Dwija Cendekia: Jurnal Riset Pedagogik
Volume 10 (1), 2026, pp. 231-246

Analysis of elementary school students mathematical problem-solving abilities based on the IDEAL model stages

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Receipt: 26 February 2026; Revision: 25 March 2026; Accepted: 21 April 2026

Abstract: The mathematical problem-solving abilities of elementary school students still show variations in achievement at each stage of problem-solving. This study aims to map the mathematical problem-solving abilities of fourth-grade elementary school students based on the five stages of the IDEAL model (Identify, Define, Explore, Act, Look Back). The study used a quantitative descriptive approach with total sampling of 24 students. The instrument was a contextual problem-solving test assessed using an analytical rubric on a scale of 0–4 at each stage. The scores were analyzed through average calculations and conversion of ability categories. The results showed that the Act (2.79) and Explore (2.54) stages were in the capable category, while the Identify (2.46) and Define (2.33) stages were in the sufficient category, and the Look Back (1.92) stage was the weakest aspect. Overall, most students were classified as capable, but weaknesses were still found in the stages of formulating information and verifying solutions. These findings emphasize the importance of strengthening reflective strategies in mathematics learning. This IDEAL stage-based competency mapping can serve as the basis for more systematic problem-solving learning planning in elementary schools.
Keywords: elementary school; problem-solving; mathematics learning; IDEAL model

INTRODUCTION

Mathematical problem-solving skills are a fundamental competency that must be developed from the elementary school level because they involve not only completing tasks, but also interpreting situations, making decisions, and reasoning logically. These skills combine cognitive and metacognitive processes that help students face unfamiliar situations flexibly and reflectively. Their development requires explicit instructional support, as students need guidance to regulate learning strategies effectively (Dignath & Veenman, 2021).

In line with this, the demands of 21st-century learning require students to identify essential information, consider alternative strategies, and reevaluate their decisions. Therefore, problem-solving becomes a core competency in mathematics education, as it is essential for addressing complex learning situations supported by educational technology and instructional strategies such as scaffolding and collaboration that enhance students' problem-solving abilities (Lu & Xie, 2024).

Empirical studies show that students' problem-solving abilities improve when they are provided with opportunities to explore diverse strategies. Teachers who facilitate classroom discussions, encourage strategy sharing, and use visual heuristic tools can help students develop more structured thinking processes, thereby strengthening their ability to solve mathematical problems (Kaitera & Harmoinen, 2022). In addition, the integration of digital tools such as Quizizz has been shown to increase students' engagement and responsiveness during mathematical problem-solving activities (Setiyani et al., 2020). However, despite these instructional efforts, challenges in students' problem-solving processes still persist.

One of the main difficulties occurs at specific stages of problem-solving. Research shows that while students tend to perform well in identifying problems, they experience significant difficulties in the evaluation stage, indicating the need for structured scaffolding to support higher-order thinking skills (Azizah et al., 2025). This condition is closely related to self-regulated learning processes involving planning, monitoring, and evaluating thinking. Self-regulation plays an important role in helping students manage cognitive processes and reflect on solutions, indicating that higher-order thinking develops gradually through structured learning experiences (Noor et al., 2025).

Furthermore, problem-solving models have been shown to positively influence students' abilities by guiding them to identify problems, formulate strategies, apply mathematical concepts, and evaluate solutions (Nabihah et al., 2025). These findings emphasize the importance of a structured problem-solving approach, and in this regard the IDEAL model becomes relevant because it explicitly organizes these cognitive and metacognitive processes.

To analyze students' thinking processes more systematically, an appropriate analytical framework is required. This study adopts the IDEAL problem-solving model proposed by Bransford and Stein (1984) as its main theoretical foundation. The IDEAL model structures problem-solving into five stages: Identify the problem, Define the goals, Explore possible strategies, Act on the strategies, and Look back to evaluate the results. Compared with other frameworks such as Polya's four-step model, IDEAL provides a more explicit emphasis on problem identification, goal setting, strategic exploration, and reflective evaluation, making it more suitable for analyzing students' higher-order thinking processes in elementary mathematics education.

