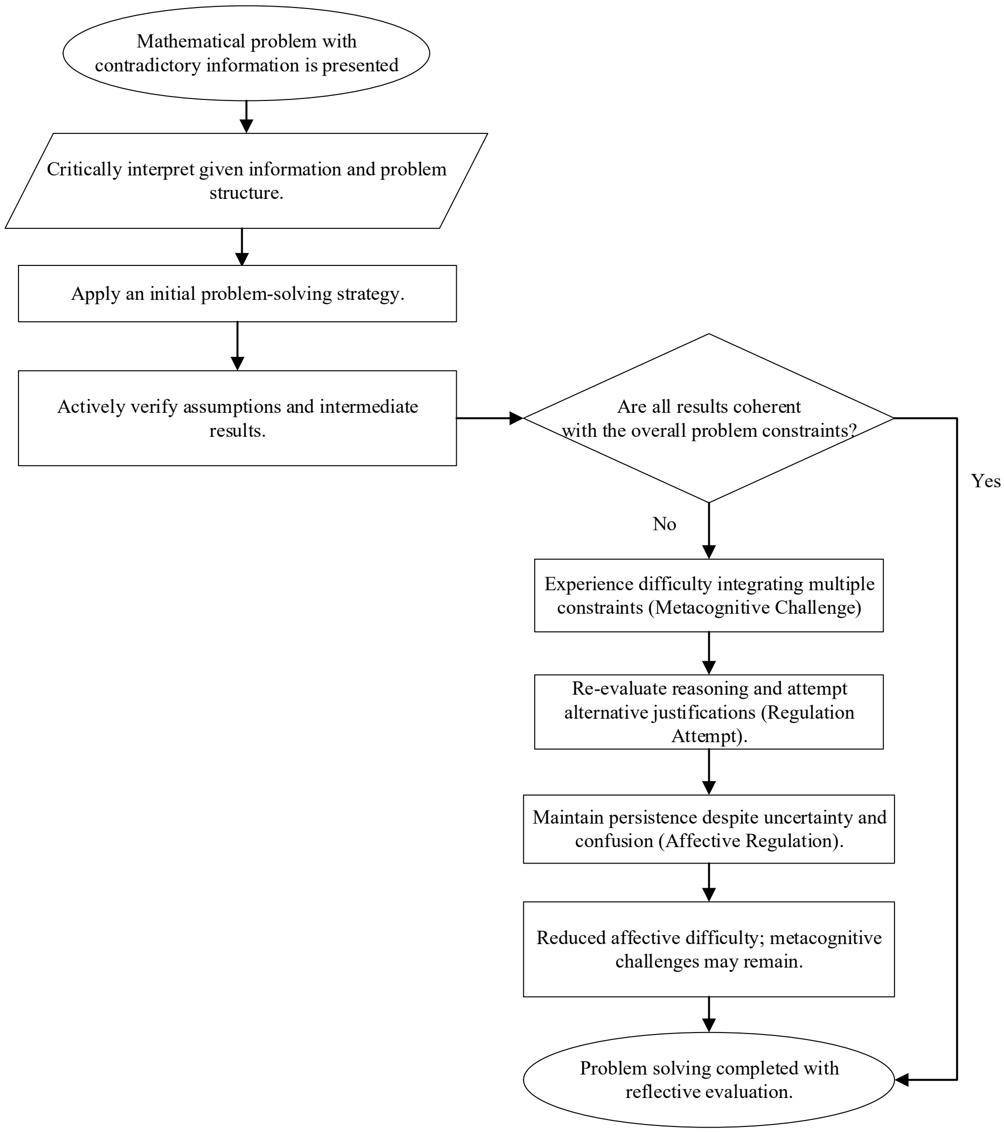

Figure 10. Reasoning process of students with high inquisitiveness

■ CONCLUSION

This study revealed that pre-service elementary school teachers experienced three interrelated categories of difficulties when solving mathematical problems containing contradictory information: cognitive, metacognitive, and affective. Cognitive difficulties were most prevalent among students with low inquisitiveness, who relied on procedural execution without verification. Metacognitive difficulties were particularly evident among students with medium inquisitiveness, who recognized inconsistencies but struggled to regulate and revise their strategies. Affective difficulties, including anxiety, frustration, and task abandonment, were strongly associated with low inquisitiveness.

Overall, inquisitiveness emerged as a critical disposition shaping how students engaged with contradictory information. Students with high inquisitiveness demonstrated greater persistence, willingness to verify assumptions, and emotional resilience, although metacognitive regulation challenges remained evident even within this group.

