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Investigating Students' Critical Thinking in Solving Fractional Problems Based on Higher Order Thinking Skills (HOTS) Viewed from Self-Efficacy and FRISCO Model

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Abstract

Background: Critical thinking is recognised as the highest level of thinking, essential for exploring knowledge and generating new ideas. In the context of mathematics education, particularly at the elementary level, understanding how students engage in critical thinking when solving Higher Order Thinking Skills (HOTS) problems is particularly important.

Objective: This study investigates students' critical thinking processes in relation to their self-efficacy levels using the FRISCO framework—Focus, Reason, Inference, Situation, Clarity, and Overview—during the HOTS mathematical problem-solving process.

Method: An exploratory case study design was conducted with 45 elementary school students. Data were gathered through a self-efficacy questionnaire, written tests, interviews, and content analysis of documentation to identify patterns and characteristics of students' critical thinking processes.

Results: Not all components of the FRISCO framework were fully demonstrated by the students. However, they were able to perform mathematical reasoning to formulate ideas and devise problem-solving strategies based on conceptual understanding. In interviews, they frequently used visual representations to clarify their thinking, especially in the 'Clarity' component. Additionally, elements of metacognition emerged spontaneously during the 'Overview' stage, suggesting self-initiated reflection without external intervention.

Conclusion: Although elementary students do not consistently exhibit all components of the FRISCO framework, their demonstrated abilities in reasoning, use of visual clarification, and spontaneous metacognitive behaviours highlight a developing capacity for critical thinking.

Unique Contribution: This study provides empirical insights into how young learners engage in higher-order thinking through the FRISCO lens, illustrating a novel application of the framework in elementary mathematics education and examining the moderating influence of self-efficacy.

Key Recommendations: Educators should cultivate learning environments that foster metacognitive development and encourage the use of visual tools to aid conceptual clarity. Future research should investigate scaffolding strategies to strengthen each FRISCO component across varying levels of self-efficacy.

Keywords: Critical Thinking; Fractional Problems; Higher Order Thinking Skills (HOTS); Self-Efficacy

Introduction

Mathematics is a discipline designed to develop critical and creative thinking skills through problem-solving-based learning. As noted by Subanji et al. (2023), mathematics instruction serves as a vehicle for cultivating reasoning and thinking skills. Reasoning can occur when students think critically, solve problems, or make decisions (Faizah et al., 2022). At the elementary level, mathematics provides the foundational knowledge students need to understand and apply concepts at higher levels (Sachdeva & Eggen, 2021). Students commonly experience difficulties with fractions, including challenges in concretising fraction concepts, understanding problem statements, and performing calculations (Deringöl, 2019). In the problem-solving process, Jarrah et al. (2022) found that students struggled to interpret the information embedded in fraction problems, did not solve problems in clearly articulated steps, and often failed to verify their

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solutions. These difficulties align with weaker performance on measures of mathematical critical thinking. To identify critical thinking skills, this study adopts Ennis's (2011) FIRSCO framework, which encompasses Focus, Reason, Inferences, Situation, Clarity, and Overview.

Within FRISCO, *Focus* refers to identifying the relevant information in a problem. Reason involves providing logical justifications based on evidence pertinent to the task. Inference concerns drawing appropriate conclusions and supporting them with reasons. Situation addresses the completeness and alignment of the given information with the mathematical concepts required for the solution. Clarity captures the ability to explain the results of problem-solving. An overview entails reviewing and evaluating the solution process and its outcome.

Wekwete (2024) reported that students' critical thinking remains below expectations. The study further showed that no students were in the high category; most of them demonstrated low critical thinking, and 15% fell into the very low category. One avenue for improvement is the use of Higher Order Thinking Skills (HOTS) tasks. Situated at the upper levels of Bloom's taxonomy, HOTS require learners to analyse, evaluate, and create—moving beyond recall to engage deeply with concepts and construct new knowledge (Basak & Yucel, 2024). As such, critical thinking becomes a central component of HOTS, functioning as a cognitive tool that enables students to navigate complex problems and generate innovative solutions. According to Zhou et al. (2024), assessments grounded in HOTS principles can effectively stimulate and optimise students' critical thinking abilities by encouraging them to question assumptions, make reasoned judgments, and reflect on alternative perspectives. Chen and Wang (2023) and Nugroho (2024) assert that consistent exposure to such tasks can sharpen students' analytical capacity, promote conceptual clarity, and foster metacognitive awareness. Therefore, integrating HOTS into classroom practice is not merely a pedagogical trend but a strategic approach to cultivating lifelong learners capable of critical inquiry in diverse contexts.

