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Mathematical Problem-Solving Processes across Self-Efficacy Levels in Fifth-Grade Students

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Abstract

Solving least common multiple (LCM) and greatest common factor (GCF) word problems requires conceptual reasoning and systematic verification, yet how fifth-grade students' problem-solving processes vary across mathematics self-efficacy levels remains insufficiently described. This study aims to examine these processes through Polya's four problem-solving stages. The study employed a qualitative descriptive design involving 39 fifth-grade students at Dabasah 3 Public Elementary School, Bondowoso, Indonesia, who completed a 16-item self-efficacy questionnaire and an eight-item constructed-response LCM/GCF assessment. Five students with contrasting self-efficacy and performance profiles were purposively selected for interviews and analysis of written solutions, supported by a teacher interview and documentation. Descriptive results indicated moderate self-efficacy among 21 students (53.8%) and moderate problem-solving performance among 32 (82.1%). Cross-case findings showed that the high-self-efficacy student selected a suitable strategy but failed to detect errors when checking. Students with moderate self-efficacy demonstrated divergent performance, including one high-performing case, whereas the low-self-efficacy student hesitated and incompletely monitored solutions. Across cases, recording given information and verifying answers posed recurring difficulties. This study contributes case-based evidence that self-efficacy and demonstrated performance did not consistently align, with implications for combining confidence-building support with conceptual explanation, procedural accuracy, and explicit checking routines.

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1. Introduction

Mathematical problem solving in elementary school requires more than merely obtaining a correct numerical answer. Students need to interpret information, determine appropriate strategies, carry out procedures accurately, and assess the reasonableness of the results obtained. Polya's four-stage framework, namely understanding the problem, devising a plan, carrying out the plan, and looking back, remains relevant for examining this process because it can indicate the stage at which a solution begins to become incomplete or

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unstable (Polya, 1945). Recent evidence in elementary mathematics learning also shows that explicit attention to structured problem-solving strategies can strengthen students' understanding and the quality of their solutions, whereas weak monitoring and reflection can leave procedural errors undetected (Fitriani, 2025; Oudman et al., 2022).

Process-oriented analysis is particularly important for least common multiple (LCM) and greatest common factor (GCF) problems. This topic requires students to coordinate the concepts of factors and multiples, distinguish the conditions for using each concept, and translate contextual information into mathematical procedures. Research in Indonesian elementary schools has reported recurring difficulties in LCM and GCF word problems, including weak conceptual understanding, confusion in distinguishing factors from multiples, inappropriate strategy selection, and calculation errors (Amaliyah et al., 2022; A. Fitriani et al., 2024; Mahmud et al., 2023; Nurmajumitasari, 2023). Similar difficulties are evident in analyses of elementary-school problem solving using Polya's stages, including LCM and GCF tasks (Nurhasanah et al., 2026; Yulianti et al., 2023). These findings indicate that a final answer alone is insufficient to describe how students deal with the demands of an LCM or GCF problem.

The problem-solving process also involves affective beliefs. Self-efficacy refers to students' judgments of their ability to organize and carry out the actions required to complete a particular task (Bandura, 1997). In mathematics, stronger self-efficacy is generally associated with willingness to face difficult tasks, persistence after making mistakes, and confidence in using strategies. Recent reviews show that mathematics self-efficacy is closely related to learning behavior and performance, while its development is shaped by mastery experiences, social models, feedback, and emotional states (Bjerke, 2026; Bjerke et al., 2026; Street et al., 2024; Zakariya, 2022). Mathematics self-efficacy is also associated with anxiety and mathematics performance, so students' beliefs need to be understood as part of a broader cognitive-affective experience rather than as a stand-alone characteristic (Caviola et al., 2022; Wang et al., 2024; Živković et al., 2023).

Mathematics education research generally shows a positive relationship between self-efficacy and problem-solving ability (Adetia & Adirakasiwi, 2022; Aprilia et al., 2022; Faozan & Kusno, 2023; Putri & Juandi, 2022). Research in elementary school contexts also shows that students with stronger efficacy beliefs tend to be more persistent and more productive in using strategies, although high confidence does not automatically guarantee conceptual or procedural accuracy (Chytrý et al., 2020; Mustofa & Danuri, 2025; Rahman et al., 2024). This distinction is important. Students may feel confident using a familiar factor-tree procedure, yet still select an incorrect mathematical relationship, overlook important information, or fail to check their results. Conversely, students

with moderate confidence may complete a task accurately when their conceptual knowledge and procedural control are adequate.

