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Analysis of Mathematical Problem-Solving Skills of SMK Class XI Students in Statistics Material

Rika Agustina[1], Neneng Tita Rosita[2], Agus Jaenudin[3]
[1,2,3]University of Sebelas April, Sumedang, Indonesia

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ABSTRACT

The purpose of this study is to characterize students' mathematical problem-solving skills in statistics using problem-solving indicators, such as comprehending the problem, coming up with a strategy, executing the plan, and looking back, as well as examining the different kinds of mistakes that students make. The study used a qualitative descriptive approach. Purposive sampling was used to choose twenty-eight eleventh-grade students from SMK Perkasa for the 2025–2026 school year as the subjects. The research tool was an essay test that assessed mathematical problem-solving skills. In order to examine the data, students' skills were divided into three categories: high, medium, and low. The proportion of mistakes for each indication was then determined. The findings indicate that pupils' aptitude for solving mathematical problems was typically classified as low. In all, 57.14% of pupils fell into the low group, 25.00% into the middle category, and 17.86% into the high category. Error rates were highest while implementing the solution plan (53%), followed by coming up with a strategy (41%), comprehending the problem (25%), and looking back (39%). These results show that pupils have trouble grasping procedures and doing computations accurately. Therefore, in order to enhance pupils' mathematical problem-solving skills, instructional efforts are needed.

Corresponding Author:

Neneng Tita Rosita
University of Sebelas April, Sumedang, Indonesia
Email: nenengtita_fkip@unsap.ac.id

1. INTRODUCTION

One of the fundamental subjects that is very important for human survival is mathematics. Mathematics is not only used for calculations in everyday life, but also for understanding patterns, making predictions, and making decisions based on data [1]-[4]. Therefore, mathematics learning is not only oriented towards mastering formulas and procedures, but also aims to form a logical, systematic, critical, and objective mindset. In

line with this, Karim and Nurrahmah [5] state that mathematics plays a role in shaping a person's way of thinking rationally. However, there are still many students who consider mathematics to be a difficult subject, so their interest and awareness of the importance of mathematics are low [6].

One of the goals of mathematics in education is for students to understand mathematical concepts, recognize the relationships between concepts, and implement concepts accurately and perfectly in problem solving [7]. Problem-solving skills are an important competency because students are not only required to solve routine problems, but also to face problems related to real life. According to Santos-Trigo [8], problem-solving is the main activity in mathematics learning because mathematics develops through the process of formulating problems and finding strategies for solving them. This opinion is reinforced by Mukarromah et al. [9], who show that mathematical problem-solving skills are still considered one of the important competencies that students must develop in 21st-century mathematics learning.

Mathematical problem-solving skills include the ability to: (1) understand the problem, (2) formulate a strategy, (3) implement the plan, and (4) evaluate the results [10]-[12]. This ability is important for students to have because it can help them solve problems in learning as well as in daily life [13], [14]. However, in reality, students' mathematical problem-solving skills are still relatively low [15]-[17]. Low problem-solving ability results in students only being able to do routine problems or exactly the same as those given by the teacher, so students are not used to doing non-routine problems and may make mistakes when solving math problems. Mistakes that are often found in solving math problems include misunderstanding the problem, formula errors, calculation errors, and errors in interpreting mathematical symbols [18]. Munengsih et al. [19] stated that students had difficulty solving problems because they were only motivated by formulas. Due to a lack of understanding of how to apply story problems, students focus only on working on problems using formulas. As a result, students struggle when faced with problems that require mathematical thinking and problem-solving skills.

According to some studies, students are only able to meet one or two of the four math problem-solving indicators, suggesting that their math problem-solving skills are still lacking. The findings of a study conducted by Kushendri and Zanthy [20], which tested the mathematical problem-solving ability of high school students in dealing with statistical problems, showed that students' problem-solving abilities were at an adequate level. According to a study by Andayani and Lathifah [21], students with low abilities were only able to understand problems but were not yet able to construct mathematical models, determine solution strategies, and double-check the answers obtained. The results of the study show that students' mathematical problem-solving skills still need to be improved, especially in materials that require reasoning and data interpretation.

In addition, other research has shown that mathematical problem-solving abilities are closely related to students' metacognitive abilities [22]-[25], and students who can plan, monitor, and evaluate their thought processes tend to be more successful in solving mathematical problems, especially in statistical learning [26]-[29]. In statistics education, students are not only required to do calculations, but also understand data, interpret

information, and make decisions based on the results of data analysis [30], [31]. This makes statistics one of the most complex materials for students.

Statistical material was chosen in this study because statistics have a strong connection with daily life and the world of work, especially in vocational education [32]. Vocational school students are often faced with data, graphs, tables, and numerical information that require analytical and decision-making skills. However, in practice, many students still have difficulty understanding the meaning of data and solving statistical problems. These difficulties show that students are not yet fully able to apply mathematical concepts in a real context.