Students' confidence in tackling HOTS-based problems is crucial. In this study, students' confidence in solving HOTS-based math problems was identified through self-efficacy. Self-efficacy is a factor within the individual that can affect learning success. Students with higher self-efficacy approach problems more optimistically (Sudirman et al., 2024). Basak & Yucel (2024) emphasise that support for students' self-confidence can help them confront challenges effectively.

Prior research underscores the importance of investigating critical thinking. Accordingly, this study evaluates students' critical thinking while also examining their confidence in their abilities. Self-efficacy, which is an affective dimension of mathematics learning, plays a pivotal role in academic success. Beliefs, attitudes and emotions are three affective elements that can affect students' learning processes **(**Güler & Tarim, 2024). Focusing on elementary students is essential, as this is a formative stage of cognitive development.

This study examines students' critical thinking processes when solving HOTS-based fraction problems from the perspective of self-efficacy. The use of HOTS-based problems makes the test more specific and relevant. By concentrating on fraction tasks, the study aims not only to illuminate students' critical thinking processes but also to provide practical insights for teachers seeking more effective instruction on fractions. The research questions are:

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1) What are students' confidence levels as indicated by self-efficacy test results?
2) How do students engage in critical thinking when solving HOTS problems?
3) How are students' critical thinking processes characterised using the FRISCO model?

Methodology

Design Research

This research adopts a qualitative approach with an exploratory case study design. The qualitative method is grounded in the post-positivist paradigm, which emphasises understanding phenomena in natural settings where the researcher serves as the primary instrument of data collection. The inquiry focuses on how students engage in critical thinking when solving HOTS fraction problems, examined through their self-efficacy and the FRISCO framework (Focus, Reason, Inference, Situation, Clarity, and Overview). The exploratory case study design is particularly suited for this research because it allows for an in-depth investigation of complex cognitive processes within a real-world educational context, especially when the boundaries between the phenomenon and its context are not clearly defined. Data were collected through multiple instruments, including a self-efficacy questionnaire, written tests, interviews, and documentation, to enable triangulation and enrich the depth of analysis. Unlike phenomenological studies that seek to uncover the essence of lived experiences, the exploratory case study design examines patterns, behaviours, and strategies employed by students, yielding a comprehensive understanding of how critical thinking manifests in specific learning scenarios.

Data Collection

This research employs a qualitative approach with an exploratory case study design, which is appropriate for exploring complex learning behaviours in real educational contexts. Participants were 45 fourth-grade students from three regions in East Java, Indonesia, selected to represent diverse socio-educational backgrounds. These participants served as the primary subjects for investigating critical thinking processes in solving HOTS-based fraction problems, analysed through the lens of self-efficacy and the FRISCO framework. Data were collected through multiple instruments, including a self-efficacy questionnaire, written mathematical problem-solving tests, semi-structured interviews, and documentation of students' work, which together formed the primary data sources. In addition, secondary data were obtained through interviews with homeroom teachers to provide contextual insights into students' learning characteristics and classroom behaviour. To ensure validity, method triangulation was applied by cross-referencing students' written responses with their verbal explanations during interviews. When consistency was found between the two sources, the data were considered credible. This comprehensive and rigorous data collection and validation process supports the exploratory case study design in revealing meaningful patterns and variations in how elementary students critically engage with mathematical tasks.

Written tests were used to identify students' critical thinking processes when solving HOTS-based problems. Test development followed these steps: (1) select fraction content; (2) specify targeted cognitive levels; (3) construct HOTS-based items; (4) prepare keys and scoring rubrics;

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and (5) administer items to students. Rubric grids captured indicators aligned with FRISCO: Focus, Reason, Inference, Situation, Clarity, and Overview. In addition, all research instruments were first validated by expert validators in the field of mathematics education prior to use. Validation addressed content appropriateness, construction suitability, language clarity, and item quality. The results of the validity test are presented in percentage form using the following formula:

$$V_e = \frac{T_{esa}}{T_{es}} \times 100\%$$

Description:
V_e = Expert validation
T_{esa} = Total empirical score achieved
T_{es} = Total expected score

Interpretation criteria appear in Table 1.