The literature indicates a need for a more specific analytical focus, namely, examining self-efficacy together with the sequence of students' actions at each Polya stage, particularly in elementary school LCM and GCF problems. Some existing studies report correlations, group scores, or general categories of mathematics self-efficacy (Nurhalisha et al., 2025; Ramlan et al., 2026; Samsuddin & Retnawati, 2022; Wiguna et al., 2022), whereas closer examination is needed of how confidence, doubt, strategy selection, execution, and checking appear together in students' written solutions and interview explanations. A qualitative cross-case analysis can clarify this relationship without positioning self-efficacy as the sole causal explanation for students' performance.

On this basis, this study aimed to describe the mathematical problem-solving processes of Grade V students at the Public Elementary School of Dabasah 3, Bondowoso, Indonesia, for LCM and GCF problems across high, moderate, and low self-efficacy levels. The analysis addressed two questions: (1) how are students' levels of self-efficacy and mathematical problem-solving ability distributed; and (2) how do representative students at different self-efficacy levels proceed through Polya's stages of understanding the problem, devising a plan, carrying out the plan, and looking back? This study provides a process-based account of how reported self-efficacy relates to engagement alongside the conceptual, procedural, and metacognitive demands evident in students' solutions.

2. Methods

This study employed a qualitative descriptive design to examine students' mathematical problem-solving processes under natural classroom conditions. This design was selected because the purpose of the study was to describe how students with different levels of self-efficacy proceed through each stage of problem solving, rather than to estimate the causal effect of self-efficacy. The use of multiple data sources and in-depth case analysis follows qualitative design principles that emphasize the connection of data to context and research questions (Creswell & Poth, 2018). Frequency summaries were used only to provide descriptive context regarding the self-efficacy and problem-solving profiles of all students.

The study was conducted in the second semester of the 2025/2026 academic year at Public Elementary School of Dabasah 3 Bondowoso, East Java, Indonesia. The enrolled class consisted of 51 students, but 12 students did not complete the full data-collection sequence because of school activities or absence. Therefore, the class data analyzed came from 39 students who

completed the self-efficacy questionnaire and the LCM/GCF problem-solving test. From this group, five students were purposively selected for in-depth analysis based on variation in self-efficacy levels and problem-solving abilities: one high-self-efficacy case, three moderate-self-efficacy cases with high, moderate, and low problem-solving abilities, and one low-self-efficacy case. Purposive case selection was used because the cases were identified according to characteristics most relevant to the purpose of cross-profile analysis, rather than to represent the population statistically (Campbell et al., 2020).

Data were collected from four sources. First, a 16-item mathematics self-efficacy questionnaire was developed from the magnitude/level, strength, and generality dimensions of Bandura's self-efficacy theory (Bandura, 1997), taking into account task-specific scale-construction guidelines and the language and contextual adaptation of the Indonesian version of the GSES-12 (Soetjipto et al., 2023). Thus, the questionnaire used in this study was a researcher-developed measure of mathematics self-efficacy, not a direct use of GSES-12. Total scores were used to classify students into high (≥78), moderate (62–77), and low (≤61) categories. Second, an eight-item constructed-response test on LCM and GCF was used to obtain written evidence across Polya's four stages: understanding the problem, devising a plan, carrying out the plan, and looking back (Polya, 1945). The operationalization of the stages in the context of elementary mathematics also considered recent research on the use of Polya strategies and metacognition in problem solving (Fitriani, 2025; Govender et al., 2024; Kusaka & Ndihokubwayo, 2022). Test scores were classified as high (≥77), moderate (35–76), and low (≤34). The thresholds for both instruments followed the categorization used in the thesis, which served as the data source. They were used only for descriptive grouping and case selection, not as standardized diagnostic cutoffs.

Third, semi-structured interviews with the five selected students were used to trace how students interpreted problems, selected strategies, performed calculations, judged their confidence, and checked their final results. Fourth, a teacher interview and documentation were used as supporting sources for triangulation. The interview guide was aligned with the self-efficacy dimensions and Polya's four stages so that written responses could be compared with students' oral explanations. Table 1 summarizes the analytical framework for problem-solving evidence.

