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ANALYSIS OF STUDENTS' PROBLEM-SOLVING ABILITIES BASED ON COGNITIVE STYLE

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Abstract

This research departs from the problem that students do not have adequate mathematical ability to solve complex problems. This study aims to investigate students' mathematical problem-solving skills based on cognitive styles and identify the difficulties students face in solving problems. The research method used was an explanatory sequential mixture conducted at SDN Ncera, and the research subjects were selected using purposive sampling. The test instruments used are MFFT, description test, and interview. Data analysis uses quantitative descriptive analysis and qualitative descriptive analysis. The results showed that 1) grade V students of SDN Ncera with impulsive cognitive styles were more than students with reflective cognitive styles in mathematical problem-solving skills. Impulsive students tend to be rushed and less check their answers, resulting in incorrect solutions, while reflective students provide more accurate solutions even if it takes longer. 2) The results of the identification of students' difficulties in solving problems showed that students with a reflective cognitive style already understood information formulas and could solve problems related to the area of the parallelogram. However, he did not re-examine his work and conclude the results of his work. Meanwhile, students with impulsive cognitive styles showed that students experienced difficulties, especially in the steps of implementing the plan and checking the final results. Students make mistakes in calculations because they do not spend enough time and are not thorough.

Keywords: difficulty learning, impulsive cognitive style, problem-solving, reflective cognitive style

Abstrak

Penelitian ini bertolak dari masalah siswa belum memiliki kemampuan matematis yang memadai dalam memecahkan masalah kompleks. Penelitian ini bertujuan untuk menyelidiki kemampuan pemecahan masalah matematis siswa berdasarkan gaya kognitif, serta mengidentifikasi kesulitan yang dihadapi siswa dalam memecahkan masalah. Metode penelitian yang digunakan adalah campuran *sekuensial eksplanatori*, dilakukan di SDN Ncera dengan subjek penelitian yang dipilih menggunakan *purposive sampling*. Instrumen tes yang digunakan adalah MFFT, tes uraian, dan wawancara. Analisis data menggunakan analisis deskriptif kuantitatif dan deskriptif kualitatif. Hasil penelitian menunjukkan bahwa 1) siswa kelas V SDN Ncera dengan gaya kognitif impulsif lebih banyak daripada siswa dengan gaya kognitif reflektif dalam kemampuan pemecahan masalah matematika. Siswa impulsif cenderung terburu-buru dan kurang memeriksa jawaban mereka, mengakibatkan solusi yang salah, sedangkan siswa reflektif memberikan solusi yang lebih akurat meski memerlukan waktu lebih lama. 2) Hasil identifikasi kesulitan siswa dalam pemecahan masalah menunjukkan bahwa pada siswa dengan gaya kognitif reflektif sudah memahami informasi, rumus, dan mampu menyelesaikan soal terkait luas jajar genjang. Namun, tidak memeriksa kembali pekerjaannya dan mengambil kesimpulan terhadap hasil pekerjaan. Sedangkan pada siswa dengan gaya kognitif impulsif menunjukkan bahwa siswa mengalami kesulitan terutama pada langkah pelaksanaan rencana dan pengecekan hasil akhir. Siswa melakukan kesalahan dalam perhitungan karena kurang menghabiskan waktu yang cukup dan kurang teliti.

Kata kunci: kesulitan belajar, gaya kognitif impulsif, pemecahan masalah, gaya kognitif reflektif

INTRODUCTION

Mathematical problem-solving skills have become an essential aspect of human life. Problem-solving ability refers to thinking critically, making decisions, and applying appropriate strategies to solve problems effectively (Choudhary, 2015). Problem-solving

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skills are essential for individual success and for improving group dynamics and organizational outcomes, as students can solve problems collaboratively (Karla et al., 2022)

However, the 2022 PISA report shows that students have not yet acquired the ability to model complex situations mathematically and to select, compare, and assess appropriate problem-solving strategies to overcome them (OECD, 2023). This difficulty was also found by Khabibah et al. (2018), who found that almost all students understand problems. However, there are still many students who are not able to use data effectively and connect their knowledge to solving problems. These difficulties are caused by students' negative assumptions about mathematics as a complex subject (Durasa et al., 2024).