Research on mathematical problem-solving skills has indeed been carried out a lot, but most previous research has only focused on the final results of students' abilities without examining the mistakes made by students on each problem-solving indicator. In addition, research that specifically analyzes problem-solving abilities in statistical materials in vocational education environments is still relatively limited. In fact, the characteristics of vocational school students differ from those of public school students because learning in vocational schools is closer to the application of concepts in the world of work and real life. Therefore, research is needed to describe students' problem-solving abilities and analyze errors that arise at each stage of problem solving.

Based on this description, this research was conducted to describe students' mathematical problem-solving abilities in statistical materials based on problem-solving indicators, namely understanding problems, planning solutions, implementing plans, and re-examining answers. In addition, this study also aims to analyze student mistakes based on high, medium, and low ability levels so that it can provide a clearer picture of the location of students' difficulties in solving statistical problems.

2. METHOD

The method used in this study is qualitative descriptive. The research was conducted in the even semester at one of the vocational schools in Sumedang for the 2025/2026 school year. The sampling technique used was purposive sampling [21], with research subjects of 28 students in grade XI. The grouping of students' abilities is carried out based on the results of the mathematical problem-solving ability test. Students with a score of ≥ 53 were categorized as high (5 students), a score of 37–53 in the medium category (7 students), and a score of <37 in the low category (16 students) [33]. The research instrument consists of three descriptive questions containing indicators of problem-solving ability based on the Polya stages, namely understanding the problem, planning solutions, implementing plans, and re-examining the results of the answers. The instrument was first validated by two mathematics education lecturers and one mathematics teacher to assess the suitability of the material, language, and question indicators. The instrument's reliability was assessed through limited trials before the study was carried out. The research data were obtained through tests and interviews. Interviews were conducted with student representatives from the high, medium, and low categories, each lasting about 10–15 minutes. During the interview, the researcher used field notes. Data were analyzed through the stages of data reduction, data presentation, and concluding. The coding is done based on the student's

ability category and the type of difficulty found. The validity of the data is strengthened through triangulation by comparing test results and interviews.

3. RESULTS AND DISCUSSION

3.1. Results

The results of the mathematical problem-solving ability test were used as a tool for data collection. Students' level of mathematical problem-solving ability in statistics is evaluated using a mathematical problem-solving ability exam. The information collected comes from a math problem-solving ability test. Table 1 shows the results.

Table 1. Mathematical Problem-Solving Test Results

Number of Students	Value			
	Minimum	Maxsimum	Red	S.Deviation
28	27	56	45	8

The number of students who took the math problem-solving exam was 28, according to the statistics in Table 1. Students obtained a minimum score of 27 and a maximum score of 56 out of a desired maximum score of 100. Students have an average score (mean) of 45, with a standard deviation of 8. All student results did not reach the required level of competency compared to the 75-point Learning Goal Achievement Criteria (KKTP) for class XI. This shows that students' ability to solve mathematical problems is still generally lacking. However, some students have superior skills despite not having reached the KKTP, as shown by the highest score of 56. These findings are used to classify students' math problem-solving skills into three groups: high, medium, and low.

Table 2. Percentage of Mathematical Problem-Solving Ability Criteria

Categories	Value criteria	Number of students	Percentage
Height	$\bar{X} > 53$	5	17,86%
Medium	$37 \leq \bar{X} < 53$	7	25,00%
Low	$\bar{X} < 37$	16	57,14%
Total		28	100%

Based on Table 2, the majority of students' mathematical problem-solving skills are in the low category. This can be seen from the percentage of students in the low category of 57.14% or as many as 16 students. Meanwhile, students in the medium category amounted to 7 students (25.00%) and 5 students (17.86%) in the high category. Although the average ability of students is in the medium category, the percentage results show that most students still have low mathematical problem-solving skills.

The following is a histogram of the percentage calculation results to make it easier to identify the mistakes made by students in solving statistical problems, reviewed from the indicator of mathematical problem-solving ability.

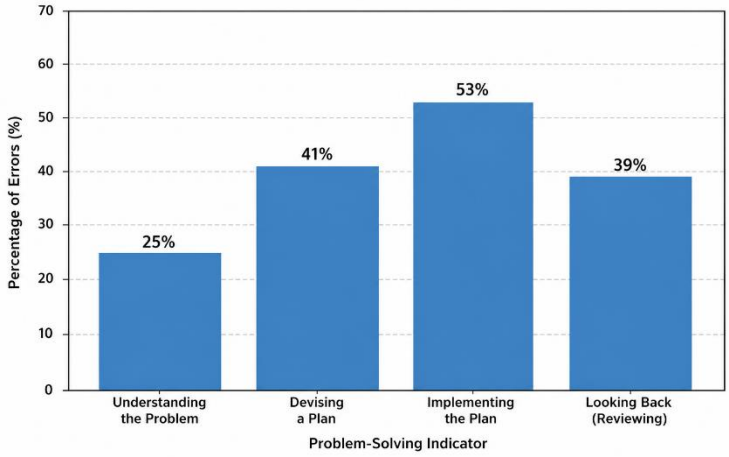

Figure 1. Error Percentage Based on Mathematical Problem-Solving Ability Indicator