Table 1.
Analytical framework for evidence across Polya stages in LCM and GCF problems

No	Polya Stage	Operational evidence in LCM and GCF problems
1	Understanding the problem	Identifying relevant numbers, known and asked-for information, and determining whether the problem requires LCM, GCF, or a related relationship.
2	Devising a plan	Selecting and, when possible, explaining an appropriate strategy, such as prime factorization, factor pairs, or lists of multiples.
3	Carrying out the plan	Carrying out factorization/multiple procedures and calculations accurately, sequentially, and in a traceable manner.
4	Looking back	Checking the factorization and calculations, ensuring the result addresses the contextual problem, and writing a conclusion.

Before the main study, the instrument designs were reviewed by experts and practitioners in terms of construct, content, language, and usability, and were then piloted with 44 Grade V students at another school. The self-efficacy questionnaire validation percentages reported in the thesis were 80% for construct, 92% for content, 96% for language, 93% by practitioners, and 67% by a psychology reviewer. Of the initial 22 items, six were eliminated, leaving 16 items with item–total correlations ranging from .301 to .698. The problem-solving test obtained validation percentages of 80% for construct, 94% for content, 90% for language, and 94% by practitioners; all eight items were retained with item–total correlations of .800–.947. The reporting of content evidence and item analysis followed principles of scale development and item evaluation (DeVellis & Thorpe, 2022).

The research procedure was organized from classroom mapping to case-based analysis. An initial observation was conducted to establish the research focus, after which the self-efficacy questionnaire and problem-solving test were administered to 39 students. The scores were used to construct descriptive profiles and support the purposive selection of five cases. The selected students then participated in semi-structured interviews. Written responses, questionnaire scores, students' explanations, teacher information, and documentation were then compared through triangulation. Figure 1 presents the research flow from establishing the focus to concluding.

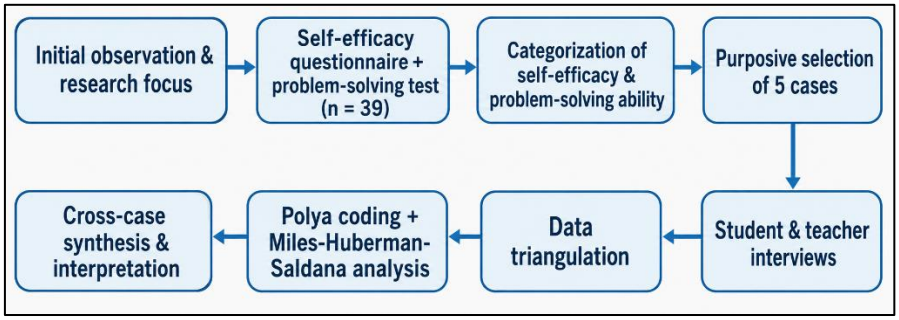


Fig. 1. Research procedure in this study
Source: Authors' research procedure, 2026.

Data analysis followed the interactive process of data condensation, data display, and conclusion drawing and verification (Miles et al., 2020). During condensation, written responses and interview transcripts were deductively coded according to Polya's four stages. Evidence at the understanding-the-problem stage included identifying known and requested information and recognizing whether the problem required an LCM or GCF relationship. Evidence at the devising-a-plan stage included strategy selection and the reasons for that strategy. The carrying-out-the-plan stage included the accuracy and sequence of factorization, determination of multiples, and calculations. The looking-back stage included checking the process, verifying the consistency of the result with the question, and formulating a conclusion. Within-case and cross-case matrices were used to compare patterns at each self-efficacy level. The credibility of the interpretations was strengthened through method triangulation among the questionnaire, written test, interviews, and documentation, as well as source triangulation between students' explanations and information from the classroom teacher (Creswell & Poth, 2018; Flick, 2022). The implementation of the study was coordinated with the school, and students' identities were replaced with case codes during data processing and reporting.

3. Results

The results are presented in five subsections. The first subsection describes the distribution of self-efficacy and problem-solving ability at the class level. The next three subsections present the high-, moderate-, and low-self-efficacy cases, followed by a cross-case synthesis based on Polya's stages.

