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Exploring Students' Problem-Solving Skills Reviewed from Gender Perspective in Elementary School

[1]Laely Farokhah, [2]Dessy Norma Juita, [3]Venna Puspita Sari, [4]Muhammad Zulfadhli, [5]Apit Dulyapit
[1]Pendidikan Guru Sekolah Dasar, Fakultas Ilmu Pendidikan, Universitas Negeri Jakarta,
[2]Teknik Industri, Fakultas Teknik, Universitas Bhayangkara Jakarta Raya,
[3]Pendidikan Dasar, Fakultas Ilmu Pendidikan, Universitas Negeri Jakarta
e-mail: [1]laelyfarokhah@unj.ac.id

Abstract
Mathematics education serves a fundamental role in developing students' 21st-century competencies, particularly in fostering reasoning, communication, critical thinking, and problem-solving skills. However, instructional practices in elementary schools still tend to emphasize routine and procedural tasks, resulting in students' limited exposure to non-routine problems that require higher-order thinking strategies. This study aims to explore elementary school students' mathematical problem-solving skills reviewed from gender perspective. A qualitative research approach was employed. The data were collected through problem-solving skill tests, observations, interviews, and documentation, and subsequently analyzed using the Miles and Huberman model. The findings indicate that students with high problem-solving skill are able to carry out problem-solving steps in a coherent and systematic manner, although reinforcement is still needed in terms of accuracy and verification. In contrast, students with low problem-solving skill experience difficulties at almost all stages of the problem-solving process. These difficulties are characterized by insufficient conceptual understanding, inability to organize information, lack of proficiency in performing mathematical operations, and the absence of habits related to checking calculation results. Both male and female students demonstrate adequate basic problem-solving abilities. However, female students exhibit more structured, systematic, and detail-oriented thinking processes at each stage. In contrast, male students tend to be less consistent in utilizing all available information, rely more heavily on visual approaches, and show less accuracy in verifying their solutions. These findings highlight the necessity of designing mathematics instruction that prioritizes the development of problem-solving skills while incorporating an awareness of gender-based variations in students' cognitive processing.

Keywords: *Elementary School, Gender Perspective, Mathematics Education, Problem-Solving Skill, Students*

Introduction

Mathematics education is widely recognized as a fundamental discipline for cultivating key competencies essential in the 21st century (Beswick & Fraser, 2019; Szabo et al., 2020). In general, mathematics education is designed to facilitate the development of a range of skills, particularly mathematical skills (Riyanto, 2025). Mathematical skills represent an essential component of life skills that students are expected to develop, especially in fostering reasoning, communication, and problem-solving abilities needed to address challenges encountered in everyday life (Kemendikbud, 2016). Based on the objectives of mathematics education, problem-solving skill is regarded as one of the core competencies that elementary school students are expected to master (Riyadi, Syarifah, Nikmaturrohmah, 2021).

Mathematical problem-solving is essential to be developed at the elementary school level (Phonapichat et al., 2014). Problem-solving skill refers to a strategic competence demonstrated by students in understanding problems, selecting appropriate approaches and solution strategies, and constructing comprehensive models to identify solutions to given problems (Lubis et al., 2017). In mathematics learning, a problem can be defined as a task that can be understood by students, presents a meaningful challenge, and cannot be solved through previously learned routine procedures. Accordingly, students need to be accustomed to developing abilities that can be applied in addressing a wide range of problems, both mathematical problems and more complex challenges encountered in everyday life.

Polya proposed four problem-solving processes, consisting of understanding the problem, devising a plan, carrying out the plan, and reviewing the solution. By applying Polya's problem-solving steps, students are expected to approach mathematical problems in a more coherent and structured manner (Lestanti, 2015). When students are able to understand how to solve mathematical problems that require each step of Polya's problem-solving method sequentially, they may come to realize that mathematics, as a whole, is not impossible to master, and consequently, they will be able to apply what they have learned long after they have left the classroom (Yuan, 2013).