Based on the results of the analysis, the most student mistakes appeared at the stage of implementing the plan and re-checking the answers. At the stage of understanding the problem, most students are already able to write down the information that is known and asked, so the frequency of errors is relatively lower. However, when entering the completion stage, many students make procedural mistakes such as misusing formulas, making mistakes in calculation steps, and not completing the process until the final result. In addition, conceptual errors were also found, for example, students did not understand the meaning of statistical data and were not correct in choosing the solution method. The interview results showed that some students felt confused about determining the first step of completion and rarely double-checked the answers they had made. This condition shows that students' metacognitive abilities are still low, especially in planning strategies, monitoring the work process, and evaluating the final results. This is in line with the findings of research conducted by Aljura et al. [34] and Wibowo et al.[35] stating that errors in problem solving often occur at the stage of implementing strategies and reflection due to the limitations of students' metacognitive abilities.

3.2. Discussion

The results of the analysis show that students' mistakes in solving mathematical problems do not only occur at one specific stage, but are spread across several stages of problem solving, especially at the implementation and evaluation stages. This pattern of errors indicates that students do not have optimal abilities in managing their thinking processes systematically. In addition, low accuracy and a lack of habit to reflect on answers are factors that also affect the quality of student problem solving. Errors at the implementation stage indicate weaknesses in procedural consistency and calculation accuracy, while errors at the re-checking stage indicate a lack of evaluation habits of the solutions obtained. The findings of the research conducted by [25] are in line with the literature that emphasizes that metacognitive skills, especially monitoring and evaluation, are very decisive for success in solving mathematical problems correctly.

Comparisons with previous studies show a change in students' error patterns, especially at the relatively low level of understanding problems, different from the findings

of some studies that still report these initial difficulties. This reinforces that learning interventions that emphasize metacognitive strategies can improve students' initial understanding, but need continuous habituation to improve application and reflection skills. These findings are in line with Widiyasari [36]. Implementing a systematic and integrated learning model with metacognitive strategies will contribute significantly to reducing overall student errors.

The math problem-solving questions consist of three descriptive questions about statistics, which are arranged based on math problem-solving indicators. Students' math problem-solving abilities can be seen from their results and answers, which are grouped into high, medium, and low categories. The analysis of students' answers revealed various mistakes that students made in answering statistical questions. Here are the students' answers:

In question no. 1, students are expected to be able to determine what month the research will be carried out. The questions given are as follows: "*A study conducted by Shen in China in 2020 produced data that 34% of bus passengers were infected from 1 patient who was contaminated with COVID-19. The transmission occurred because none of the passengers on the bus wore masks. The research was conducted when the Chinese government had not yet issued a regulation requiring the use of masks on public vehicles. It is not yet known when the research was conducted; however, there is information that the study began on the 31st of 2020, in the month before the first quartile. Determine in what month the research began!*" The following are the answers of students grouped into high, medium, and low categories.

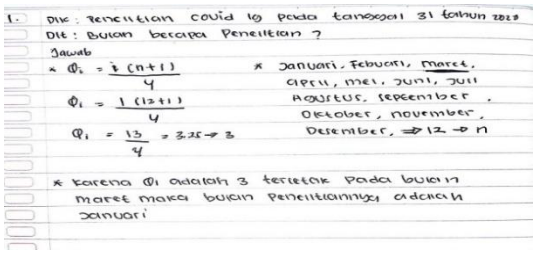

Figure 2. Answer to Question Number 1 High Category

In Figure 2, student number 1 is in the high category. Students can understand the problem by writing down the known information and the questions asked, preparing an appropriate solution plan, carrying out calculations correctly, and checking again by writing the final conclusion. The interview results show that students are used to reading the questions carefully and double-checking the answers before completing them. The teacher also said that students in this category have a habit of thinking carefully and reflectively when solving problems. These findings corroborate that high-ability students have good control of thought processes, as stated by [11], [37]-[40].