From this problem, it is necessary to research and analyze students' abilities and difficulties in solving mathematical problems. This study explores students' skills and identifies students' difficulties in solving mathematical problems based on students' cognitive styles. Analysis and identification based on this cognitive style is fundamental because each student has a unique problem-solving method, thus impacting the time used. Based on time differences, cognitive styles include reflective cognitive styles and impulsive cognitive styles. Students who use reflective cognitive styles will spend more time investigating problems and finding possible solutions.

In contrast, students with impulsive cognitive styles quickly solve problems and do not spend long examining them (Rochika & Cintamulya, 2017). The same thing was also stated by Yuniasari and Zainuddin (2019): impulsive students can respond or answer a question quickly without paying too much attention to accuracy. Meanwhile, reflective students are students who respond slowly or answer a question by focusing more on the accuracy of the answer.

Several previous studies have also examined how to improve problem-solving skills from the perspective of cognitive style. The findings show that students with reflective cognitive styles tend to take longer to answer questions but are more thorough in their approach, meeting all indicators of mathematical problem-solving ability, including planning, monitoring, and solution evaluation (Hidayanto et al., 2022). Equivalent research was also conducted by Fatmala et al. (2022), which found that students with impulsive cognitive styles tend to face more difficulties in problem-solving than those with reflective cognitive styles. Other findings also suggest that reflective cognitive styles promote a thorough

problem-solving process, while impulsive cognitive styles focus on quick solutions without extensive planning or alternative considerations (Satriawan et al., 2018).

Some of the above studies have substantial differences with this study. This study focuses on identifying students' difficulties in solving problems based on students' cognitive styles with flat building materials in grade V elementary school students. This research is significant because the findings of this study can be used as a fundamental basis for educators in determining learning strategies in the classroom and an essential foundation for parents in accompanying students' independent learning strategies at home.

METHODS

This study uses an explanatory sequential mixed methods design. Pane et al. (2021) explained that this design analysis involves 2 (two) specific stages: The initial stage consists of collecting, examining, and utilizing findings from quantitative research to plan the next research stage, which is achieved through a qualitative approach. Data from quantitative analysis was used to identify interview participants. The first stage also determines which questions should be directed to the informant. The second stage is to interview the informant in more depth based on the results of the student's answers on the description test sheet.

This research was conducted at Ncera State Elementary School (SDN), Belo District, Bima Regency, West Nusa Tenggara Province. The research subject was determined using purposive sampling: all 16 students in class V who learned about *Luas Bangun Datar* material. This technique is instrumental in research to deeply understand a particular problem (Lee & Landers, 2022). Determining the subject of this study involves several steps, including determining the selection criteria, identifying potential participants, and ensuring that the sample is diverse enough to capture different perspectives while still being manageable (Denieffe, 2020; Ames et al., 2019).

This study uses the MFFT (Matching Familiar Figures Test) test instrument with as many as 15 questions, description test instruments, and non-test instruments through interviews. The description test instrument applied is: "*A parallelogram with a base length of 32 cm and a height of 9 cm. What is the area of the parallelogram*?". At the same time, some interview questions can be presented in Table 1.

Table 1. Interview Questions

Problem Solving stages	Interview Questions
Understanding the Problem	What is known and asked about this issue?
Plan an Action	Has any additional information been found but not disclosed?
Problem-Solving	▪ Did You experience solving problems? If there is one, it can be mentioned! ▪ Is there anything that confuses you? Is the problem difficult to understand or difficult to find a solution? ▪ What did you do first to solve the problem? ▪ Is there any other way you know besides the way you wrote? If there is any, please mention it! ▪ Describe the procedure you used to complete the test questions!
Double-check	What is the conclusion of your answer earlier?