This structured framework not only guides students through complex problem-solving processes but also enables teachers to assess developmental progress at each cognitive stage (Rosyada & Wibowo, 2023). Moreover, metacognitive skills such as planning, monitoring, and evaluation are not always activated automatically during problem-solving but can be strengthened through structured reflective support, highlighting the importance of fostering students' metacognitive awareness throughout the learning process (Susanna et al., 2026). This is consistent with findings that metacognition plays a crucial role in enabling students to regulate strategies and evaluate solutions effectively during problem-solving (Toikka et al., 2024).

Despite the importance of structured problem-solving, studies examining elementary students' performance across all five IDEAL stages using a quantitative approach remain limited. Students' problem-solving abilities vary across stages, including understanding problems, planning solutions, implementing strategies, and evaluating results, indicating that each stage requires different levels of cognitive support. These variations highlight the importance of targeted interventions to improve students' problem-solving skills and support more effective instructional and assessment practices (Wahyuni et al., 2025).

In addition, students' success in solving problems depends on their ability to progress through each stage, suggesting that structured guidance is needed to help them complete each stage effectively (Mufliva et al., 2024). Previous findings also show that the IDEAL model can improve creative thinking skills and mathematics learning outcomes when supported by appropriate instructional approaches or learning media (Kurniasih, 2021). In this sense, problem-solving should function as a thinking process guide rather than merely a procedure for obtaining a final answer (Lestari & Juandi, 2023).

This issue is highly relevant to the learning conditions in Grade IV at Cimahi Mandiri 3 Public Elementary School, where teachers report persistent variations in students' ability to understand problem contexts, identify key information, and solve real-world problems. Moreover, much of the existing research on problem-solving in mathematics education has predominantly focused on the effectiveness of instructional models, including IDEAL, in improving learning outcomes, while less attention has been given to a detailed analysis of students' thinking processes at each stage of problem-solving. This indicates a gap in the literature regarding stage-by-stage analysis of elementary students' mathematical problem-solving performance, particularly using a quantitative rubric-based approach. Therefore, the novelty of this study lies in providing a comprehensive stage-by-stage profile of fourth-grade students' mathematical problem-solving abilities based on the IDEAL model using an analytical rubric.

Therefore, the selection of the IDEAL model is strongly justified in elementary mathematics education. Compared with broader frameworks such as Pólya's four-step model, IDEAL provides more explicit and structured stages of problem-solving, namely identifying problems, defining goals, exploring strategies, implementing actions, and evaluating results. These structured stages are highly relevant for elementary school students who still require clear guidance and scaffolded thinking processes.

Accordingly, this study aims to analyze fourth-grade students' mathematical problem-solving abilities based on the five IDEAL stages using a quantitative approach and an analytical rubric, with the purpose of describing students' performance at each stage and identifying areas of strength as well as stages that present the greatest challenges.

METHODS

This study employs a quantitative descriptive approach to present empirical phenomena through numerical data. This approach aims to describe the characteristics of variables systematically without manipulating them and does not focus on testing causal relationships, as descriptive research is non-experimental and involves no manipulation of variables, with the research design selected based on the objectives of the study (Slater & Hasson, 2025). Therefore, this approach is considered appropriate for achieving the objectives of this study.

The research subjects consisted of all fourth-grade students at Cimahi Mandiri 3 Public Elementary School (n = 24). The research was conducted on Thursday, 26 February 2026. A total sampling technique was employed because the population was relatively small and homogeneous, allowing all members to be included in the study. This technique is appropriate for descriptive research, which is designed to systematically describe the characteristics of a population without focusing on causal relationships or inferential generalizations (Siedlecki, 2020).