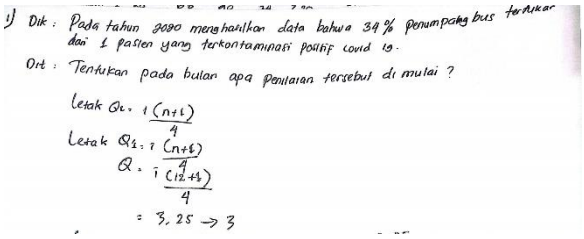

Figure 3. Answer to Question Number 1 Medium Category

The responses of students in the moderate group are shown in Figure 3. Although they seem to understand the problem and devise a plan of action, they still make mistakes during the implementation and evaluation phases. A lack of precision in calculations generally causes errors, as does not writing down the conclusion. The interview results showed that students were aware of the importance of writing down known and asked, but were often in a hurry when counting and did not double-check. These findings are in line with [41]-[43], which state that medium-ability students often experience procedural errors due to low accuracy.

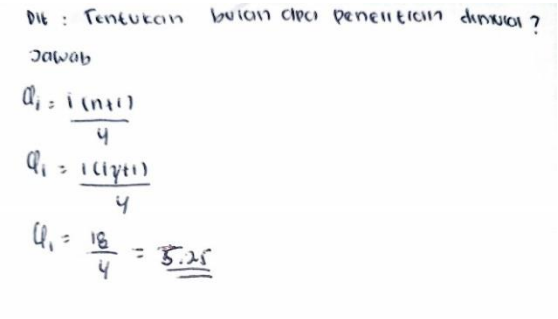

Figure 4. Answer to Question Number 1 Low Category

Figure 4 shows the students' answers in the low category. Students are unable to identify important information, so they make mistakes in drawing up plans and implementing solutions. As a result, students cannot double-check or write conclusions. The interview results revealed that students felt confused about identifying known information and only memorized formulas without understanding their use. The teacher emphasized that students in this category are not used to solving non-routine problems. These findings reinforce the results [44]-[46] that initial errors impact the failure of subsequent stages.

In question no. 2, students were able to determine the highest hardware performance test score for the reduced CPU. Question no. 2 is "*A computer lab will reduce the number of CPUs based on hardware performance measured through an application. The measurement results obtained hardware performance test score data of 61-65, 66-70, 71-75 with frequencies of 2, 4, 8 while for hardware performance test scores of 76-80, 81-85, 86-90 obtained frequencies of 12, 6, 8 if the CPU will be reduced by 25% of the total existing CPU, determine the highest hardware performance test score for the reduced CPU*?" The following are the answers of students grouped into high, medium, and low categories.

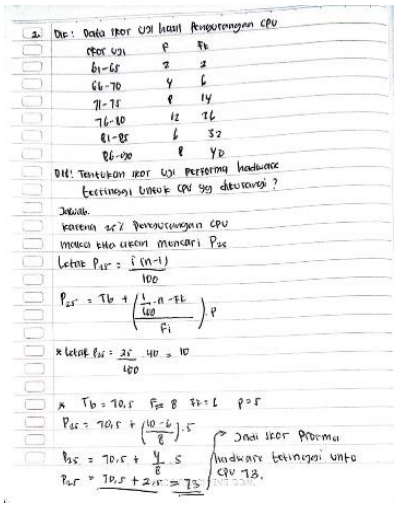

Figure 5. Answer to Question Number 2 High Category

Figure 5 shows the answers to question no. 2, with the high category being able to determine the exact location of the percentile, using the appropriate formula, and writing the final conclusion correctly. The interview results show that students understand the reasons for using the percentile and double-check the results of the calculations. The teacher said that students were able to relate the concept of statistics to the context of the problem. These findings are in line with [47]-[49], which state that mastery of statistical concepts has a significant effect on the success of contextual problem solving.

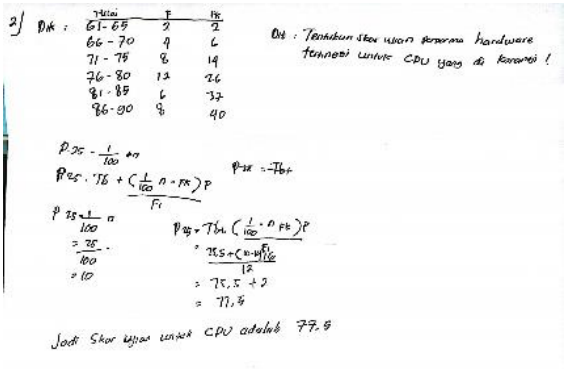

Figure 6. Answer to Question Number 2 Medium Category

Figure 6 is the answer to question no. 2 with a medium category. Medium category students understood the problem and made a plan, but made mistakes in determining the percentile location, which impacted the final result. The interview results showed that students were less thorough in the early stages and more focused on calculations. The teacher said that students rarely evaluate the steps. These findings are in line with Nisa and Hadi [50], which states that errors in transforming concepts into procedures are characteristic of moderately capable students in the form of graphs, tables, or descriptives. Analysis and interpretation of these results are necessary before they are discussed.