3.1 Distribution of Self-Efficacy Levels and Problem-Solving Ability

The distribution of self-efficacy was dominated by the moderate category. Of the 39 students, 21 students (53.8%) were in the moderate category, 10 students (25.6%) in the high category, and 8 students (20.5%) in the low category. The distribution of problem-solving ability was more concentrated: 32 students (82.1%) were in the moderate category, 6 students (15.4%) were in the low category, and only 1 student (2.6%) reached the high category. Both distributions are presented in Table 2.

Table 2.
Distribution of self-efficacy levels and problem-solving ability

Construct	High	Moderate	Low	Total
Self-efficacy	10 (26%)	21 (54%)	8 (20%)	39 (100%)
Problem-solving ability	1 (3%)	32 (82%)	6 (15%)	39 (100%)

Note. Percentages were calculated using 39 students as the denominator and rounded to one decimal place. Minor differences from 100% may occur because of rounding.

The two profiles did not show identical patterns. The group of students with high self-efficacy was relatively large, but high-category problem-solving ability

was found in only one student. This pattern provided the basis for examining evidence from written responses and interviews, rather than assuming that self-efficacy categories directly represented levels of problem-solving ability.

3.2 High Self-Efficacy: Strategic Confidence without Comprehensive Checking

The representative high-self-efficacy case (SE1) had moderate-category problem-solving ability. At the understanding-the-problem stage, the student generally understood the demands of the problem but did not explicitly write the known and asked-for information. At the devising-a-plan stage, the student appropriately selected the factor-tree strategy and explained that this method made it easier to determine the LCM or GCF. The student's explanation showed confidence in the selected procedure, although the student also acknowledged being easily confused by the final result.

At the carrying-out-the-plan stage, the main procedure could be identified and was largely appropriate, but there was still a calculation error in the final result. At the looking-back stage, the student stated that checking had been performed, but the checking was not sufficiently comprehensive to identify the error. This case shows a combination of confidence in selecting a strategy and incomplete monitoring of execution and result verification.

3.3 Moderate Self-Efficacy: Variation in Execution and Strategy Justification

The three moderate self-efficacy cases represented high (SE2), moderate (SE3), and low (SE4) problem-solving ability. The patterns across the three cases differed. SE2 was able to use the factor-tree strategy systematically and obtain the correct result. However, the interview showed that the strategy was selected mainly because it was familiar and considered safer than other alternatives. SE3 used prime factorization but did not clearly organize the steps and the final answer. When asked about the rationale for selecting the strategy, the student could not provide one and expressed difficulty with almost every part of the task. SE4 used a multiples strategy but did not yet consistently connect it with the appropriate LCM concept.

Across these three cases, understanding of the problem was often partial and was not yet fully represented in writing. Students were generally able to select a strategy, but their conceptual justification varied. Execution ranged from accurate and orderly to incomplete or incorrect. The looking-back stage was generally brief and did not yet involve a systematic evaluation of the entire solution. Interview evidence also showed fluctuating confidence. SE4, for example, stated that the student was “very confident,” but at the same time acknowledged having felt doubtful while searching for the answer. This indicates that a single global statement of confidence did not fully represent the student's certainty at every moment in the problem-solving process.

3.4 Low Self-Efficacy: Doubt and Incomplete Process Control

The representative low-self-efficacy case (SE5) had moderate-category problem-solving ability. The written response did not explicitly identify the known and asked-for information. At the devising-a-plan stage, the student attempted to use a multiples or factor-tree strategy, but the selection remained tentative and was not supported by a clear conceptual reason. The execution of the steps was also not yet organized into a stable sequence, reducing the accuracy of the final result.

The clearest difference appeared at the looking-back stage. The student did not conduct a final verification and explained in the interview that uncertainty about the selected method often created confusion about whether the solution was correct. Thus, doubt appeared not only in the student's statements but was also evident in strategy selection, execution of the steps, and the absence of final checking.

3.5 Cross-Case Patterns across Polya's Stages

Across the five selected cases, devising a plan was the stage at which differences in self-efficacy appeared most clearly in the decisiveness of strategy selection, whereas carrying out the plan and looking back also required procedural control and monitoring. Table 3 synthesizes the cross-case evidence. The high-self-efficacy case was able to select the correct strategy but still failed to detect an execution error; the moderate-self-efficacy group showed both successful and unsuccessful execution, whereas the low-self-efficacy case showed the strongest doubt and the weakest checking behavior.