This instrument has passed the validity of the content through qualitative assessments by experts. In addition, data collection techniques using MFFT Sheets were used to identify students' cognitive styles and mathematical problem-solving abilities. Test sheets are used to look, and interview sheets are used to identify students' problem-solving difficulties. Data analysis uses quantitative descriptive analysis to determine students' problem-solving ability and qualitative descriptive to identify students' problem-solving challenges. The qualitative descriptive approach provides a comprehensive summary of events to generate practical insights for application in practice settings with stages of reduction, presentation, and conclusion drawing (Tamayo et al., 2020).

The procedures for this research are as follows: 1) collecting data from the results of the MFFT test and the student description test that has been carried out; 2) analyzing the data to determine groups of students with reflective cognitive styles and groups of students with impulsive cognitive styles; and 3) select which respondents are suitable as informants to collect qualitative data through interviews. The interview results are used to provide a more meaningful explanation departing from the results of the student description test. This study selected respondents as informants departing from the MFFT test results.

RESULTS AND DISCUSSION

Analysis of Students' Problem-Solving Ability Based on Cognitive Style

The results of the study show that the provisions of the Matching Familiar Figures Test (MFFT) test of 15 questions must be completed by students within 20 minutes. Students who have a reflective cognitive style are those who use more than 10 minutes (t > 10) to

answer and answer more than eight questions correctly (> 8). Meanwhile, students who have an impulsive cognitive style, namely students who spend less than 10 minutes (t < 10) and answer eight questions or less correctly (≤ 8). Based on the above provisions, the results of this study can be presented in Figure 1.

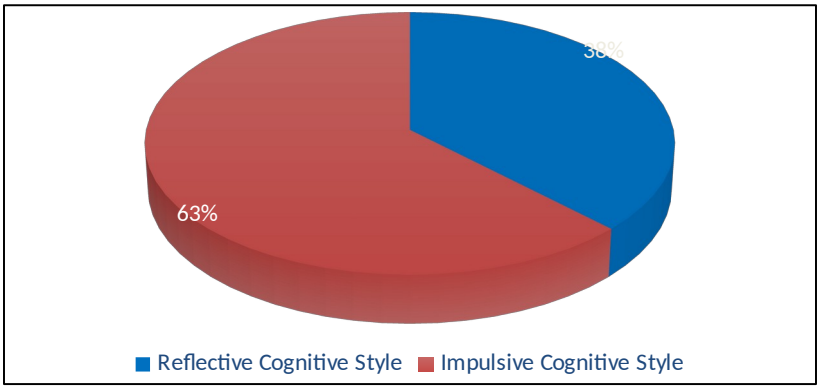

Figure 1 Students' Mathematical Problem-Solving Ability Based on Cognitive Style

Figure 1 shows that the mathematical problem-solving ability of students with impulsive cognitive style (63%) is more than that of mathematical problem-solving ability with reflective cognitive style (38%) in grade V students of SDN Ncera, which means that grade V students of SDN Ncera are more likely to be in a hurry to solve problems. This difficulty can be caused by students not fully understanding the problem, failing to plan the planning strategy adequately, and even not double-checking the students' answers, resulting in the wrong solution. In contrast, students with a reflective cognitive style, reflective students take longer to solve problems but tend to provide more accurate solutions (Widyastuti & Jusra, 2022).

This study's findings differ from those of Jamil et al. (2022), where there are more students with reflective styles than students with impulsive styles. This difference is, of course, caused by other factors that affect students' cognitive styles, such as 1) personality maturity factors and the level of ability of high school and elementary school students. Vranic et al. (2021) explained that cognitive styles, influenced by personality traits and the need for cognition, vary with age and impact how individuals process information and solve problems. 2) the application of teaching methods that may be more supportive or appropriate to impulsive students, 3) a learning environment that allows impulsive students

to freely try and learn from mistakes so that it takes time. In addition, Grigoriev et al. (2022) also found that internet addiction factors tend to show students' impulsive cognitive styles.

The findings of this study provide implications that teachers can explore the potential benefits of combining teaching strategies that accommodate both cognitive styles—for example, facilitating stimulating and diverse activities for impulsive students while providing time and space for reflective students to analyze and find solutions. In addition, continuous assessment of effective teaching and adjustment methods can improve problem-solving skills for all students, regardless of the student's cognitive style.