From a theoretical perspective, this study contributes to mathematics education research by extending the construct of inquisitiveness beyond a cognitive trait, positioning it as a dispositional factor that mediates cognitive accuracy, metacognitive regulation, and affective resilience in problem solving. The findings suggest that inquisitiveness alone is insufficient without explicit metacognitive support, thereby highlighting the need to conceptualize inquisitiveness as interacting dynamically with self-regulatory processes rather than operating in isolation.

Practically, the findings have important implications for teacher education programs. Mathematics instruction for pre-service teachers should move beyond procedural mastery and explicitly integrate learning experiences that cultivate inquisitiveness through verification-oriented tasks, reflective questioning, and metacognitive scaffolding. Teacher educators are encouraged to design problem-solving activities that intentionally include contradictory information and guide students to monitor, justify, and revise their reasoning. Such practices can help future teachers develop not only conceptual understanding but also the emotional resilience required to model productive struggle and inquiry in their own classrooms.

■ REFERENCES

Abdelghani, R., Law, E., Desvaux, C., Oudeyer, P. Y., & Sauzéon, H. (2023). Interactive environments for training children's curiosity through the practice of metacognitive skills: a pilot study. *Proceedings of IDC 2023 - 22nd Annual ACM Interaction Design and Children Conference: Rediscovering Childhood*, 495–501. https://doi.org/10.1145/3585088.3593880

Bardone, E., & Secchi, D. (2017). Inquisitiveness: distributing rational thinking. *Team Performance Management*, *23*(1–2), 66–81. https://doi.org/10.1108/TPM-10-2015-0044

Barham, A. I. (2020). Investigating the development of pre-service teachers' problem-solving strategies via problem-solving mathematics classes. *European Journal of Educational Research*, *9*(1), 129–141. https://doi.org/10.12973/eu-jer.9.1.129

Cansoy, R., & Turkoglu, M. E. (2017). Examining the Relationship between Pre-Service Teachers' Critical Thinking Disposition, Problem Solving Skills, and Teacher Self-Efficacy. *International Education Studies*, *10*(6), 23. https://doi.org/10.5539/ies.v10n6p23

Chew, K. S., Van Merrienboer, J. J. G., & Durning, S. J. (2019). Perception of the usability and implementation of a metacognitive mnemonic to check cognitive errors in clinical setting. *BMC Medical Education*, *19*(1), 1–12. https://doi.org/10.1186/s12909-018-1451-4

Fusaro, M., & Smith, M. C. (2018). Preschoolers' inquisitiveness and science-relevant problem solving. *Early Childhood Research Quarterly*, *42*(July 2017), 119–127. https://doi.org/10.1016/j.ecresq.2017.09.002

Hadi, F. R., & Maharani, S. (2022). Analysis of prospective elementary school teachers' inquisitiveness in solving mathematics problems. *QALAMUNA: Jurnal Pendidikan, Sosial, Dan Agama*, *14*(2), 995–1010. https://doi.org/10.37680/qalamuna.v14i2.3854

Hadi, F. R., & Mulyadi, M. (2025). Exploring the evolution of inquisitiveness in education: a bibliometric perspective over the last decade. *EDUKASIA: Jurnal Pendidikan Dan Pembelajaran*, *6*(1), 373–384. https://doi.org/10.62775/edukasia.v6i1.1417

Hadi, S., Herman, T., & Hasanah, A. (2018). Students' difficulties in solving mathematical problems. *International Journal of Educational Science and Research*

(IJESR), *8*(1), 55–64. https://doi.org/10.1063/5.0120257

Hannula, M. S. (2015). Emotions in Problem Solving. In S. J. Cho (Ed.), *Selected regular lectures from the 12th international congress on mathematical education* (1st ed., pp. 269–288). Springer Cham. https://doi.org/10.1007/978-3-319-17187-6

Hardy, J. H., Ness, A. M., & Mecca, J. (2017). Outside the box/ : Epistemic curiosity as a predictor of creative problem solving and creative performance. *PAID*, *104*, 230–237. https://doi.org/10.1016/j.paid.2016.08.004

Herwin, H., Costa, A., & Cristal, I. S. (2023). International journal of educational methodology graded response models on the curiosity measurement of elementary school students. *International Journal of Educational Methodology*, *9*(1), 53–62. https://doi.org/10.12973/ijem.9.1.53

Herwin, H., & Nurhayati, R. (2021). Measuring students' curiosity character using confirmatory factor analysis. *European Journal of Educational Research*, *10*(2), 773–783. https://doi.org/10.12973/eu-jer.10.2.773

Hong, S. S., Bae, J., Son, L. K., & Kim, K. (2023). Negative emotion can be "more negative" for those with high metacognitive abilities when problem-solving. *Frontiers in Psychology*, *14*(March), 1–13. https://doi.org/10.3389/fpsyg.2023.1110211