Table 1: Criteria for Validation Results

Achievement Level	Category	Test Decision
85% - 100%	Very Valid	Use without revision
70% - 85%	Fairly Valid	Use, minor revisions as needed
50% - 70%	Less Valid	Do not use; major revision required
01% - 50%	Invalid	Do not use

Instruments meeting ≥70% were considered usable (with minor revisions as appropriate). Instruments below 70% were revised to address identified weaknesses.

The mathematics self-efficacy questionnaire consisted of 17 statements that reflected three facets: magnitude (perceived difficulty), strength/tenacity, and generality (breadth). Responses were evaluated using a 4-point Likert scale (1–4). Scoring parameters were:

Number of items: 17
Maximum total score: 17 × 4 = 68
Minimum total score: 17 × 1 = 17
Mi (Mean) = $\frac{1}{2}$ (Maximum score + minimum score) = $\frac{1}{2}$ (68 + 17) = $\frac{1}{2}$ (85) = 42.5
SDi (Ideal Standard Deviation) = $\frac{1}{6}$ (Maximum score - minimum score) = $\frac{1}{6}$ (68 - 17) = $\frac{1}{6}$ (51) = 8.5

Self-efficacy levels were categorized using the intervals in Table 2.

Table 2: Self-Efficacy Level Category Formula

Score Interval	Self-Efficacy Level
X ≥ Mi + Sdi	High
Mi – SDi ≤ X < Mi + Sdi	Medium

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X < Mi – Sdi	Low

Based on the previous calculation, the selection of research subjects was based on the students' self-efficacy level as shown in Table 3.

Table 3: Self-Efficacy Level Categories

Score Interval	Self-Efficacy Level
X ≥ 51	High
34 ≤ X < 51	Medium
X < 34	Low

Data Analysis

Data were analysed using an interactive content-analysis model with four stages: data collection, data reduction, data display, and conclusion drawing/verification. At the *data collection* stage, the researcher gathered information from four primary sources: a self-efficacy questionnaire to assess students' confidence levels, written tests to examine critical thinking skills in solving HOTS-based fraction problems, semi-structured interviews to gain deeper insight into students' thought processes, and documentation of students' work as tangible evidence of their reasoning and problem-solving strategies. *Data reduction* involved selecting, simplifying, and organising raw data into meaningful categories. The researcher thoroughly reviewed all data, identifying information relevant to the research objectives, specifically the students' critical thinking abilities as viewed through the lens of self-efficacy and the FRISCO framework. Irrelevant or unexpected data were not discarded but rather noted as supporting or supplementary findings that could provide additional context to the study. During data reduction, categorisation into themes aligned with FRISCO components was carried out, followed by double-checking and verification to minimise errors in classification and interpretation.

Next, data display allowed for a systematic presentation via descriptive narratives, matrices, tables, and illustrative interview excerpts, which helped surface patterns across self-efficacy levels and FRISCO components. This stage aimed to make visible the emerging patterns of students' critical thinking processes and allow for comparison across different self-efficacy levels and FRISCO components. The final stage was conclusion drawing and verification, in which the researcher interpreted the findings. These conclusions were initially provisional and subject to change upon the discovery of new evidence. Therefore, continuous verification was conducted through method triangulation, particularly by comparing students' written test responses with their interview explanations. Consistency between sources was taken as evidence of validity. Additionally, peer debriefing was used to minimise subjective bias. This analytic process produced a robust account of patterns, strategies, and characteristics in elementary students' critical thinking when solving HOTS-based fraction problems relative to their self-efficacy.

Results

Fractions are a core topic in elementary mathematics and are foundational for later learning. Based on the questionnaire results, students' self-efficacy fell into three categories (Table 4).