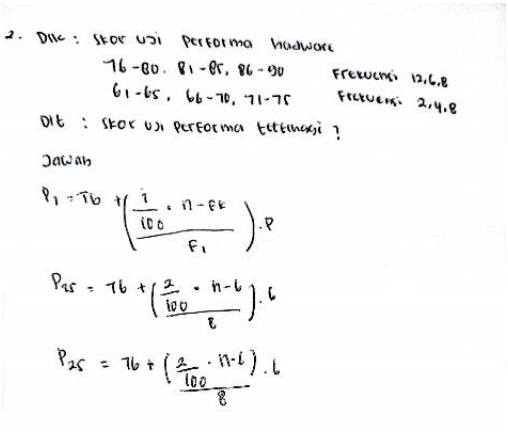

Figure 7. Answer to question number 2 low category

Figure 7 shows the students' answers in the low category. Students are unable to draw up a completion plan and immediately do calculations without a clear strategy. Interviews show that students do not understand the concept of percentile and are hesitant to determine a step. The teacher emphasized that students had difficulty associating concepts with procedures. These findings are in line with [51], which states that conceptual weaknesses are the main cause of statistical problem-solving failures.

In question no. 3, students are expected to determine the order of the three finalists based on the standard deviation. As for question no. 3, "*In the cooking competition, there were 3 participants who entered the final round. The results of the 3 finalists' cooking will be judged by 4 different judges. The total score of the 3 finalists turned out to be the same, which is as follows.*"

Nilai / Finalis	Juri 1	Juri 2	Juri 3	Juri 4	Total
Finalis 1	88	68	90	74	320
Finalis 2	82	78	80	80	320
Finalis 3	80	64	94	82	320

If the three finalists are sorted by standard deviation, determine the order of the three finalists! The following are the answers of students grouped into high, medium, and low categories.

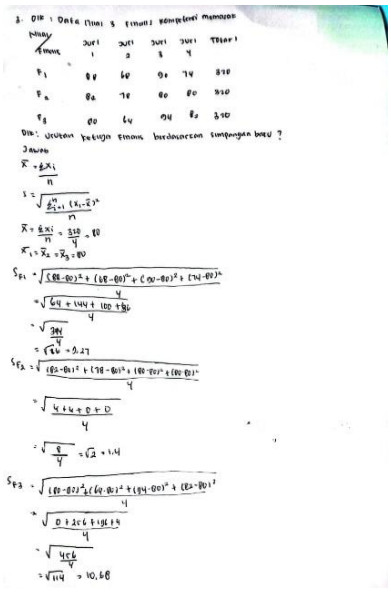

Figure 8. Answer to Question No 3 High Category

Figure 8 shows the answers to question number 3 for the high category. Students in the high category in question number 3 were able to calculate the average and standard deviation correctly, but some did not write down the final conclusion. The interview results showed that students considered the calculation results sufficient without the need for interpretation. The teacher stated that students still need to be accustomed to writing down the meaning of the results. These findings are in line with Amelia et al. [52], who state that students often neglect the reflection stage even when the calculations are correct.

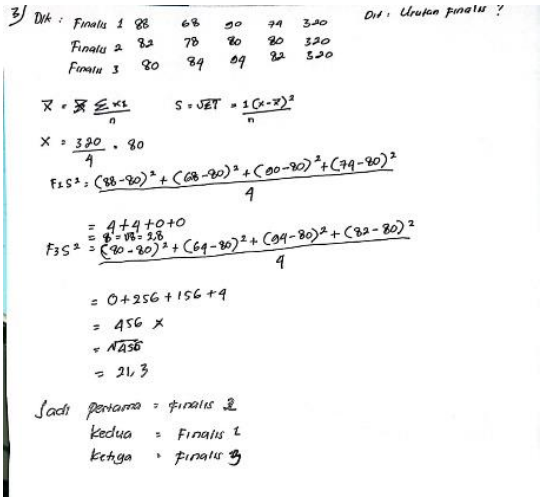

Figure 9. Answer to Question Number 3 Medium Category

Figure 9 is the answer to question number 3 with the medium category. Medium category students have understood the problem and developed a plan, but made a procedural error because they did not include all the data in the calculation. The interview showed that

the students were less thorough and did not realize the mistake even though they had checked. The teacher stated that the students in the medium category were still weak in procedural consistency. These findings are in line with [33].