Identify Students' Problem-Solving Difficulties Based on Cognitive Style

The large number of students who have mathematical problem-solving skills with impulsive cognitive styles requires further analysis. The goal is to identify students' problem-solving difficulties based on their cognitive style. The students' cognitive styles in this study can be grouped by coding, as presented in Table 2.

Table 1. Grouping of Research Subjects

Student Name	Codename	Cognitive Style
TSK	SR	Reflective
FTR	SI	Impulsive

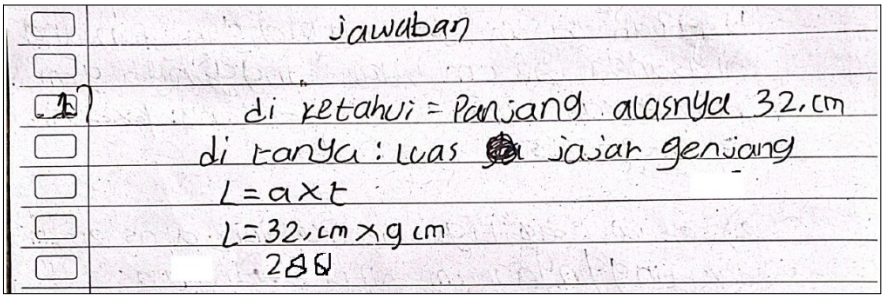

Figure 2. Results of Student Description Test with Reflective Cognitive Style

Figure 2 above shows that in SR 1) students already understand the information provided and what to look for, namely the area of the parallelogram; 2) students already know the correct formula to calculate the area of the parallelogram; 3) students can solve the problem of 288 cm^2 and 4) However, the students do not re-examine their work and draw conclusions about the results of their work. This finding aligns with the interview results, which showed that SR students understand the given problem, the formula used, and the solution strategy. SR students also confirmed that they were confident in the results of their work but forgot to conclude.

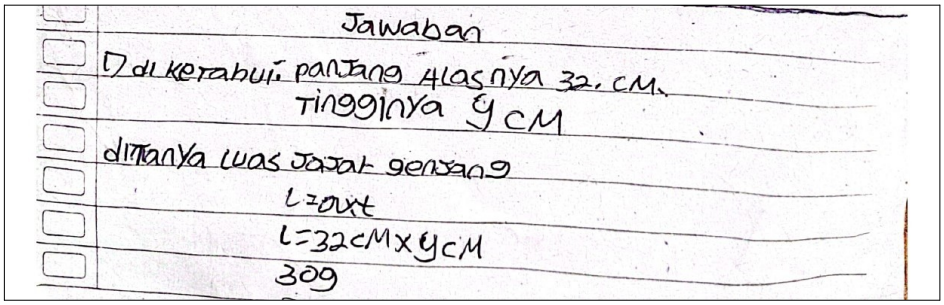

Figure 3. Results of the Student Description Test with Impulsive Cognitive Style

From Figure 3 above, it can be concluded that the main difficulty of students seems to be in implementing the plan and checking the final result. Although they understood the problem and planned well, there was an error in the calculation (32 cm × 9 cm should have been 288 cm^2 instead of 309 cm^2). In addition, students do not record the double-checking steps, which should help them find the error. This finding is supported by the results of interviews, which show that the main difficulties faced by students in solving the problem of parallelogram area lie in the implementation stage of the plan, especially in doing stacked multiplication. There is a lack of habit in checking the calculation results. Teachers should be given more practice in basic mathematical operations and the habit of double-checking answers to overcome this problem.

Students With Reflective Cognitive Styles

Theoretically, a reflective cognitive style is characterized by students' tendency to be cautious, consider each step thoroughly before taking action, and evaluate and double-check the results of their work (Chen, 2021). Students with a reflective cognitive style make more accurate decisions despite requiring more time (Naza & Syamsuri, 2022). This cognitive style significantly affects how students approach and solve math problems. For example, students with a reflective cognitive style demonstrate a systematic and structured approach to problem-solving, ensure a good understanding of the problem, plan solutions carefully, and carefully implement and review problem-solving steps that lead to correct answers (Dewi & Nugraheni, 2023; Wily et al., 2024; Yusrina et al., 2023). Additionally, reflective students use mathematical symbols and visual representations, such as diagrams,

to support their problem-solving process, further aiding their careful and detailed approach (Rahayu et al., 2023).