Table 3.
Cross-case patterns across Polya's problem-solving stages

Case	Self-efficacy	Understanding	Plan	Execution	Checking	Overall Profile
SE1	High	Known/asked information not written	Factor tree selected correctly and confidently	Procedure generally appropriate; final calculation error	Checking did not detect the error	Moderate
SE2	Moderate	Generally adequate	Appropriate familiar strategy	Orderly and accurate	Brief checking	High
SE3	Moderate	Partial; difficult to explain the problem demands	Strategy without clear justification	Steps less organized; final answer unclear	Limited monitoring	Moderate
SE4	Moderate	Partial	Multiple-based strategy not yet consistent with the concept of LCM	Confidence fluctuated; execution uncertain	Superficial checking	Low
SE5	Low	Known/asked information not written	Strategy still tentative	Steps not yet orderly	No final verification	Moderate

Very Strong | Strong | Moderate | Weak | Very Weak

Source: Authors' original cross-case matrix. The wording of the case descriptions is retained.

Cross-case evidence also showed that self-efficacy categories did not correspond directly to problem-solving ability categories. SE2, who had moderate self-efficacy, achieved high problem-solving ability, whereas SE1, with high self-efficacy, remained in the moderate problem-solving ability category. This contrast was retained as an important comparative case in interpreting the relationship between affective beliefs and mathematical performance.

4. Discussion

The main findings show differences in how students with different self-efficacy levels approach LCM and GCF problems, but self-efficacy cannot be used as a direct indicator of problem-solving quality. The class profile illustrates this distinction: 25.6% of students were in the high self-efficacy category, whereas only 2.6% reached the high problem-solving ability category. At the case level, the student with high self-efficacy selected an appropriate strategy confidently but still made an execution error that was not detected when checking the answer. Conversely, one student with moderate self-efficacy was able to solve the problem accurately. This pattern is consistent with Bandura's (1997) view that self-efficacy concerns perceived capability that regulates effort, choice, and persistence, rather than guaranteeing task mastery. Recent reviews also affirm that mathematics self-efficacy is important for learning engagement but exists within a network of experiences, prior achievement, emotions, and learning conditions (Bjerke et al., 2026; Street et al., 2024).

The findings of this study further clarify the positive relationship between self-efficacy and mathematical problem solving that has been widely reported previously. Systematic reviews and empirical studies generally show that students with stronger self-efficacy tend to demonstrate better problem-solving performance or more persistent engagement (Adetia & Adirakasiwi, 2022; Nurhalisha et al., 2025; Putri & Juandi, 2022). Research in elementary schools also reports associations between self-efficacy, strategy selection, and persistence (Mustofa & Danuri, 2025; Wiguna et al., 2022). The cases in this study illustrate differences at the behavioral approach level: the high-self-efficacy case selected a strategy decisively, whereas the low-self-efficacy case expressed doubt. Nevertheless, the comparison between SE1 and SE2 shows that this relationship is not deterministic. Confidence can support readiness to engage with a task, but accurate problem-solving still requires conceptual knowledge, procedural fluency, and monitoring.

The contrast between SE1 and SE2 also raises a broader question about the correspondence between perceived capability and demonstrated mathematical competence. Yang Hansen et al. (2024), examining third- and fourth-grade students across six European countries, identified discrepancies between item-specific confidence judgments and mathematics performance.

Their findings provide an international comparison for understanding why perceived competence should not be equated with demonstrated accuracy. However, the present study used a mathematics self-efficacy questionnaire and selected qualitative cases, whereas Yang Hansen et al. examined confidence judgments linked to individual test items. These constructs and measurements are not interchangeable. Consequently, the SE1–SE2 contrast should not be described as evidence of a measured calibration effect or the Dunning–Kruger phenomenon. Rather, it demonstrates the analytical value of examining self-efficacy classifications alongside actual solution processes and identifying where confidence and performance do not coincide.