The instrument used was a contextual problem-solving test designed to represent the five stages of the IDEAL model. The test consisted of one contextual problem followed by five structured questions/items that corresponded to the IDEAL stages, namely problem identification, information analysis, strategy planning, computation/ implementation, and evaluation of results. Student responses were assessed using an analytical rubric with a scale of 0–4 for each stage. The use of an analytical rubric enables a more detailed evaluation of students' cognitive processes, particularly in understanding problems, planning solutions, applying strategies, and evaluating results, so that students' strengths and weaknesses can be identified more specifically (Yanti et al., 2026). The instrument was developed based on content and construct validity principles, including the alignment of indicators, clarity of descriptors, and feasibility of assessment. It was further validated through expert judgment involving two elementary school teachers and one mathematics education lecturer to ensure its appropriateness and authenticity (Amelia et al., 2024).

Data collection was conducted through an individual written test. Students' responses were scored based on the five IDEAL stage descriptors using a transparent and consistent scoring procedure (Panadero et al., 2023). The total score for each student was obtained by summing the scores across all stages (range 0–20). In addition, stage-by-stage analysis was performed by calculating the average score for each stage, which was then converted into ability categories by rounding to the nearest integer to ensure stable interpretation.

The data were analyzed using descriptive statistical techniques, including the calculation of mean, median, maximum and minimum scores, as well as the percentage of achievement at each IDEAL stage. Descriptive statistical analysis is widely used in educational research to describe students' performance levels and categorize learning outcomes in a systematic manner (Apino et al., 2024; Raganit, 2021). The analysis of students' achievement at each stage refers to the IDEAL problem-solving framework, which provides a structured approach to examining students' abilities in understanding problems, planning solutions, implementing strategies, and evaluating results (Abduh et al., 2020). The results are presented in tables and graphs to provide a comprehensive and structured description of students' mathematical problem-solving ability profiles, allowing clearer interpretation of learning outcomes.

RESULTS AND DISCUSSION

The Results and Discussion section presents the main findings of the study on fourth-grade students' mathematical problem-solving abilities based on the five stages of the IDEAL model, which include Identify, Define, Explore, Act, and Look Back. The results are presented using descriptive statistics to provide an overview of score variations, ability category trends, and patterns of students' strengths and weaknesses at each stage of problem-solving. Furthermore, the discussion relates these empirical findings to theory and previous research results to interpret the factors that influence student performance and explain the pedagogical implications. Thus, this section not only presents numerical achievements but also provides a critical and comprehensive interpretation of how students undergo the problem-solving process according to the IDEAL structure.

Result

This section presents the results of the analysis of students' mathematical problem-solving abilities based on the five IDEAL stages, namely Identify, Define, Explore, Act, and Look Back. The data were analyzed using descriptive statistics, ability category distribution, and inter-stage performance comparisons. To provide a comprehensive understanding, the presentation of results is supplemented with relevant tables and graphs so that patterns of trends, strengths, and weaknesses of students can be seen comprehensively. The description of the research results is arranged in stages, starting from an overview of problem-solving abilities, analysis per IDEAL stage, to a summary of trends in students' problem-solving abilities.

Overview of Students' Problem-Solving Abilities

A descriptive analysis of the total problem-solving scores shows that the students' abilities vary considerably. Of the 24 students who were the subjects of the study, the total scores ranged from 7 to 18, which means that all the class as a whole has not yet achieved consistency at the basic to high levels. The complete distribution of ability categories is presented in Table 1.

Table 1. Categories of Students' Problem-solving Abilities (Total Scores)

Ability Category Test	Score Range	Number of Students	Percentage
Very capable	16 - 20	4	16,7%
Capable	11 - 15	12	50%
Less capable	6 - 10	8	33,3%
Not capable	0 - 5	0	0
Total		24	100%

As shown in the Table 1, half of the students (50%) are in the “Competent” category, and 16.7% are in the “Highly Competent” category. These findings indicate that most students demonstrate adequate competence in solving mathematical problems. However, there are 33.3% of students who are still in the “Less Capable” category, so there is still a need to improve the abilities of one-third of the class. No students are in the “Not Capable” category, which indicates that all students already have basic problem-solving skills.