In this context, the finding that SR students forget to recheck their work suggests that although reflective tendencies exist, the habit of reflection has not been fully implemented. This result is in line with the research of Faisal et al. (2023) that reflective cognitive styles do not always guarantee perfect performance. Reflective students may still struggle with certain aspects of mathematical reasoning (Chusnudhin et al., 2023).

On that basis, several things must be considered in learning: *First*, strengthening the habit of reflection. Provide additional guidance on the importance of result verification to enhance students' habit of reflection in each step of problem-solving. *Second*, students perform recheck exercises. Provides exercises emphasizing the importance of double-checking the results of calculations to ensure accuracy and thoroughness. *Third*, the metacognitive approach. Please encourage students to develop metacognitive awareness, which is awareness of their thought processes, to be more careful in evaluating their work.

Students with impulsive cognitive styles

Theoretically, impulsive cognitive style is characterized by students' tendency to respond to tasks quickly, often without thoroughly considering the available information or double-checking their answers (Chen, 2021). Students with impulsive cognitive styles tend to make more mistakes and exhibit less productive cognitive activity than those with reflective cognitive styles (Grigoriev et al., 2022). For example, in solving mathematical problems, impulsive students often rush through the stages of understanding problems, planning, and implementing solutions, which leads to frequent errors in calculation and formula application (Kurniawati et al., 2022; Rohadatul Aisy et al., 2022).

Empirically, the image of students with impulsive cognitive styles can be crisscrossed as follows: 1) Students with impulsive cognitive styles may often be hasty in performing calculations, as shown in interviews that students struggle with the multiplication of 32×9, resulting in 309 calculation errors. This problem reflects impulsive behaviour where students do not spend enough time ensuring their correct calculations. 2) Students with impulsive cognitive styles are also usually less in the habit of double-checking their answers. This finding aligns with the research results of Hidayanto et al. (2022), which show that this

haste is evident in their inability to double-check their work or draw accurate conclusions, as they tend to ignore details and make careless mistakes.

The following strategies can be applied in learning to help students be impulsive: *First*, basic math operations exercises. Provide regular practice in basic operations to strengthen calculation skills and reduce errors due to haste. This approach helps students improve their calculation skills and reduce errors caused by haste, as impulsive students often make mistakes due to a lack of attention and self-control necessary to correct possible errors (Torto-Seidu et al., 2021). *Second*, the habit of rechecking is developed. Teaching and encouraging the habit of always double-checking the calculation results. This encouragement can be done by providing examples and structured exercises for teaching, and encouraging students to double-check their results can be achieved through exercises and structured examples, which are beneficial in reducing impulsive errors —t*hird*, metacognitive techniques. Encouraging students to think about their thought processes (metacognition) can help them become more aware of the importance of rigour and double-checking.

CONCLUSION

The findings of this study show that grade V students of SDN Ncera have more impulsive cognitive styles than students with reflective cognitive styles in mathematical problem-solving skills. Impulsive students tend to be rushed and less check their answers, resulting in incorrect solutions, while reflective students provide more accurate solutions even if it takes longer.

The results of identifying students' difficulties in solving problems showed that students with a reflective cognitive style already understood information formulas and could solve problems related to the area of the parallelogram. However, the findings showed that SR students did not re-examine their work and draw conclusions against the work results. Meanwhile, students with impulsive cognitive styles showed that students experienced difficulties, especially in the steps of implementing the plan and checking the final results. Students make mistakes in calculations because they do not spend enough time and are not thorough.

This study has limitations in the use of research samples. Also, it does not consider other external factors that may affect students' problem-solving abilities, such as family support, social environment, and access to additional learning resources. Therefore, the limitations of this study can be a follow-up study for future researchers.

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