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Table 4: Students' Self-Efficacy Categories

Category Level	Number of Students	Percentage
High	17	70%
Medium	7	30%
Low	0	0%

As shown in Table 4, no students were classified as low self-efficacy; therefore, only high- and medium-self-efficacy groups were included in the case analyses. From each level, the student with the highest score was selected as the focal case: EDCS (high self-efficacy) and AKN (medium self-efficacy). After identifying these cases, each student completed a written test and a think-aloud interview.

> *"Fika, Lina, and Ani were playing together while enjoying layer cakes made by Ibu Lina in various flavors. Each cake was cut into equal pieces: the chocolate cake into 6 pieces, the strawberry cake into 8 pieces, and the pandan cake into 12 pieces. The children ate 4 pieces of chocolate cake, 5 pieces of strawberry cake, and 6 pieces of pandan cake. Lina's mother wants to keep one cake that still has the largest remaining piece. Which cake should she keep?"*

Think-aloud interviews were used to probe students' critical thinking aligned with FRISCO (Focus, Reason, Inference, Situation, Clarity, Overview). Excerpts below illustrate key moments.

Focus

The *Focus* component concerns students' ability to identify problem information in the problem. The results showed that the research subjects experienced errors when understanding the information, as illustrated in the following interview excerpt.

R : The chocolate cake was cut into 6 pieces which were eaten by 4. So how many pieces are left?
EDCS : Because it is subtracted, there are 2 pieces of chocolate cake left ma'am.
R : What do you think if what is asked is the part saved then what fraction is used?
EDCS : $\frac{4}{6}, \frac{5}{8}$, *and* $\frac{6}{12}$

EDCS was less thorough in reading and understanding the questions about the problem. He was not fully able to identify relevant information correctly. Based on the interview results, EDCS understood that there were three types of cakes, each with a different number of pieces. The chocolate cake was cut into six pieces, the strawberry cake was cut into eight pieces, and the *pandan* cake was cut into 12 pieces. EDCS also correctly mentioned that the cake was eaten in several pieces; for example, the chocolate cake was cut into 6 pieces, and the ones eaten were 4, so the remaining cake was two pieces. However, EDCS confidently assumed that the fractions for the saved parts of the cake were 5/8 and 6/12. This indicates that EDCS was not careful in understanding the core of the problem, as the question asked to find the part of the

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cake that was stored, not eaten.

Meanwhile, AKN (medium self-efficacy) made the same mistake: he continued to eat the portions he had already consumed. In fact, the question asked to determine the fraction of the cake that is stored. This shows that he was less careful in distinguishing relevant information according to the problem. AKN did not convert the fraction correctly for the saved part, despite being able to mention the number of remaining pieces of cake during the interview. For example, although he could state that 2 of 6 chocolate pieces remained, he recorded $\frac{2}{6}$.

The *Focus* component requires recognising that the task concerns the remaining (uneaten) fraction. Immediate use of the given numbers without re-checking the question led both students to misidentify which fractions to compare. Despite having a high level of self-efficacy, EDCS was not careful in identifying important information about the problem. EDCS used the fractions mentioned in the problem without analysing the information in depth. Therefore, at this *Focus* stage, it was found that higher self-efficacy does not guarantee precise alignment with the problem's focal demand. A high focus on the main problem is a very important first step in critical thinking.

Reason

The *Reason* component evaluates whether students justify strategy choices with relevant facts and correct procedures. EDCS (high self-efficacy) articulated a sound plan: find the least common multiple (LCM) of 6, 8, and 12 (LCM = 24) to create equivalent fractions and compare. He correctly described that the LCM is "the smallest number divisible by 6, 8, and 12 without remainder." This shows that EDCS understood the concept of LCM and its application in equalising the denominator of fractions. Additionally, EDCS could explain how to obtain the fraction. $\frac{15}{24}$, Namely, by dividing 24 by 8, which results in 3, then multiplying 3 by 5 to obtain 15. This explanation demonstrates that EDCS understood the steps to convert fractions correctly.