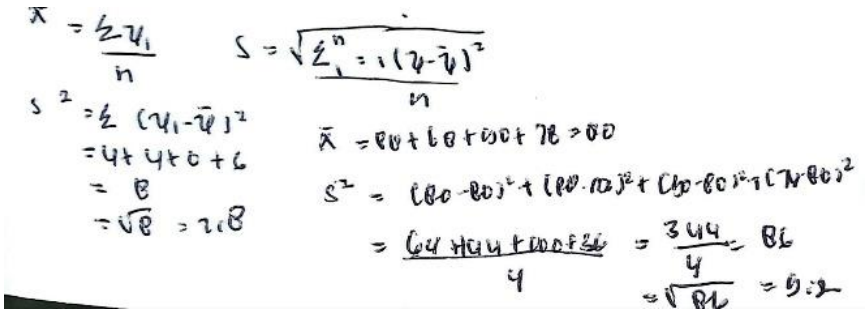

Figure 10. Answer to Question Number 3 Low Category

Figure 10 shows the students' answers in the low category. The low-category students in question number 3 were not able to understand the problem and made mistakes in using statistical formulas. The interview results show that students only memorize formulas without understanding the concepts. The teacher said that students need intensive assistance. These findings are in line with Wijaya et al. [53], who state that a weak understanding of basic concepts leads to thorough errors in problem solving.

Based on the results of student work on questions 1, 2, and 3, there is a consistent pattern that student mistakes occur most often at the stage of implementing the completion plan. This condition arises because some students understand the information in the question but still have difficulty applying the concept to the correct solution steps. Many students make calculation errors, choose the wrong formula, or lack thoroughness in completing the procedure. In addition, students tend to focus on finding the final answer without paying attention to the accuracy of the processing process. This condition is related to students' metacognitive abilities. Students with good metacognitive abilities tend to be better able to plan, monitor, and evaluate the completion process, while students with low abilities are more likely to be in a hurry and less thorough. These findings show that statistical learning, especially in vocational education, needs to emphasize concept understanding, problem-based learning, and reflective thinking habits. Giving non-routine questions can also help students become more accustomed to thinking critically, strategizing, and evaluating answers. Compared to the previous study, student errors in this study were more dominant at the stage of implementing strategies and evaluating answers, no longer at the stage of understanding the problem [47],[50],[52]-[54].

4. CONCLUSION

Based on the findings and analysis of this study, it can be concluded that grade XI students at vocational schools in Sumedang often have poor mathematical problem-solving skills. This is shown by the many mistakes that students make at almost every step of the problem-solving process, especially in the most important phases such as planning and

implementing solutions. At this stage, procedural errors and careless calculations are the main causes of errors, resulting in inaccurate final results.

Students with high abilities can complete most of the problem-solving stages well, although they still lack writing the final conclusion. Students with moderate abilities can already understand the problem and make plans, but still often make mistakes at the implementation and re-check stages. Meanwhile, students with low abilities have difficulty at almost all stages of problem solving due to poor understanding of concepts and procedural skills. The results of this study show that mathematics learning needs to emphasize more problem-solving exercises, reflective thinking habits, and non-routine problems so that students' abilities can develop more optimally.

This research still has limitations, namely the relatively small number of samples, the research was only conducted in one school, and the use of a qualitative approach that has not been able to describe the conditions broadly. Therefore, further research is recommended to involve a larger sample, more diverse schools, and develop learning methods or models that can improve students' mathematical problem-solving skills.

REFERENCES

[1] B. A. Khasanah, R. C. I. Prahmana, S. Adiputra, and M. Arnal-Palacián, "The beauty of mathematics in Indonesian culture: An impactful and meaningful context in number patterns learning," *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, vol. 10, no. 1, pp. 68–80, 2025.

[2] B. Firmansyah, E. Gradini, and N. Husna, "Enhancing mathematical literacy: Evaluating the effectiveness of the ELPSA framework in mathematics classrooms," *Journal of Mathematics Education Research*, vol. 12, no. 1, pp. 11–26, 2025.

[3] M. S. Lubis and S. S. B. Ginting, "Development of a mathematics module based on HOTS questions on social arithmetic material," *Journal of Mathematics Education Research*, vol. 12, no. 1, pp. 86–99, 2025.

[4] N. T. Rosita, "Analysis of algebraic reasoning ability of cognitive style perspectives on field dependent, field independent and gender," *Journal of Physics: Conference Series*, vol. 983, p. 012153, 2018.

[5] A. Karim and A. Nurrahmah, "Analysis of students' mathematical comprehension skills in number theory courses," *Journal of Analysis*, vol. 4, no. 1, pp. 24–32, 2018.

[6] R. Oktavia and F. H. Hidayati, "The impact of student perception on mathematics lessons at the high school level," *Scholars: Journal of Education and Learning*, vol. 16, no. 2, pp. 27–37, 2022.

[7] S. Syamsuddin and M. A. P. Utami, "Teachers' perspectives on measurement and assessment dimensions in mathematics learning," *AXIOM: Journal of Education and Mathematics*, vol. 12, no. 1, pp. 1–13, 2023.

[8] E. Santos-Trigo. "Problem solving in mathematics education: Tracing its foundations and current research-practice trends," *ZDM–Mathematics Education*, vol. 56, no. 2, pp. 211–222, 2024.