Mathematical problem solving is a process that involves multiple stages, requiring individuals to employ patterns of thinking, organization, and logical reasoning in resolving problems (Aufin, 2012). Problem solving is not only important for those who will pursue mathematics in greater depth in the future, but also for those who will apply it in other fields of study as well as in everyday life (Yuniawatika, 2015).

The importance of problem-solving skills is not fully aligned with the mathematical literacy achievements of some elementary school students. Research findings indicate that students lack sufficient exposure to problem-solving activities and tend to rely on routine and procedural tasks (Diputra, 2019). The low level of students' problem-solving skills is further supported by previous studies, which reported that students' mathematical problem-solving abilities reached 52.37% at the problem-understanding stage, 29.09% at the planning stage, 23.09% at the problem-solving stage, and 8.88% at the stage of generating alternative solutions (Trisniawati, 2017). Furthermore, students' limited ability to comprehend word problems, coupled with insufficient practice in identifying essential information and translating it into mathematical expressions, has resulted in difficulties in constructing mathematical representations and determining appropriate problem-solving strategies (Damayanti, 2023).

Furthermore, from a gender perspective, mathematical problem-solving skills often exhibit variations between male and female students. Variations in cognitive and thinking patterns may influence problem-solving performance, including problem comprehension, strategic planning, and solution evaluation. Therefore, analyses of problem-solving abilities should incorporate gender considerations so that instructional strategies can effectively address these variations and support the optimal development of all students.

Various previous studies have emphasized the importance of mathematical problem-solving skills for elementary school students, both as a means of developing logical reasoning, mathematical communication, and life skills relevant to 21st-century needs (Diputra, 2019; Trisniawati, 2017; Damayanti, 2023; Phonapichat et al., 2014; Nufus & Mursalin, 2020; Rohid & Rusmawati, 2019; Szabo et al., 2020). Neverthless, a number of studies indicate that student achievement remains low. However, most of these studies focus on a general overview of problem-solving skills without considering the specific factors that may influence them. An aspect that has received limited scholarly attention is gender perspective. Accordingly, this study addresses this gap by providing an in-depth examination of elementary school students' mathematical problem-solving skills through a gender-based lens. Rather than merely outlining students' performance at each stage of the problem-solving process, the study further explores patterns of differences between male and female students and discusses their implications for the development of gender-responsive instructional strategies. Consequently, this research advances the body of knowledge on mathematics education at the elementary school level and offers empirical evidence to inform the design of more adaptive and effective instructional interventions.

Method

This research uses a qualitative approach. The use of a qualitative approach is expected to uncover the aspects being studied. Specifically, this research adopts a qualitative exploratory case study design, focusing on an in-depth investigation of students' mathematical problem-solving skills within a single elementary school context. The qualitative approach was selected because it enables the exploration of students' cognitive processes, reasoning patterns, and problem-solving strategies in a natural learning environment, which cannot be sufficiently captured through quantitative methods.

This study aims to explore elementary school students' mathematical problem-solving skills reviewed from gender perspective. The location of this research was conducted at one of public elementary schools in Bandung city. The selected school is a public elementary school implementing the national curriculum (independent curriculum). This school has a heterogeneous student population in terms of academic ability and socioeconomic background, making it suitable for exploring variations in students' mathematical problem-solving skills. To maintain institutional confidentiality, the name of the school and specific administrative details are not disclosed. The selection of a single school as the research setting allows for a comprehensive and contextualized understanding of students' problem-solving behaviors from a gender perspective.

The subjects in this research were fifth grade elementary school students who were taking mathematics. The subject consisted of fifth-grade students representing both male and female students. The total number of participants involved in this study was 24 students, consisting of 10 male students and 14 female students. The categorization of students' problem-solving abilities into high and low levels was determined based on the results of the problem-solving skill test administered by the researcher. Students with high problem-solving ability were identified as those who demonstrated mastery across Polya's four problem-solving stages, while students with low problem-solving ability showed difficulties in multiple stages of the problem-solving process.

The participant selection employed purposive sampling. This sampling technique was chosen to ensure the representation of students based on gender and problem-solving ability levels. Participants were selected after the administration of the problem-solving skill test, which served as the main criterion for grouping students into high and low problem-solving ability categories. This approach allowed the researcher to conduct an in-depth analysis of students' problem-solving processes from both gender and ability perspectives.