R : Why 24?
EDCS : Because the LCM value is the same value and the smallest.
R : Explain how to get $\frac{15}{24}$*!*
EDCS: I divided 24 by 8 and the result is 3. Then 3 times 5 equals 15. So the result is $\frac{15}{24}$

EDCS explained that the appropriate strategy to solve the HOTS problem was to use the Least Common Multiple (LCM) and fraction comparison. This condition shows that a high level of self-efficacy can encourage students to be more confident in explaining their strategies. AKN (medium self-efficacy) adopted the same core idea—equalise denominators via the LCM (24)—and then compared the fractions. AKN could also explain in detail the problem-solving steps to obtain the results. In fact, AKN mentioned that there was another way to get the LCM, which is to use a factor tree.

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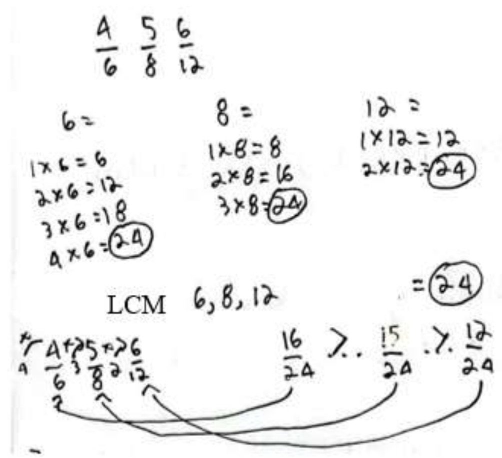

Figure 1. Student Work at the *Reason* Stage

R : *What strategy did you use to solve the problem?*

AKN : *The trick is to multiply 6, 8, and 12. Then multiply the numbers until you find the same result. After that, we found the LCM of 6, 8, and 12 which is 24. To get $\frac{16}{24}$, I divided 24 with 6; the result is 4, then 4 times 4 equals 16. So, the answer is 16. I did the same for the other fractions and compared them."*

AKN adopted a solution method he found more straightforwarddirect multiplication. This suggests a strong grasp of foundational concepts, enabling him to justify his choice of strategy clearly and appropriately. He solved the problem using a relevant, easily understood approach. Despite having moderate self-efficacy, AKN provided reasoning that was accurate and consistent with his chosen method. The analysis indicates that although he initially expressed uncertainty, he ultimately solved the problem systematically by understanding the task's context and selecting an appropriate strategy.

Inference

The *Inference* component examines students' ability to draw appropriate conclusions and justify them with sound reasons. EDCS demonstrated strong critical thinking in this domain. He concluded that the cake with the largest portion to be saved was the chocolate cake, represented by the fraction $\frac{16}{24}$. His self-confidence was evident in the way he explained the conclusion based on the strategy employed. EDCS stated that he was confident in his conclusion because he had equalised the denominators of the fractions and compared the results. This indicates that EDCS not only arrived at a result but also understood the procedural and conceptual steps leading to his conclusion.

Students with high self-efficacy often exhibit stronger self-regulation, motivation, and academic

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performance, and tend to show greater interest in mathematics than peers who experience math anxiety. Beyond confidence, EDCS aligned his conclusion with the strategies used. The *Inference* component assesses students' ability to draw appropriate conclusions and provide correct reasons to support them.

AKN, who had moderate self-efficacy, also reached the correct conclusion that the chocolate-flavoured cake ($\frac{16}{24}$) represented the most significant portion based on his computations. Although he expressed some doubt about his answer, his conclusion was consistent with his initial plancomparing fractions after establishing a common denominator. His hesitation likely reflected confidence rather than conceptual misunderstanding. Overall, AKN produced a correct conclusion supported by appropriate reasoning to support the conclusion.

R : Are you sure that your conclusion is correct?
AKN : Actually I have doubts ma'am.

In practice, students may feel confident yet still err if early steps are not carefully evaluated. Conversely, as in AKN's case, a student may express uncertainty yet reason correctly when the underlying understanding is sound. Thus, students with moderate self-efficacy do not necessarily experience obstacles in making logical conclusions, provided they have a firm grasp of the relevant concepts and procedures.

Situation

The *Situation* component assesses students' ability to utilise all relevant information for the problem. Analysis showed that neither case fully met this criterion. Both the high- and medium–self-efficacy students sought answers quickly without fully interpreting the meaning of each piece of information. For example, EDCS overlooked that the quantity of interest was the uneaten portion of each cake.