Analysis based on Polya's stages makes this distinction even more apparent. Understanding of the problem was often implicit and not represented explicitly, while some students moved immediately to calculations. However, not writing the known and asked-for information does not necessarily mean that students failed to understand the problem. Recent research on word problems in elementary schools also shows that students experience difficulty coordinating information, representations, and strategy selection (Govender et al., 2024; Kusaka & Ndihokubwayo, 2022). The most consistent weakness across the five cases was at the looking-back stage. Even students who selected an appropriate procedure tended to perform only superficial verification. Metacognitive research with elementary school students shows that monitoring and evaluation are important for detecting inconsistencies in mathematical solutions (Oudman et al., 2022). Research on self-regulation in elementary mathematics also highlights its relevance to learning engagement (Purnomo et al., 2024). Thus, Polya's final stage should not be treated merely as an additional activity after calculation, but as an opportunity to evaluate the accuracy of a solution.

A closer distinction between representing a problem and monitoring a solution helps explain the educational significance of these findings. The absence of written statements about known and unknown quantities may indicate incomplete documentation rather than an inability to understand the problem. Teachers, therefore, need to examine students' explanations before interpreting such omissions as conceptual errors. Orosco and Reed (2024) demonstrated the relevance of explicit comprehension-strategy instruction for third-grade English learners experiencing mathematical problem-solving difficulties, including identifying questions and distinguishing relevant information. Their population and intervention differed from the present study, but the findings provide a rationale for making problem interpretation observable. At the checking stage, Oudman et al. (2024) found that primary pupils were not consistently aware of the accuracy of their monitoring judgments and that self-scoring improved regulation-related awareness for some pupils. These findings strengthen the case for investigating how students check their answers, not merely whether they report having checked.

The characteristics of the content also help explain the patterns found. LCM and GCF are conceptually related but require different relational judgments. Research in elementary schools has documented students' difficulties in distinguishing factors from multiples, determining whether a contextual problem requires LCM or GCF, and carrying out factorization procedures accurately (Amaliyah et al., 2022; Fitriani et al., 2024; Mahmud et al., 2023). Recent analyses have also reported difficulties in applying the complete stages of problem solving to LCM and GCF problems (Yulianti et al., 2023). These content-specific obstacles help explain why confidence alone is insufficient. Students may have strong self-efficacy toward mathematics in general or toward a familiar method, yet still lack the conceptual discrimination required to select or explain the use of LCM rather than GCF. This interpretation is also consistent with recent reviews emphasizing that mathematics self-efficacy needs to be understood according to task and contextual specificity (Street et al., 2024).

The diversity within the moderate-self-efficacy group is another important finding. SE2, SE3, and SE4 were in the same self-efficacy category but demonstrated high, moderate, and low problem-solving ability. The interviews revealed different reasons for using familiar strategies: one student used the factor-tree strategy effectively but selected it because it was considered safer, another student was unable to explain the reason for selecting the method, and another expressed both confidence and doubt. This variation is consistent with evidence that mathematics self-efficacy is task-sensitive and related to emotional states and learning experiences (Bjerke, 2026; Street et al., 2024; Živković et al., 2023). Meta-analytic findings on mathematics anxiety also show that affective experiences and achievement are systematically related, but no single construct by itself explains the entire performance process (Caviola et al., 2022). Thus, categorical questionnaire scores are useful for mapping, but interview evidence and written responses remain necessary for understanding how confidence is manifested when students solve a particular problem.

The differences among SE2, SE3, and SE4 further suggest that selecting a familiar procedure and understanding its mathematical justification are related but distinct aspects of problem solving. SE2's successful use of a factor tree demonstrates that a familiar strategy can be applied accurately even when the student offers a limited explanation for choosing it. In contrast, the difficulties reported for SE3 and SE4 point to the importance of examining whether students can connect a procedure with the mathematical structure of the task. Liu and Jacobson (2022), studying fourth-grade pupils' fraction-comparison strategies, showed that strategy selection and successful implementation varied across methods. Although their research concerned fractions rather than LCM and GCF, it provides a relevant comparison: knowing or preferring a strategy does not

guarantee that it is mathematically appropriate or accurately executed. The contribution of the present cases lies in revealing this distinction within the same broad self-efficacy category.

In instructional practice, the findings suggest that strengthening self-efficacy and teaching problem-solving should be developed simultaneously rather than sequentially. Teachers can strengthen self-efficacy through attainable mastery experiences, peer modeling, strategy-focused feedback, and opportunities to revise solutions, as suggested by intervention research (Zakariya, 2022). At the same time, students need explicit routines at each stage of Polya's method: writing the known and asked-for information, explaining the reason for using LCM or GCF, carrying out the selected method in a traceable sequence, and checking whether the result addresses the original context. Research on explicit instruction using Polya's strategy for Grade V word problems supports the importance of making these stages visible and habitual (Fitriani, 2025). Instruction can also reduce dependence on a single familiar method by asking students to compare factor trees, lists of multiples, and other valid representations before explaining an appropriate strategy.