In this study, the primary research instrument was the researcher, who directly engaged in the field to collect data relevant to the research focus through problem-solving ability tests, observations, interviews, and documentation. In qualitative research, the researcher assumes a central role in the data collection process. To facilitate data collection, the researcher was guided by observation guidelines, interview guidelines, and documentation guidelines.

The interviews conducted in this study were semi-structured interviews. This interview format allowed the researcher to follow predetermined guiding questions while also providing flexibility to probe students' responses more deeply based on their explanations. The interview guidelines were developed based on Polya's problem-solving stages and included key questions such as identifying known information from the problem, explaining the intent of the question, determining problem-solving strategies, describing the steps taken to carry out the solution, and stating the final result obtained.

Data collection was conducted through problem-solving skill tests, observations, interviews, and documentation. The problem-solving skill test was conducted to obtain an overview of elementary school students' problem-solving skills. The observation technique used was direct non-participatory observation. These interviews were conducted directly between the researcher and the research subjects through dialogue, questions and answers, and discussions. Documentation was used to describe the findings through documents.

The problem-solving skill test consisted of four essay-type questions. Each question corresponded to one indicator of Polya's problem-solving stages, namely: (1) understanding the problem, (2) planning a strategy, (3) implementing the strategy, and (4) rechecking the solution. Thus, each indicator was represented by one test item, resulting in a total of four questions used to assess students' problem-solving skills.

Data analysis follows the method of Miles and Huberman (Sugiyono, 2012), which consists of four activity flows: data collection, data reduction, data display, and verification or data conclusion. Data reduction in research will be carried out by grouping the collected data according to the aspects of the research problem. The reduced data is then presented (displayed) in descriptive form according to the aspects of the research. This data presentation is intended to facilitate researchers in interpreting the data and drawing conclusions.

This study adhered to ethical principles in conducting research involving child participants. Prior to data collection, permission was obtained from the school principal and classroom teachers. In addition, informed consent was secured from the students' parents or guardians. Participants were informed about the purpose of the study and their voluntary involvement. The confidentiality of participants' identities was ensured by using pseudonyms, and all collected data were used solely for academic and research purposes. The data were stored securely to protect participants' privacy and prevent unauthorized access.

Results and Discussion

Results

The results present key findings on students' problem-solving abilities based on Polya's stages and from a gender perspective. Data were obtained through a problem-solving skill test, with indicators referring to Polya's (1973) four stages: (1) understanding the problem, (2) planning a strategy, (3) implementing the strategy, and (4) rechecking. The results showed that 44% of students were able to solve the problem-solving tasks, while 66% experienced difficulties. A more detailed description of students' problem-solving abilities is presented in the following sections.

High Category Students' Problem-Solving Skill

Students with high problem-solving skills were found to be able to master all of Polya's (1973) problem-solving stage indicators. In the first indicator, students' ability to understand the problem is described as follows.

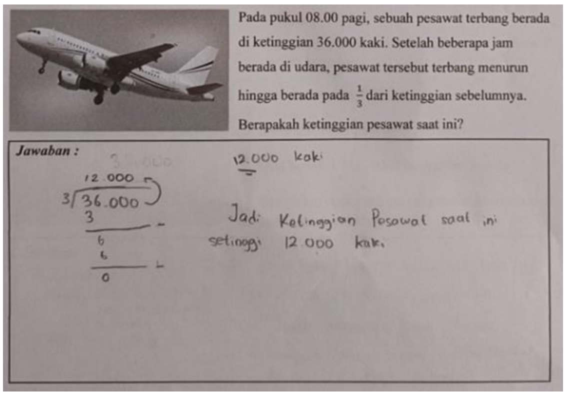


Figure 1 Students' Ability to Understand Problems

Based on the students' answers, they were able to identify the core information in the problem, as indicated by the correct selection of operations when dividing the plane's altitude of 36,000 feet to determine one-third of its initial height. These calculation steps reflect an operational understanding of the relationship between the given data and the problem's objective. This interpretation is further supported by the following interview excerpts.