Overall, this distribution pattern shows that problem-solving abilities in the class tend to be at a medium to high level, but there is still a clear variation between students. This variation provides an important basis for further examining the differences in performance at each stage of IDEAL in problem-solving.

Overview of Students' Problem-Solving Abilities

The descriptive statistics in Table 2 provide a quantitative overview of student score trends at each IDEAL stage. Based on the data, the Act stage has the highest mean (2.79), while Look Back shows the lowest mean (1.92). The median for each stage is in the range of 1 to 3, which means that the general performance of students is at a moderate level of ability in most stages.

The minimum–maximum score range of 1 to 4 in all stages indicates a fairly wide variation in ability within the class. This variation is more evident when viewed through the standard deviation values. The Act stage has the largest standard deviation (1.10), followed by Explore (0.98) and Look Back (0.95), indicating that these three stages have relatively high diversity in student abilities. Meanwhile, the Identify and Define stages have lower standard deviations (0.72 and 0.82), indicating a more homogeneous distribution of abilities compared to other stages.

Table 2. Descriptive Statistics for Each IDEAL Stage

IDEAL Stage	Average	Median	Max Score	Min Score	Stand. Dev.
Identify	2.46	3	3	1	0.72
Define	2.33	2	4	1	0.82
Explore	2.54	2	4	1	0.98
Act	2.79	2	4	1	1.10
Look Back	1.92	1	4	1	0.95

In this section, the presentation focuses on the statistical characteristics of each stage without directly comparing performance between stages. Thus, readers can understand the distribution and variation of data objectively before moving on to the comparative analysis in the next section.

Comparison of Abilities at Each Stage of IDEAL

The comparison of student abilities at each stage of IDEAL was conducted by referring to the average scores and category interpretations presented in Table 3. This analysis aimed to identify which stages students had mastered, which stages they were still weak in, and performance trends based on the problem-solving process structure. Table 3 summarizes the position of each stage and provides a more focused overview of student achievement.

Table 3. Recapitulation of Average Scores per IDEAL Stage

IDEAL Stage	Average	Interpretation	Description
Identify	2.46	Less capable	Some students are able to identify problems, but the class as a whole has not yet achieved consistency at this stage.
Define	2.33	Less capable	Many students still have difficulty formulating important information and solution objectives.
Explore	2.54	Capable	Students are relatively capable of determining strategies or solution steps.
Act	2.79	Capable	The calculation stage is the strongest and most mastered stage for students.
Look Back	1.92	Less capable	Most students have not demonstrated the ability to double-check or verify their answers.

The comparison results show that Act is the stage with the highest score (average 2.79) and is in the Capable category. This finding indicates that students have a strong tendency in terms of procedure, especially in the implementation of calculation steps. The stability of scores at this stage shows that most students have understood and can apply the solution algorithm relatively consistently.

The Explore stage ranks next with an average of 2.54 (Capable category). This shows that students have the basic ability to choose problem-solving strategies, although their consistency is not yet uniform. At this stage, it can be seen that some students can determine the appropriate steps, but there are still students who are unable to select strategies effectively.

Unlike the previous two stages, the abilities at the Identify stage (average of 2.46) and Define stage (average of 2.33) are in the Less Capable category. The low achievement at this stage reflects that some students still have difficulty understanding the core of the problem, identifying important information, and formulating solutions.

Difficulties in the early stages of problem-solving can affect the quality of the strategies chosen and the accuracy of the next steps.

The Look Back stage is the stage with the lowest performance (average 1.92) and is also in the Less Capable category. This stage requires evaluative and metacognitive activities, such as reviewing the steps taken to solve the problem and assessing the accuracy of the results. The low scores at this stage indicate that most students are not yet accustomed to reflecting after completing a problem, so the problem-solving process has not been carried out fully in accordance with the IDEAL framework.