A similar issue arose for AKN (medium self-efficacy), who did not initially identify the necessary difference to determine the remaining pieces. This suggests that self-efficacy alone is insufficient for critical analysis unless paired with a habit of systematic thinking. Self-efficacy is not the only factor influencing students' handling of conceptual complexity or their academic performance.

R : How did you use the information in the problem?
AKN : I immediately calculated the part of the cake that was eaten and used those fractions to decide

Students who feel confident may overlook important information if their ability to self-reflect has not been developed. The situation component requires students to adjust their knowledge and strategies in response to a problem. Critical thinking involves systematically testing whether information is factual, relevant, and sufficient. When students fail to connect the problem's context with an appropriate strategy, it indicates limited practice in contextual reasoning. Accordingly, cultivating contextual and systematic thinking is essential for improving students' ability to

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analyse a problem's conditions. Such habits are best supported by learning environments that foster student learning.

Clarity

The *Clarity* component assesses students' ability to explain their conclusions further and to define or use mathematical terms accurately. EDCS articulated his strategy and terminology well. He explained that to obtain an equivalent fraction, he multiplied. $\frac{2}{6}$ by the number 2 to produce $\frac{4}{12}$. This explanation shows that EDCS understood the concept of equivalent fractions. He was able to explain that there were 4 shaded boxes. He stated that the 4 boxes were shaded because they showed the value of the numerator and that 12 is the denominator. This reflects a good understanding of the relationship between the numerator and denominator in fractions. EDCS also understood how to represent fractions in visual form.

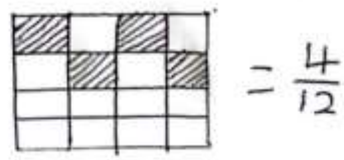

Figure 2. Student Work at the *Clarity* Stage

R : Can you briefly explain the steps you used to find the answer?
EDCS : I multiplied it by two so that the result is $\frac{4}{12}$. Then I drew the fraction using boxes
R : Why are only 4 squares shaded?
EDCS: Because 4 is the numerator and 12 is the denominator.

AKN, who demonstrated moderate self-efficacy, also executed his strategy appropriately, though with some hesitation and fewer details. This indicates that students with moderate self-efficacy may still possess sufficient conceptual understanding. Thus, self-efficacy supports not only problem-solving but also the willingness to express one's thoughts openly and confidently.

Overall, students' explanations reveal the structure of their critical thinking. The ability to articulate reasoning coherently signals organised thought, which aids in analysing information, concluding, and making decisions. Clear mathematical communication is, therefore, an essential component of effective mathematics learning.

Overview

The Overview component assesses students' ability to re-examine their problem-solving processes and results from start to finish. A clear difference emerged between the high- and medium–self-efficacy cases in their initiative to verify work. EDCS (high self-efficacy) proactively rechecked his solution by recalculating intermediate steps. AKN (medium self-efficacy) conducted a brief review before submitting, but with less thorough reflection. Effective mathematics instruction

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should cultivate not only students' cognitive skills but also students' enthusiasm in learning mathematics.

Students' self-initiated reviewing indicates metacognitive activity, undertaken without external prompting. Learners with higher metacognitive awareness generally evaluate their work more effectively. In this study, higher self-efficacy aligned with a stronger impulse to confirm answers, whereas the medium self-efficacy case tended toward a more cursory check without reflection.

Discussion

The findings suggest that self-efficacy is closely related to students' attitudes when facing problems, making decisions, implementing strategies, and evaluating their work. Students' self-perceptions strongly influence their perseverance in solving math problems (Mukuka et al., 2021). Learners with high self-efficacy tend to demonstrate courage, initiative, and confidence in expressing their ideas. By contrast, students with moderate self-efficacy often show hesitation; however, when they understand the underlying concepts, they are still able to solve problems correctly. Robust critical thinking is supported by strong cognitive abilities in problem solving, synthesis, and evaluation (Alhowail & Albaqami, 2024).