P: How does Adinda T understand the meaning of the question in this question?

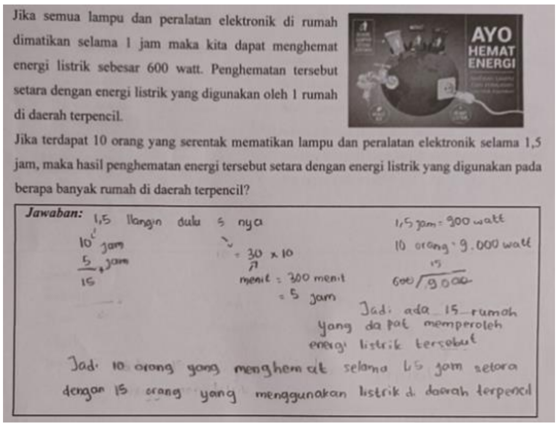
T: I tried reading it over and over again to see if the question was about the plane's altitude after descent. So, I had to find 1/3 of 36,000 feet. I immediately divided 36,000 by 3, ma'am. Because a third means dividing by three. So, 36,000 divided by 3 equals 12,000.

P: So, what is the conclusion of Adinda T's answer to this question?

T: In conclusion, the altitude of the aircraft after descent was 12,000 feet.

Based on the interview transcript, the student began the problem-solving process by carefully reading the problem to identify key information. The student also understood the main question in the problem. This understanding was demonstrated by the statement that he read the problem several times until he understood the essence of the question. Furthermore, the student was able to connect the information in the problem to relevant mathematical concepts. This process demonstrated that the student not only understood the information provided but also correctly interpreted the question's intent before proceeding to the solution stage.

In the second indicator, students' ability to plan strategies is described as follows.


Jika semua lampu dan peralatan elektronik di rumah dimatikan selama 1 jam maka kita dapat menghemat energi listrik sebesar 600 watt. Penghematan tersebut setara dengan energi listrik yang digunakan oleh 1 rumah di daerah terpencil.

Jika terdapat 10 orang yang serentak mematikan lampu dan peralatan elektronik selama 1,5 jam, maka hasil penghematan energi tersebut setara dengan energi listrik yang digunakan pada berapa banyak rumah di daerah terpencil?

Jawaban:

Figure 2 Students' Ability to Plan Strategies

Based on the students' responses, the students were able to identify key information from the problem. The students' efforts to compare the number of people, the duration of the outage, and the amount of energy produced indicate their understanding of the need to integrate multiple pieces of information in order to arrive at a solution to the given problem. The strategy employed is evident through the use of step-by-step calculations and attempts to establish equivalence between energy savings and household energy consumption in remote areas. Based on this approach, the students' thinking patterns already reflect systematic strategic planning. These findings from the students' written responses are also supported by the results of the interviews, as follows.

P: What initial step did you plan in order to solve the problem?

S: I tried to compare the number of people with the amount of energy saved. So, I first calculated the energy by converting the time into minutes or hours so that it could be compared. I made a comparison between the number of people turning off the electricity and the length of time. Then, I converted 1.5 hours into another form. After that, I looked for how much energy would be equivalent to the electricity consumption of several households in remote areas.

Based on the interview results, it can be identified that the student has demonstrated a fairly systematic ability to plan problem-solving strategies. The student began the problem-solving process by reading the question and identifying key information. In planning the strategy, the student explained that they compared the number of people with the amount of energy saved and converted the duration of time into other units to facilitate the calculations. Although the student perceived the steps used as appropriate, the interview findings indicate that the ability to plan strategies has been established but still requires reinforcement. Therefore, it can be concluded that students' strategic planning abilities have developed and only require strengthening in calculation accuracy and understanding of energy concepts.

In the third indicator, students' ability to implement strategies is described as follows.