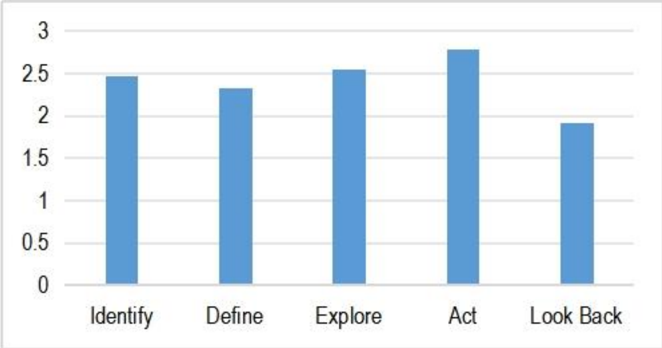

Figure 1. Average Scores for Each IDEAL Stage

The visualization in Figure 1 confirms this comparative pattern. The average scores form a hierarchical order from strongest to weakest, namely: Act → Explore → Identify → Define → Look Back. This hierarchical pattern makes it clear that students have a better grasp of procedural aspects than interpretive and evaluative aspects. Thus, the hierarchy of scores between stages not only shows the relative position of each stage, but also reflects the general tendency of students' thinking strategies in solving mathematical problems.

Comparison of Abilities at Each Stage of IDEAL

The distribution of student ability categories at each stage of IDEAL is presented in Table 4. In general, this distribution provides a more detailed picture of the diversity of student performance in carrying out problem-solving steps. The distribution pattern shows that each stage has different characteristics of weaknesses and strengths, thus indicating which aspects need further pedagogical attention.

Table 4. Recapitulation of Average Scores per IDEAL Stage

IDEAL Stage	Very Capable (4)	%	Capable (3)	%	Less Capable (2)	%	Not Capable (1)	%
Identify	0	0,00	14	58.33	6	25	4	16.67
Define	1	14.17	10	41.67	9	37.50	4	16.67
Explore	4	16.67	7	29.17	8	33.33	5	20.83
Act	9	37.50	2	8.33	11	45.83	2	8.33
Look Back	2	8.33	5	20.83	3	12.50	14	58.33

In the Identify stage, more than half of the students (58.33%) were in the “Able” category, indicating that most students were able to understand the context of the problem. However, the presence of students in the “Unable” category (16.67%) showed that some students still had difficulties in recognizing relevant information or the core of the problem. The Define stage shows the most even distribution among the four ability categories. This condition indicates inconsistency among students in formulating important information or determining the objectives for completion. The proportion of students in the “Less Capable” (37.5%) and “Not Capable” (16.67%) categories shows that this stage is one of the critical aspects that requires intensive guidance.

The distribution of abilities in the Explore stage shows progress in strategic planning abilities. A total of 29.17% of students were in the “Capable” category and 16.67% in the “Very Capable” category. However, the proportion of students in the “Less Capable” and “Not Capable” categories (more than 50%) indicates that the ability to choose strategies is still unstable and uneven among students. In the Act stage, students' procedural abilities appear to be the most dominant. The proportion of students in the “Very Capable” category reached 37.5%, the highest compared to other stages. This indicates that most students are relatively skilled in performing solution steps and calculations. However, the existence of students in the “Less Capable” category (45.83%) shows a performance gap between individuals at this stage. The Look Back stage was the stage with the lowest performance. A total of 58.33% of students were in the “Not Capable” category, indicating weak evaluative and metacognitive abilities among students. The majority of students did not show any effort to review the process or the answers they had obtained, so this stage needs special pedagogical attention.

Overall, the distribution pattern of ability categories in Table 4 shows that the students' main strength lies in the procedural stage (Act), while the most prominent weakness is in the evaluative stage (Look Back). This condition indicates that the students' problem-solving process has not been carried out in a complete and structured manner in accordance with the IDEAL model.

Summary of Strengths and Weaknesses

Based on the analysis of average scores at each stage of IDEAL, students' problem-solving abilities have not yet shown optimal integration across all stages. The pattern that has emerged shows imbalances between stages, indicating that students' thinking processes are still dominated by procedural activities rather than reflective and metacognitive activities. These patterns of strengths and weaknesses are comprehensively visualized in Figure 2 in the form of a radar chart.