[9] S. Mukarromah, I. Junaedi, and N. R. Dewi, "The influence of learning models on students' mathematical problem-solving abilities," *Al-Khwarizmi: Journal of Mathematics Education*, vol. 9, no. 1, pp. 45–58, 2025.

[10] U. Sumarmo, *Mathematical Thinking and Disposition*. Bandung: FMIPA UPI, 2010.

[11] K. E. Lestari and M. R. Yudhanegara, *Mathematics Education Research*. Bandung: Refika Aditama, 2021.

[12] Y. N. Disparrilla and E. A. Afriansyah, "Analysis of students' mathematical problem-solving ability and self-efficacy on SPLDV material," *SIGMA: Journal of Mathematics Education*, vol. 14, no. 2, pp. 148–161, 2022.

[13] S. Fadillah, "Mathematical Problem-Solving Ability," in *National Seminar on Research, Education, and Application of Mathematics and Natural Sciences*, Yogyakarta, 2009.

[14] G. Polya, *How to Solve It: A New Aspect of Mathematical Method*. Princeton, NJ: Princeton University Press, 1973.

[15] D. Majekroatina and D. D. Yohanie, "Mathematical problem-solving ability of students' two-variable linear equation system," *Scientific Journal of Citra Bakti Education*, vol. 11, no. 1, pp. 218–232, 2024.

[16] R. Adetia, "Mathematical problem-solving ability reviewed from student self-efficacy," *Journal of Educatio FKIP UNMA*, vol. 8, no. 2, pp. 526–536, 2022.

[17] J. R. Lasdianto and A. P. Abadi, "Mathematical problem-solving skills of junior high school students based on mathematics anxiety," *Journal of Mathematics Education*, vol. 14, no. 1, pp. 88–102, 2023.
[18] F. Harahap, "Analysis of students' mistakes in solving mathematical story problems on opportunity topics based on Watson's criteria," Dissertation, UIN Syekh Ali Hasan Ahmad Addary, 2024.
[19] E. Munengsih, A. Lukito, and T. Y. E. Siswono, "Analysis of students' mathematical problem-solving ability based on Polya stages," *Journal of Mathematics Education*, vol. 12, no. 2, pp. 145–158, 2021.
[20] Kushendri and L. S. Zanthy, "Analysis of the mathematical problem-solving ability of high school students," *Journal on Education*, vol. 1, no. 3, pp. 94–100, 2019.
[21] F. Andayani and A. N. Lathifah, "Analysis of Junior High School Students' Problem-Solving Ability in Solving Social Arithmetic Problems," *Journal of Scholars*, vol. 3, no. 1, pp. 1–10, 2019.
[22] S. Toikka, L. Eronen, P. Atjonen, and S. Havu-Nuutinen, "Combined conceptualisations of metacognitive knowledge to understand students' mathematical problem-solving," *Cogent Education*, vol. 11, no. 1, p. 2357901, 2024.
[23] J. Smith, "Supporting metacognitive talk during collaborative problem solving: A case study in Scottish primary school mathematics," *Education 3–13*, vol. 52, no. 8, pp. 1578–1593, 2024.
[24] R. Rajadurai and H. Ganapathy, "Effect of use of metacognitive instructional strategies in promoting mathematical problem solving competence amongst undergraduate students in facing competitive examination," *Cogent Education*, vol. 10, no. 1, 2023.
[25] M. Suliani, D. Juniati, and A. Lukito, "The influence of student's mathematical beliefs on metacognitive skills in solving mathematical problems," *International Journal of Evaluation and Research in Education*, vol. 13, no. 3, pp. 1481–1491, 2024.
[26] S. Toikka, L. Eronen, P. Atjonen, and S. Havu-Nuutinen, "Combined conceptualisations of metacognitive knowledge to understand students' mathematical problem-solving," *Cogent Education*, vol. 11, no. 1, p. 2357901, 2024.
[27] Y. Zhao and S. Saleh, "Metacognition and mathematical problem-solving: An empirical investigation into series problems with junior high school students," *Mathematics Education Journal*, vol. 9, no. 1, 2024.
[28] R. Hidayat, Hermandra, and S. T. D. Ying, "The sub-dimensions of metacognition and their influence on modeling competency," *Humanities and Social Sciences Communications*, vol. 10, p. 763, 2023.
[29] Y. Wangguway, T. Nusantara, Sudirman, and Susiswo, "Students' metacognitive activities in contextual mathematical problem solving," *International Journal of Evaluation and Research in Education*, vol. 14, no. 1, pp. 229–239, 2025.
[30] J. Garfield and D. Ben-Zvi, "Developing students' statistical reasoning and literacy," *Statistics Education Research Journal*, vol. 17, no. 2, pp. 1–8, 2023.
[31] Y. Wangguway, T. Nusantara, Sudirman, and Susiswo, "Students' metacognitive activities in contextual mathematical problem solving," *International Journal of Evaluation and Research in Education*, vol. 14, no. 1, pp. 229–239, 2025.
[32] H. MacGillivray, "Getting the foundations right," *Statistical Journal of the IAOS*, vol. 37, no. 3, pp. 669–676, 2021
[33] L. Purnaamasari and W. Setiawan, "Mathematical problem-solving ability of junior high school students in SPLDV material," *Journal of Medives*, vol. 3, no. 2, pp. 207–215, 2019.
[34] A. N. Aljura *et al.*, "Understanding high school students' errors in solving mathematics problems: A phenomenological research," *IJOLAE*, vol. 7, no. 2, pp. 154–178, 2025.
[35] A. M. Wibowo, M. N. Isnazuharoh, and N. Arfinanti, "Analysis of students' mathematical problem-solving abilities reviewed from metacognition," *De Fermat*, vol. 8, no. 1, pp. 334–347, 2025.
[36] R. Widiyasari, "Metacognition patterns of the students in solving mathematical problems," *Al-Jabar*, vol. 14, no. 2, pp. 449–465, 2023.
[37] R. Amalia and H. Susanto, "Mathematical problem solving and reflection ability," *Journal of Mathematics Education*, vol. 17, no. 2, pp. 145–158, 2023.
[38] A. S. Sa'adah *et al.*, "Analysis of mathematical problem-solving ability of grade XII students," *JKPM*, vol. 10, no. 1, pp. 99–112, 2024.
[39] A. Maharani and M. Misni, "Students' metacognizance in solving mathematical problems," *Histogram*, vol. 7, no. 1, pp. 442–451, 2023.
[40] A. D. Safitri *et al.*, "Analysis of students' mathematical problem-solving strategies," *Journal of Mathematical Window*, vol. 3, no. 1, pp. 7–16, 2025.
[41] M. Lunemo, D. Kaunang, and V. E. Regar, "Analysis of learner errors in SPLDV," *De Fermat*, vol. 8, no. 1, pp. 306–311, 2025.
[42] A. D. Dena, G. A. M. A. Putri, and P. S. Noviantari, "Analysis of student errors based on the Newman procedure," *Journal of Mathematics Learning and Development*, vol. 5, no. 2, pp. 211–219, 2025.
[43] R. A. Saputra, S. K. Nisa, and C. Pramesti, "Analysis of student errors on trigonometric material," *Polynomial* Analysis, vol. 4, no. 3, pp. 747–759, 2025.