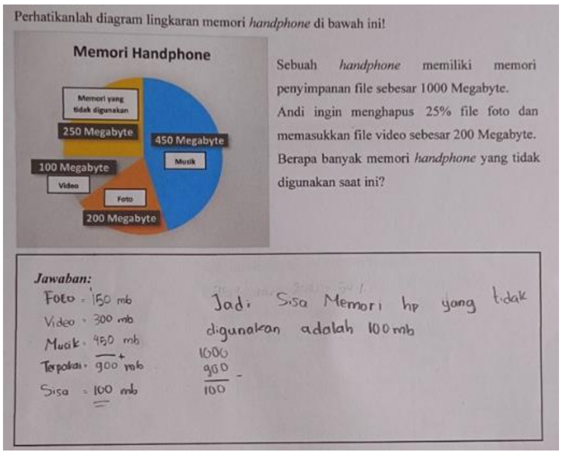


Figure 3 A Students' Ability to Implement Strategies

Based on the students' answers, it appears that they have been able to implement the problem-solving strategy according to their planned steps. Student identified the amount of memory used by each file types and then added up all the memory usage to obtain the total memory used before adjustments. Next, they calculated the remaining memory by subtracting the total storage capacity of their phone. Although they did not include additional information from the problem, such as deleting 25% of the photo files and adding 200 MB of new videos, the written process demonstrates that they have been able to implement the calculation strategy sequentially, from determining the required data, performing addition operations, to concluding the final result. These findings from the students' answers are also supported by the following interview results.

P: When working on the problem about cellphone memory, what was the first step you took?
S: I'll see first, Ma'am, how much memory is used for photos, videos, and music, then I write them down one by one. I added it all up, ma'am, so I know the total memory used.
P: How do you determine the remaining memory on the cellphone?
S: After getting the total, I subtracted it from the phone's 1000 MB capacity. That gave me the remaining unused memory.

Based on the interview results, they began by identifying the basic information available. They then added up all the memory usage to obtain the total used. The next step was to determine the remaining memory by subtracting the total usage from the phone's initial capacity of 1000 MB. Throughout the process, the students acknowledged using the information in the diagram, although they did not consider additional information such as deleting some photos or adding new videos. In general, the students felt that the steps they took were coherent and consistent with their understanding, indicating a grasp of the basic procedures for solving data-based problems. This indicates that students' ability to implement strategies has developed, but still needs to be improved in their accuracy.

In the fourth indicator, students' ability to recheck is described as follows.

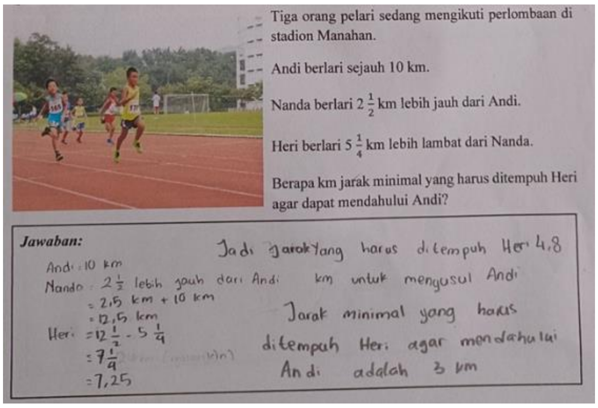


Figure 4 Students' Ability to Recheck

Based on the student's written response, it can be observed that the student attempted to understand the relationship among the running distances of Andi, Nanda, and Heri by performing step-by-step calculations. The student first determined Andi's running distance. Subsequently, the student added 2½ km to calculate Nanda's total running distance. In the next step, the student attempted to determine Heri's running distance by subtracting 5¼ km from Nanda's distance. However, the calculation was not accurate, leading to a result of 7.25 km. Furthermore, the student concluded that the minimum additional distance required for Heri to overtake Andi was 3 km. These findings are also supported by the interview results, as follows.

P: When working on the problem about the running distances of Andi, Nanda, and Heri, what was the first step you took?
S: First, I looked at Andi's running distance, Ma'am. The problem stated that Andi ran 10 km, so I used that as a reference. I added 2½ km to Andi's distance, Ma'am. So, 10 km plus 2.5 km resulted in 12.5 km. Heri was 5¼ km slower than Nanda. So, I subtracted 5.25 km from 12.5 km, Ma'am.

P: Did you recheck this final step before writing down your answer?