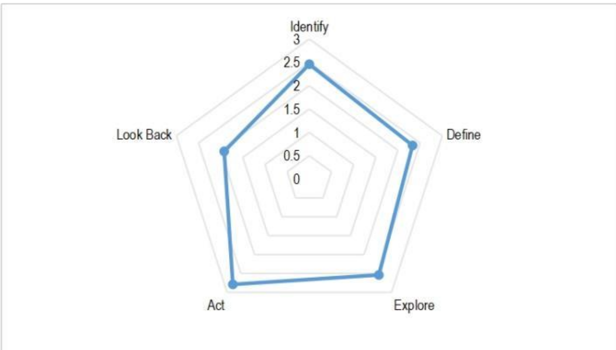

Figure 2. Radar Chart of Strengths and Weaknesses in the IDEAL Stage

Based on Figure 2, the Act stage occupies the highest position with the highest average score. This shows that students are relatively most proficient in the implementation of procedures and calculations in the problem-solving process. This finding indicates that students are accustomed to carrying out algorithmic steps after a solution strategy has been determined. Thus, the main strength of students lies in their technical and operational solution execution abilities. Conversely, the Look Back stage obtained the lowest average and became the main weakness in the profile of students' problem-solving abilities. The low achievement at this stage indicates that most students are not yet accustomed to reflecting, rechecking, and evaluating the correctness of the answers obtained. The weakness of the Look Back stage reflects a low mastery of metacognitive aspects, particularly in terms of monitoring and evaluating the thinking process.

The Define stage shows the lowest level of stability compared to the other stages. The wide variation in scores at this stage indicates significant differences in students' abilities to filter relevant information, formulate solution objectives, and formalize problems mathematically. This condition shows that students' initial analytical abilities are still heterogeneous. The Identify and Explore stages are in the middle category. This shows that students are quite capable of recognizing problems and designing solution strategies, but consistency and depth of understanding still need to be improved so that the problem-solving process can take place more systematically.

Overall, the pattern in Figure 2 confirms that students excel in algorithmic and procedural aspects but still experience weaknesses in problem interpretation, careful planning, and evaluation of the solution process and results. These findings indicate the importance of strengthening learning that is oriented towards the development of higher-order thinking skills (HOTS) and metacognitive abilities, particularly through reflection exercises, discussion of thought processes, and the habit of verifying solutions.

Discussion

This discussion interprets the research findings based on the IDEAL model structure and relates them to metacognition theory, executive functions, and previous research findings. In general, the results show that the mathematical problem-solving abilities of fourth-grade students vary considerably, with a dominant tendency toward procedural aspects (Act) compared to the initial stage (Identify–Define) and the reflective stage (Look Back).

This pattern is in line with findings that low variation in classroom learning is often the cause of weak problem-solving skills and productive disposition in students, so that mathematics learning tends to focus on routine procedures without emphasizing conceptual understanding and reasoning (Pertiwi & Rohaendi, 2022). The findings of this study are also in line with previous research showing that the systematic implementation of problem-based learning (PBL) based on higher-order thinking skills (HOTS) in elementary school through classroom action research leads to continuous improvement in students' mathematical problem-solving skills, with learning outcomes increasing across learning cycles, indicating the effectiveness of a problem-based approach in strengthening mathematical thinking processes (Munawaroh et al., 2024).

These general findings are also supported by the literature, which emphasizes that elementary school students' problem-solving abilities depend on many factors. Therefore, analysis cannot be based solely on final scores but must reflect the thinking processes and cognitive components involved (Utami & Setiyawati, 2022).

This is reinforced by evidence that the use of meaningful contexts in learning has been shown to significantly improve problem-solving skills after intervention (Nugraheni & Marsigit, 2021). Thus, the variation in student achievement in this study can be understood as the result of the interaction between learning strategies, problem contexts, and individual differences among students.