Hoth, J., Larrain, M., & Kaiser, G. (2022). Identifying and dealing with student errors in the mathematics classroom/ : Cognitive and motivational requirements. *Frontiers in Psychology*, *13*(2), 1–16. https://doi.org/10.3389/fpsyg.2022.1057730

Hourani, R. B. (2013). Pre-service teachers ' reflection/ : perception, preparedness and challenges. *Reflective Practice/ : International and Multidisciplinary Perspectives*, *14*(1), 12–30. https://doi.org/10.1080/14623943.2012.732947

Hurme, T. R., Siklander, S., Kangas, M., & Melasalmi, A. (2023). Pre-service early childhood teachers' perceptions of their playfulness and inquisitiveness. *Frontiers in Education*, *8*(September), 1–12. https://doi.org/10.3389/feduc.2023.1102926

Jirout, J. J., & Matthews, S. E. (2022). Developing intellectual character: an educational perspective on how uncertainty-driven curiosity can support learning. In R. A. Beghetto & G. J. Jaeger (Eds.), *Uncertainty: A Catalyst for Creativity, Learning and Development* (pp. 253–268). Springer Cham. https://doi.org/10.1007/978-3-030-98729-9_14

Karademir, C. A. (2019). Pre-Service teachers' problem solving skills and curiosity levels*. *International Journal of Educational Methodology*, *5*(1), 151–164. https://doi.org/10.12973/ijem.5.1.163

Kemmerle, M. (2013). Promoting student questions in mathematics classrooms. *Proceedings of the 35th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*, *2004*, 1004–1011.

Kilis, S., & Yýldýrým, Z. (2018). Investigation of community of inquiry framework in regard to self-regulation, metacognition and motivation. *Computers and Education*, *126*, 53–64. https://doi.org/10.1016/j.compedu.2018.06.032

Kim, J. Y., Choi, D. S., Sung, C., & Park, J. Y. (2018). The role of problem solving ability on innovative behavior and opportunity recognition in university students. *Journal of Open Innovation: Technology, Market, and Complexity*, *4*(1), 1–13. https://doi.org/10.1186/s40852-018-0085-4

Kingsdorf, S., & Krawec, J. (2014). Error analysis of mathematical word problem solving across students with and without learning disabilities. *Learning Disabilities Research & Practice*, *29*(2), 66–74. https://doi.org/10.1111/ldrp.12029

Lithner, J. (2017). Principles for designing mathematical tasks that enhance imitative and creative reasoning. *ZDM*, *49*(6), 937–949. https://doi.org/10.1007/s11858-017-0867-3

Litman, J. A., Robinson, O. C., & Demetre, J. D. (2017). Intrapersonal curiosity: Inquisitiveness about the inner self. *Self and Identity*, *16*(2), 231–250. https://doi.org/10.1080/15298868.2016.1255250

Maharani, S., Nusantara, T., As'ari, A. R., & Qohar, A. (2019). Analyticity and systematicity students of mathematics education on solving non-routine problems. *Mathematics and Statistics*, *7*(2), 50–55. https://doi.org/10.13189/ms.2019.070204

Medina, M. S., Castleberry, A. N., & Persky, A. M. (2017). Strategies for improving learner metacognition in health professional education. *American Journal of Pharmaceutical Education*, *81*(4), 78. https://doi.org/10.5688/ajpe81478

Mehrad, A., & Mehrad, A. (2023). Student's creativity in an educational environment: revelation and inquisitiveness. *Journal of Education For Sustainable Innovation*, *1*(2), 77–84. https://doi.org/10.56916/jesi.v1i2.547

Miles, M. A., Huberman, M. B., & Saldana, J. (2014). *Qualitative data analysis, 3rd ed*. Washington DC: Sage Publications.

Muis, K. R., Chevrier, M., & Singh, C. A. (2018). The role of epistemic emotions in personal epistemology and self-regulated learning the role of epistemic emotions in personal epistemology and self-regulated learning. *Educational Psychologist*, *0*(0), 1–20. https://doi.org/10.1080/00461520.2017.1421465

Muis, K. R., Psaradellis, C., Lajoie, S. P., Di Leo, I., & Chevrier, M. (2015). The role of epistemic emotions in mathematics problem solving. *Contemporary Educational Psychology*, *42*, 172–185. https://doi.org/10.1016/j.cedpsych.2015.06.003

Oppong, E., Shore, B. M., & Muis, K. R. (2018). Clarifying the connections among regulation and self-regulated learning/ : implications for theory and practice. *Sage Journals*, *63*(2), 1–18. https://doi.org/10.1177/0016986218814008