S: Not yet, Ma'am. I just looked at the difference and wrote it down right away.

Based on the interview results, it was apparent that the student was able to explain the initial steps in solving the problem. The student also understood that Heri's distance was calculated by subtracting 5.5 km from Nanda's running distance. However, when asked about the accuracy of the calculation, the student admitted that he did not thoroughly double-check it and only briefly glanced at the results. This indicates that the student had not fully implemented the verification process in solving the problem. Through reflection at the end of the interview, the student stated that double-checking was very important and had the potential to make the answer more accurate, indicating metacognitive awareness even though it had not been fully implemented in the problem solving. Students with high problem-solving ability have mastered problem-solving steps well, characterized by a strong understanding of the problem, a well-planned strategy, consistent implementation of steps, and an initial awareness of double-checking. By strengthening calculation accuracy and verification habits, students' problem-solving abilities have the potential to develop optimally.

Low Category Students' Problem Solving Ability

The first indicator, students still have difficulty understanding the core issues presented in the questions. Although students write down their final answers, there is no apparent calculation or reasoning process that demonstrates a true understanding of the relationship between the information provided. The absence of these calculation steps indicates that students may be guessing the answer or simply relying on estimates without understanding the concept of fractions requested in the question. This indicates that students do not yet understand the context, important information, and the purpose of the question, so their answers do not reflect a complete understanding of the problem. These findings from students' answers are also supported by the following interview results.

Based on the interview, the student experienced an inability to grasp the core problem in the problem. The student also expressed confusion about fractions and was unable to connect the information in the text with the calculation steps that should be taken. This indicates that the student did not understand the context of the story, did not use complete data, and was unable to interpret the relationships between information, resulting in an inaccurate answer that lacked proper thought processes. It can be concluded that students have not been able to fully understand the problem in the given question.

The second indicator, student indicated that they were unable to systematically plan a problem-solving strategy. This was evident in the absence of calculation steps that should have been taken to connect the information in the problem. Students did not identify important data or determine the necessary mathematical operations, so their answers were irrelevant to the question and did not demonstrate an attempt to compare the total energy saved with the needs of a home in a remote area. The disorganization and lack of calculation processes in their answers indicated that students had difficulty planning and implementing problem-solving strategies appropriately.

Based on the interview, the student admitted to paying attention to only part of the information provided in the problem and did not understand how to use data such as the duration of the power outage and the number of people involved. The student also did not perform the necessary calculations, but instead merely wrote down an answer without a clear basis. The student's statement that they were "confused about where to start" and their inability to understand how to connect the available information indicate that the student was not yet able to construct systematic steps to solve the problem.

For the third indicator, the student's answer indicates that he had difficulty implementing the problem-solving strategy, even though the information in the problem was clearly presented through a pie chart. The student failed to perform the necessary operational steps. Instead of following a logical calculation process, the student immediately wrote down a number that did not match the data in the problem. This indicates that the student was unable to apply appropriate strategies to solve the problem. The student's inability to operate these steps indicates that he has not been able to implement the problem-solving strategy systematically and accurately.

The fourth indicator, students' answers demonstrated an inability to double-check their calculations. They wrote that the minimum distance Heri must travel to overtake Andi is 12 km without providing clear calculation steps. However, the problem contained several important pieces of information, including addition and subtraction of distances, that should be calculated step by step to obtain the correct answer. The students' lack of involvement in double-checking their answers indicates that they tended to accept their calculations directly without ensuring they align with the problem information and mathematical logic. This suggests that students are not yet accustomed to reviewing or validating their answers for accuracy and validity, resulting in potential errors that remain undetected before submission.

The students' written responses and interview data indicate that the student experienced difficulties in conducting a review of their calculation results. Overall, students in the low category experienced fundamental difficulties at all stages of problem-solving. These obstacles were characterized by a lack of conceptual understanding, an inability to organize information, inability to perform mathematical operations, and a lack of habitual double-checking of calculation results. These findings emphasize the need for learning that focuses on strengthening conceptual understanding, mentoring in developing strategies, practicing problem-solving in stages, and cultivating the habit of reflecting and verifying answers.