At the Identify and Define stages, students showed relatively low achievement. These two stages require the activation of metacognitive processes such as situational awareness, identification of important information, and initial planning. These early stages are critical because they determine how well students understand the problem before proceeding to solution strategies.

Previous research explains that metacognition and self-regulated learning play a crucial role in influencing students' problem-solving abilities, as these processes help students plan, monitor, and evaluate their thinking during problem-solving (Arianto & Hanif, 2024; Fauziana & Fazilla, 2022). In addition, students' problem-solving abilities develop progressively across grade levels, with higher-grade students demonstrating better performance than lower-grade students (Riyadi et al., 2021). These findings indicate that both cognitive development and metacognitive regulation are essential in supporting students' success, particularly in the early stages of problem-solving.

This pattern is evident in this study, where some students are able to recognize the general core of the problem but are not yet consistent in selecting relevant information and determining appropriate solutions. These results indicate the need for learning reinforcement that helps students develop habits of careful reading, formulating key information, and understanding the context of the problem.

At the Explore stage, student achievement improved but was not yet stable. This finding suggests that once students begin to understand the problem, they are more capable of attempting strategies, although their strategic choices are not yet consistent. This condition is consistent with research indicating that elementary students often experience difficulties in accurate self-monitoring and effective regulation of learning, reflecting that their metacognitive skills are still developing (Van Loon et al., 2021). However, some students in this study still chose strategies mechanically, following familiar patterns without considering alternatives, indicating that their strategic planning skills have begun to develop but are not yet fully mature.

This tendency becomes more evident in the Act stage, which shows the highest achievement. This indicates that students tend to be stronger in procedural and technical aspects, particularly when implementing selected strategies. Empirical literature states that even though students can master procedural steps, this mastery is not necessarily accompanied by the ability to assess the accuracy of the strategy or the results obtained, because effective problem-solving requires coordination between cognitive and metacognitive processes (Torregrosa & Albarracín, 2025).

The results of this study show a similar trend, where students are able to perform arithmetic operations, but do not always relate them to the context of the problem reflectively. The Look Back stage is the weakest component, with most students not verifying the process or final results. This finding is in line with research that found that students' metacognition in solving non-routine problems is generally not well developed; only a few students show ideal awareness, evaluation, and regulation, while low-ability students tend to be unable to display these three aspects (Kholid & Ahadiyati, 2022). A similar pattern emerged in this study, which showed that students rarely reviewed their answers or evaluated the logic of the results obtained.

This reinforces the need for reflection and self-monitoring habits in mathematics learning. Therefore, concrete recommendations for elementary school teachers are needed to improve the Look Back stage in daily learning, such as by integrating structured reflection activities, encouraging students to check and justify their answers, and using guided self-evaluation after problem-solving tasks.

When linked between stages, the apparent pattern shows that students' abilities increase in the middle stages (Explore and Act) but decrease in the initial and final stages. This pattern is consistent with research stating that although analysis and implementation skills can improve with practice, the aspects of deep understanding and evaluation remain greater challenges (Vo et al., 2024).

Even among elementary school students, metacognitive processes such as planning, monitoring, and evaluating strategies play a crucial role in determining the effectiveness of problem-solving. Students who are able to regulate their thinking processes tend to demonstrate better performance in solving problems, indicating that self-evaluation is an essential component of successful mathematical problem-solving (Paz-Baruch et al., 2025). Students with higher metacognitive awareness are generally more capable of understanding problems, selecting relevant strategies, and evaluating solutions appropriately. These abilities enable students to approach mathematical tasks in a more systematic and reflective manner.

In contrast, students with low metacognitive skills often experience persistent difficulties in monitoring and regulating their learning processes as well as making effective decisions, which may place them at risk of ongoing learning difficulties (van Loon & Roebers, 2024). This interpretation is further supported by meta-analytic evidence showing that metacognitive awareness is significantly correlated with students' mathematical achievement. Such findings indicate that stronger metacognitive skills contribute positively to better problem-solving performance (Xie et al., 2024).