[44] M. Zulyanty and A. Mardia, "Do students' errors still occur in mathematical word problem-solving?," *Al-Jabar*, vol. 13, no. 2, pp. 343–353, 2022.
[45] S. N. E. Zalfa and N. D. Rahmawati, "Analysis of student errors in statistical story problems," *Cartesian*, vol. 4, no. 1, pp. 42–51, 2024.
[46] S. Rosehana and H. Haerudin, "Students' mistakes in solving PISA problems," *Didactical Mathematics*, vol. 5, no. 2, pp. 461–470, 2023.
[47] R. I. I. Putri, Zulkardi, and Y. Hartono, "Contextual statistical problem solving," *Journal on Mathematics Education*, vol. 12, no. 3, pp. 389–404, 2021.
[48] S. R. S. Gunawan, J. A. Dahlan, and Darhim, "Concept understanding ability," *Al-Jabar*, vol. 16, no. 1, pp. 337–351, 2025.
[49] L. Mustofiyah *et al.*, "The effectiveness of problem-based statistical learning," *Pendas*, vol. 9, no. 4, pp. 250–264, 2024.
[50] K. Nisa and S. Hadi, "Analysis of students' errors in statistical problem solving," *Journal on Mathematics Education*, vol. 13, no. 1, pp. 87–100, 2022.
[51] D. Rahmawati and S. Sutiarso, "Students' difficulties in statistics," *Mosharafa*, vol. 9, no. 3, pp. 465–476, 2020.
[52] D. O. Amelia, A. Rosyadi, and A. In'am, "Mathematical problem-solving abilities with a metacognitive approach," *JPM*, vol. 11, no. 1, pp. 1–12, 2025.
[53] A. Wijaya, M. van den Heuvel-Panhuizen, and M. Doorman, "Difficulties in mathematical problem solving," *International Journal of Instruction*, vol. 12, no. 2, pp. 345–358, 2019
[54] P. Putra, B. Y. G. Fitri, A. N. Rahman, and N. T. Rosita, "Problem based learning assisted by Geogebra: Improving students mathematical problem solving abilities," Journal of Mathematics Instruction, Social Research and Opini, vol. 5. No. 1, pp. 557-568, 2026