Profile of Students' Problem-Solving Ability Reviewed from a Gender Perspective

In this study, students' problem-solving abilities, viewed from a gender perspective, were limited to the context of students with high problem-solving abilities. For female students, the answers were previously described. Based on the analysis of the responses of a male student with high problem-solving ability, the student demonstrated strong mastery of the understanding the problem indicator. He was able to identify essential information, accurately interpret fraction concepts, and select appropriate mathematical operations to obtain a correct answer. However, with regard to the planning the strategy indicator, the student did not fully present a coherent sequence of calculations, resulting in the underlying mathematical reasoning not being clearly articulated. In the executing the strategy indicator, the student still experienced difficulties in organizing calculation steps that aligned with the problem context and tended to rely on visual information without adequately adjusting to the changes in conditions provided. At the reviewing stage, the student attempted to recheck the calculations and understand the relationships among the data; nevertheless, a lack of precision in operating fractional numbers led to inconsistent results.

In general, both male and female students demonstrated strong problem-solving skills at the problem understanding stage. Both were able to identify important information in the problem, correctly interpret the question's intent, and connect it to relevant mathematical concepts, such as understanding fractions or the relationships between quantities. At the strategy planning stage, both students also demonstrated efforts to develop sequential steps to solve the problem by carefully reading the problem, identifying important information, and comparing or connecting available data. Furthermore, both students were able to implement their solution strategies by following the calculation steps they had developed, albeit with varying degrees of accuracy. In the rechecking indicator, both male and female students demonstrated an awareness of the importance of rechecking their answers, although this was not always implemented optimally. Thus, both students have a strong foundation in problem-solving skills, particularly in understanding the problem and developing basic strategies for solving it.

Although similarities were observed in the general flow of thinking, several differences emerged in the quality and depth of problem-solving skill implementation. Female students demonstrated a more coherent and structured thinking process across all indicators, as reflected in their ability to clearly explain each step, both in written responses and during interviews. They tended to be more careful in understanding the problem context, outlining the strategies to be used, and articulating the reasoning behind the steps taken. In contrast, male students, despite possessing a good conceptual understanding, appeared less consistent in presenting complete calculation processes and more frequently relied on visual information rather than integrating all available data. During strategy execution, female students were more systematic and followed their plans more carefully, whereas male students still experienced difficulties in utilizing all relevant information comprehensively. At the reviewing stage, female students exhibited stronger reflective abilities, as they were able to recognize inaccuracies after re-examining their work. Conversely, male students tended not to conduct thorough verification, resulting in less consistent final outcomes. Therefore, the primary differences lie in accuracy, consistency, and metacognitive awareness, with female students demonstrating more stable and detailed performance compared to male students.

Discussion

Based on the research results, it was found that students with high problem-solving abilities generally mastered all stages of Polya (understanding the problem, planning a strategy, implementing steps, and double-checking), although there were weaknesses in the accuracy of calculations and re-verification. Meanwhile, students with low abilities experienced fundamental obstacles at each stage, such as difficulty understanding concepts, organizing information, performing mathematical operations, and being unaccustomed to double-checking.

These findings align with previous research showing that differences in problem-solving abilities can be related to students' thinking styles and metacognitive levels. For example, in a study by Soenarjadi (2020), female subjects were reported to be more "careful and accurate" in problem-solving than male subjects, although they were not always superior in strategy execution speed. Furthermore, according to Isna Aulia & Murtiyasa (2024), students' metacognitive profiles in mathematical problem-solving differ between males and females, with female students tending to be more aware of the need to double-check (monitoring).

Beyond simply describing these differences, the observed tendency for female students to demonstrate more systematic, deliberate, and reflective problem-solving processes can be explained through cognitive and sociocultural perspectives. From a cognitive perspective, several studies have shown that female students tend to demonstrate stronger verbal processing and sequential reasoning skills, which can support clearer articulation of problem-solving steps and more consistent solution monitoring (Reinhold et al., 2020). These verbal-analytical tendencies may facilitate the organization of information and adherence to structured problem-solving steps, as required by Polya's framework.