Variations in student performance can also be understood from internal and external factors. Research shows that prior mathematical knowledge is the strongest predictor of problem-solving ability, and mathematical reading ability has an indirect influence on student success (Amalina & Vidákovich, 2023).

Students' difficulties in understanding mathematical language, especially in interpreting instructions or verbal sentences, often lead to errors, as some students focus more on symbols than contextual meaning (Agusfianuddin et al., 2024). This is consistent with previous findings showing that insufficient text comprehension significantly affects students' mathematical problem-solving performance, where higher linguistic complexity in mathematical word problems reduces solution success rates and contributes to difficulties in translating verbal information into mathematical representations (Klotz et al., 2025).

This ability is also influenced by students' readiness to learn, including aspects of self-regulated learning such as metacognition, motivation, and self-efficacy, which significantly contribute to mathematics achievement, with metacognitive monitoring identified as a key predictor (Říčan et al., 2022). In addition, external factors such as teacher competence, learning media, and the learning environment also play an important role in shaping student achievement. The combination of these internal and external factors helps explain the variation in student achievement in this study.

In line with these findings, the present study emphasizes the importance of instructional approaches that can support both cognitive and metacognitive processes in learning mathematics. This study contributes to the development of mathematics learning in elementary schools. The findings indicate that the use of structured problem-solving models, such as IDEAL, helps students think more systematically and increases their chances of successfully solving mathematical problems.

Previous studies have confirmed that well-designed problem-solving approaches can enhance students' higher-order thinking skills, including critical thinking and reasoning, through cognitively demanding activities (Ceballos et al., 2025). In addition, consistent engagement in problem-solving tasks can promote strategic thinking and deeper cognitive processes rather than merely procedural or computational skills. However, students often experience difficulties in planning strategies, implementing solutions, and evaluating results due to limited numeracy skills and insufficient conceptual understanding (Iswara et al., 2022).

This study has several limitations. The research subjects were limited to one school with a relatively small number of students, so the results must be generalized with caution. Instruments that use a single problem context do not yet describe students' abilities in more diverse contexts.

This study also did not triangulate data, for example through interviews or think-aloud protocols, so that students' cognitive processes were not explored in depth. In addition, the study did not compare the IDEAL model with other approaches, so its effectiveness could not be analyzed comparatively.

Based on these limitations, further research could expand the scope of schools, use a variety of problem contexts, and involve qualitative analysis techniques to explore students' thinking processes. An experimental design comparing IDEAL with other problem-solving models is also needed to obtain stronger empirical evidence regarding the effectiveness of the IDEAL model in elementary schools.

CONCLUSION

This study provides a comprehensive overview of fourth-grade students' mathematical problem-solving abilities based on the five stages of the IDEAL model. The results of the analysis show that students' abilities are uneven across stages. The Identify and Define stages pose the main challenges because some students are not yet able to identify important information and formulate the right solution objectives. In contrast, achievements in the Explore and Act stages indicate that most students are able to choose basic strategies and carry out calculation procedures relatively consistently. The Look Back stage received the lowest score, indicating that students' evaluative and metacognitive abilities still need to be strengthened.

Overall, the profile of student abilities is in the capable category, but with a clear imbalance between stronger procedural aspects and weaker reflective aspects. These findings emphasize the importance of learning that explicitly trains metacognitive awareness, especially in formulating important information and reviewing solutions.

This study contributes to providing a detailed mapping of problem-solving abilities based on the IDEAL model, which can be used as a reference for teachers in designing more targeted learning strategies. In addition, the results emphasize the need to integrate reflection and verification activities in mathematics learning so that the problem-solving process runs more holistically and systematically.

This study has limitations in terms of the limited number of subjects and the use of a single problem context, so the generalization of the results needs to be done with caution. Further research is recommended to involve a more diverse sample, use various problem contexts, and combine qualitative methods such as interviews or think-aloud to gain a deeper understanding of students' cognitive and metacognitive processes.

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