These findings also have implications for how teachers interpret students' confidence. High confidence cannot be treated as evidence that students no longer need guidance in checking, whereas low confidence is not equivalent to low mathematical potential. Mathematics self-efficacy can be strengthened through appropriately designed learning experiences (Zakariya, 2022). In addition, efficacy beliefs can coexist with different levels of conceptual mastery. Instructional diagnosis will be stronger when questionnaire information is read alongside written work, students' explanations, and reflective questions, rather than used as a stand-alone label. This is particularly important in elementary school, when students are still developing mathematical representations and judgments about their own capabilities (Bjerke et al., 2026; Govender et al., 2024).

For classroom assessment, the findings point to the value of combining evidence of students' reasoning with opportunities for guided verification. Teachers could ask pupils to explain why a problem requires LCM or GCF, compare alternative solutions, identify possible calculation errors, and check whether their answers fit the original situation. The study by Oudman et al. (2024) provides empirical support for examining self-scoring and monitoring awareness in primary mathematics, while Orosco and Reed (2024) highlight the potential contribution of explicit comprehension strategies. A systematic review and meta-analysis by Vessonen et al. (2025) also found positive average effects of mathematical word-problem interventions among elementary pupils. However, the implementation of interventions and study quality influenced the reported effects. These findings support further investigation of structured problem-solving

instruction. They do not establish that the instructional suggestions derived from the five cases have already been tested or proven effective.

This study has limitations that define the scope of its findings. The study was conducted at one school, and the in-depth analysis involved five cases, with only one representative case each at the high and low self-efficacy levels. The research design was qualitative descriptive, so the patterns found cannot be interpreted as a causal effect of self-efficacy. In addition, LCM and GCF may present distinctive conceptual obstacles that do not necessarily apply to all mathematics topics. Future research needs to involve more cases at each self-efficacy level, multiple schools, and repeated problem-solving episodes to trace changes in students' confidence over time. Combining stimulated recall interviews with process data may also clarify the interaction among self-efficacy, conceptual understanding, and metacognitive monitoring at specific decision points. In addition, the final reliability coefficient and the formula used to establish category thresholds were not included in the available thesis manuscript. Therefore, the categories were used as descriptive groupings for case analysis and were not interpreted as standardized diagnostic classifications.

5. Conclusion

Among the 39 Grade V students, moderate self-efficacy (53.8%) and moderate problem-solving ability (82.1%) were the most common categories. The LCM and GCF problem-solving processes of the five selected students varied across self-efficacy levels, particularly in decisiveness in selecting strategies, persistence, and the degree of doubt while solving problems. Nevertheless, the relationship between self-efficacy and problem-solving ability was not one-to-one. The high-self-efficacy case was able to select an appropriate strategy but still showed execution and verification errors, whereas one student with moderate self-efficacy achieved high problem-solving ability. Across the five cases, the most consistent weaknesses concerned difficulties in explicitly representing problem information and systematically looking back.

These findings position self-efficacy as an important affective condition associated with students' engagement, but not as a substitute for conceptual understanding, procedural accuracy, or metacognitive control. In elementary mathematics learning, experiences that support self-efficacy need to be integrated with Polya routines that require students to identify information, explain the reason for using LCM or GCF, document calculations, and verify results against the problem context. The study contributes a process-based understanding of why students' confidence should be examined alongside their written solutions and explanations. Because the study was conducted at one school and involved five in-depth cases, cross-school and longitudinal research

is needed to examine changes in confidence and problem-solving processes across repeated tasks and mathematics topics.

Declarations

All authors have reviewed and approved the final manuscript and declared no competing interests. The study involving fifth-grade students at Dabasah 3 Public Elementary School in Bondowoso, Indonesia, adhered to applicable ethical principles, including informed consent and the protection of participants' confidentiality. Grammarly was used to refine academic language and support citation consistency. Artificial intelligence was not used to generate or alter research data or findings.

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