However, not all literature supports simplistic gender performance stereotypes. A literature review by the International Education Journal indicates that gender differences in mathematics problem solving are difficult to generalize; some studies show a male advantage on complex patterned problems, but not across all problem types. Furthermore, research by Putri & Andriani (2023) using Newmann error analysis found that the types of errors made by male and female students were nearly identical, indicating that gender differences do not always correlate with large differences in problem-solving errors.

From a socio-cultural perspective, gender socialization may also play a role in shaping students' approaches to mathematical problem solving. Female students are often encouraged, both implicitly and explicitly, to demonstrate carefulness, precision, and compliance with procedural norms in academic settings, whereas male students may be more encouraged to take risks or rely on intuitive and visual strategies (Kumar et al., 2015; Glock & Kleen, 2017; Piatak & Mohr, 2019). These social expectations may contribute to differences in verification habits and levels of thoroughness observed during the problem-solving process.

The differences in problem-solving performance between male and female students observed in this analysis may be related to variations in thinking styles, levels of metacognition, and cognitive strategies, rather than reflecting an intrinsic superiority of one gender over the other. Emphasizing the strengthening of accuracy and verification habits in both groups is therefore highly relevant, as metacognitive factors such as rechecking procedures have been shown to contribute significantly to problem-solving accuracy, particularly among female students (Isna Aulia & Murtiyasa, 2024).

In addition, motivational and affective factors such as mathematical self-efficacy and stereotype related beliefs may influence students' engagement with problem-solving tasks (Nicolaidou & Philippou, 2003). Research on mathematics self-efficacy suggests that students who perceive themselves as careful and capable are more likely to persist in checking and refining their solutions, while stereotype threat may negatively affect students' confidence and performance in evaluative problem-solving situations (Stewart, 2023; Schweinle & Mims, 2009). These factors may help explain why some male students, despite demonstrating strong conceptual understanding, showed less consistency in verifying their solutions.

Overall, the results of this study indicate that differences in students' problem-solving abilities are determined not only by their mastery of mathematical concepts, but also by their individual thinking strategies and metacognitive levels. High-ability students tend to be able to carry out all Polya stages more systematically, while low-ability students still face fundamental obstacles in understanding the problem and conducting final verification. Although some studies indicate gender-specific tendencies in terms of thoroughness and monitoring, other findings confirm that these differences are not absolute and cannot be generalized to all contexts and problem types. Therefore, improving problem-solving abilities needs to focus on developing metacognitive skills, such as thoroughness and double-checking habits, for all students regardless of gender. This approach is not only relevant to previous research findings but also provides a more constructive direction for inclusive mathematics learning that is oriented towards strengthening students' thinking processes.

Despite the contributions of this study, several limitations should be acknowledged. First, this research was conducted in a single elementary school with a limited number of participants, which may restrict the generalizability of the findings to broader educational contexts. Therefore, the results should be interpreted with caution and not assumed to represent all elementary school students. Second, the qualitative nature of the study emphasizes depth over breadth, focusing on detailed analysis of students' problem-solving processes rather than statistical generalization. In addition, the interview data relied heavily on students' metacognitive abilities to articulate and reflect on their thinking processes, which may vary across individuals and influence the richness of the data obtained. Future studies are encouraged to involve multiple schools, larger and more diverse samples, and complementary data sources to further examine gender-related patterns in mathematical problem-solving and strengthen the robustness of the findings.

Conclusion

In general, students with high problem-solving ability have mastered the problem-solving steps well. Meanwhile, students with low problem-solving ability experience fundamental difficulties at all stages of problem-solving. These obstacles are characterized by a lack of conceptual understanding, an inability to organize information, inability to perform mathematical operations, and a lack of habitual double-checking of calculation results. Both male and female students have good basic problem-solving skills, especially in the stages of understanding the problem and developing initial strategies for solving it. However, differences emerge in the quality of strategy application and accuracy in problem solving. Female students demonstrate a more coherent, systematic, and thorough thought process at each stage, including explaining steps and double-checking. Conversely, male students tend to be less consistent in using all available information, rely more on visuals, and are less thorough in verifying results.

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