Pekrun, R., Goetz, T., Frenzel, A. C., Barchfeld, P., & Perry, R. P. (2011). Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ). *Contemporary Educational Psychology*, *36*(1), 36–48. https://doi.org/10.1016/j.cedpsych.2010.10.002

Peters, J. R., Eisenlohr-Moul, T. A., Upton, B. T., Talavera, N. A., Folsom, J. J., & Baer, R. A. (2017). Characteristics of repetitive thought associated with borderline personality features: a multimodal investigation of ruminative content and style. *Journal of Psychopathology and Behavioral Assessment*, *39*(3), 456–466. https://doi.org/10.1007/s10862-017-9594-x

Potvin, P. (2023). Response of science learners to contradicting information: a review of research. *Studies in Science Education*, *59*(1), 67–108. https://doi.org/10.1080/03057267.2021.2004006

Recht, S., Li, C., Yang, Y., & Chiu, K. (2025). Adaptive curiosity about metacognitive ability. *Journal of Experimental Psychology: General*, *154*(3), 852–863. https://doi.org/Journal of Experimental

Psychology: Gen. https://doi.org/10.1037/xge0001690

Reio, T. G. (2019). Curiosity and interest. *Human Resource Development Quarterly*, *30*(4), 451–452. https://doi.org/10.1002/hrdq.21376

Saygýlý, S. (2017). Examining the problem solving skills and the strategies used by high school students in solving non-routine problems. *E-International Journal of Educational Research*, *8*(2), 91–114.

Schoenfeld, A. H. (2016). Learning to think mathematically: problem solving, metacognition, and sense making in mathematics. *Journal of Mathematical Behavior*, *41*, 37–50. https://doi.org/10.1177/002205741619600202

Serin, M. K. (2019). Analysis of the problems posed by pre-service primary school teachers in terms of type, cognitive structure, and content knowledge. *International Journal of Educational Methodology*, *5*(4), 577–590. https://doi.org/10.12973/ijem.5.4.577

Skulmowski, A., & Xu, K. M. (2021). Understanding cognitive load in digital and online learning/ : a new perspective on extraneous cognitive load. *Educational Psychology Review*, *34*(1), 171–196. https://doi.org/10.1007/s10648-021-09624-7

Syamsulrizal, Khabibah, S., Lukito, A., & Madzkiyah, A. F. (2025). Students' critical thinking dispositions in view of cognitive styles: exhibiting confidence in reasoning and inquisitive. *Perspektivy Nauki i Obrazovania*, *73*(1), 583–594. https://doi.org/10.32744/pse.2025.1.37

Tee, K. N., Leong, K. E., & Abdul Rahim, S. S. (2018). The mediating effects of critical thinking skills on motivation factors for mathematical reasoning ability. *Asia-Pacific Education Researcher*, *27*(5), 373–382. https://doi.org/10.1007/s40299-018-0396-z

Umah, U., Asari, A. R., Sukoriyanto, & Sisworo. (2023). Students' inquisitive questions predict their understanding of mathematics texts. *Acta Scientiae*, *25*(6), 29–59. https://doi.org/10.17648/acta.scientiae.7466

Vogl, E., Pekrun, R., Murayama, K., Loderer, K., Schubert, S., & Fields, C. (2019). Surprise, curiosity, and confusion promote knowledge exploration/ : evidence for robust effects of epistemic emotions. *Frontiers in Psychology*, *10*(1), 1–16. https://doi.org/10.3389/fpsyg.2019.02474

Watson, L. (2015). What is inquisitiveness. *American Philosophical Quarterly*, *52*(3), 273–287. https://www.jstor.org/stable/24475463

Watson, L. (2019). Educating for inquisitiveness: A case against exemplarism for intellectual character education. *Journal of Moral Education*, *48*(3), 303–315. https://doi.org/10.1080/03057240.2019.15894

Yanarates, E. (2022). Investigation of the relationship between inquisitive thinking skills and problem. *International Journal of Education Technology and Scientific Research*, *7*(17), 158–191. https://doi.org/10.35826/ijetsar.445

Yayuk, E., & Husamah, H. (2020). The difficulties of prospective elementary school teachers in item problem solving for mathematics/ : polya's steps. *Journal for the Education of Gifted Young Scientists,* *8*(1), 361–378. https://doi.org/10.17478/jegys.665833

Zheng, J., Lajoie, S., & Li, S. (2023). Emotions in self-regulated learning/ : A critical literature review and meta-analysis. *Frontiers in Psychology*, *14*(1), 1–13. https://doi.org/10.3389/fpsyg.2023.1137010