Therefore, self-efficacy contributes to the affective dimensions of critical thinking, such as motivation, persistence, and resilience when facing challenges (Otto et al., 2024). Self-efficacy is closely related to student behaviour, especially in their effort and persistence when learning mathematics. However, it must also be complemented by accurate conceptual understanding, careful interpretation of problem statements, a systematic approach to reasoning, and habitual self-reflection to optimise solution quality. Learning that is done holistically focuses not only on cognitive aspects but also on skills and attitudes (Beltrán-Rojas et al., 2024). The components and indicators of critical thinking skills are summarised in Table 5.

Table 5: FRISCO Model in Critical Thinking

Components	Description
Focus	Identifying every piece of information contained in the mathematics problem, but this is not easy for students to do when analyzing HOTS-based mathematics problems.
Reason	Applying mathematical reasoning to determine problem solving strategies
Inference	Demonstrating accuracy in making conclusions as the final stage of HOTS problem-solving
Situation	Aligning mathematical concepts with the strategies used to solve the problem.
Clarity	Providing clear explanations through visual representations
Overview	Exhibiting awareness in reviewing each step of problem solving without intervention from others.

Students with high and medium self-efficacy did not consistently identify HOTS problems in sufficient detail; as a result, not all information in the tasks was fully understood. Weaknesses in identifying relevant information, articulating points of view, and formulating responses are

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hallmarks of underdeveloped critical thinking. Maintaining a strong focus on the central question is a crucial first step in the critical thinking process. However, in this study, we found that students were able to employ mathematical reasoning to determine problem-solving strategies that facilitated the Situation stage. Metacognition emerged during the Overview stage, as students reviewed their solutions independently and without external intervention.

Self-efficacy reflects an individual's belief in their capacity to act to solve a problem. The findings indicate that students with high self-efficacy demonstrated stronger critical thinking than those with moderate self-efficacy. Each FRISCO component poses distinct challenges; overall, self-efficacy functions as a supporting factor for critical thinking when addressing HOTS tasks. Importantly, FRISCO components do not operate in isolation; they depend on conceptual understanding and students' reasoning skills. Therefore, classroom instruction should emphasise not only the use of HOTS items but also the thinking processes required to achieve each FRISCO component in critical thinking.

Difficulties in formulating ideas, perspectives, and responses are indicative of underdeveloped critical thinking (Asrowi et al., 2025). Consistent with Yilmaz Özden (2023), self-efficacy is positively associated with students' critical thinking skills. As an internal (intrapersonal) factor, self-efficacy can influence learning success (Puozzo, 2021). According to Mukuka et al. (2021), belief in self-efficacy alone is insufficient to reveal students' ability to perform tasks. Students with higher self-efficacy tend to be more independent in learning and able to use metacognitive strategies, which in turn support better learning outcomes.

Conclusion

This study concludes that self-efficacy has a significant influence on students' performance in solving HOTS-based mathematics problems, particularly in relation to their critical thinking skills. Students with high self-efficacy tend to show stronger perseverance, initiative, and confidence in expressing ideas. However, confidence alone is not sufficient. Although higher self-efficacy aligns with stronger affective traits (e.g., motivation, resilience), many students still struggled to analyse and extract essential information from complex tasks, especially within the *Focus* component of FRISCO. This suggests that self-efficacy must be complemented by cognitive readiness and a solid conceptual understanding to enhance critical thinking in a meaningful way.

The FRISCO framework, comprising *Focus, Reason, Inference, Situation, Clarity,* and *Overview*, proved helpful in observing how critical thinking unfolds during problem solving. Students were comparatively more proficient in *Reason* and *Overview*, where they could apply logical strategies and review their work independently. Persistent difficulties, however, emerged in identifying key information and framing the correct perspective, which weakened performance in *Focus* and *Inference*.

The findings reinforce that critical thinking is a multifaceted competence that requires the integration of affective factors (such as self-efficacy), cognitive skills (including reasoning and problem interpretation), and reflective habits. Therefore, classroom learning should move

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beyond merely assigning HOTS-type problems; it should actively cultivate students' thinking processes, strategic reasoning, and metacognitive awareness. Each FRISCO component is interconnected, and students need holistic support in both skills and mindset. In sum, self-efficacy supports the affective dimension of critical thinking, but meaningful progress requires balanced development across all FRISCO components through conceptually rich and reflective learning experiences.

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