Analysis of mathematical problem solving ability in solving realistic reasoning (mnr) type of mathematical problems reviewed from brain dominance

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Abstract
This study aims to analyze the mathematical problem solving ability of high school students in solving the type of Realistic Mathematical Education (RME) problems in terms of brain dominance. This research uses qualitative research with descriptive research methods. The subjects in the study were high school class XI students in one of the schools in Tasikmalaya Regency. The subject selection technique used purposive sampling, the data was collected by giving a brain dominance questionnaire and working on mathematical problem solving ability test questions with Realistic Mathematics Nalaria problem types. The results showed that students with left brain dominance had good mathematical problem solving ability in solving Realistic Mathematical Education (RME) problem types and students with right brain dominance had poor mathematical problem solving ability in solving Realistic Mathematical Education (RME) problem types.
Keywords: Mathematical Problem Solving Ability; Mathematics Nalaria Realistic (MNR); Brain Dominance; High School Learners

Abstrak
Penelitian ini bertujuan untuk menganalisis kemampuan pemecahan masalah matematis peserta didik SMA dalam menyelesaikan tipe soal Matematika Nalaria Realistik (MNR) ditinjau dari dominasi otak. Penelitian ini menggunakan penelitian kualitatif dengan metode penelitian deskriptif. Subjek dalam penelitian adalah peserta didik kelas XI SMA di salah satu sekolah di Kabupaten Tasikmalaya. Teknik pemilihan subjek menggunakan purposive sampling, data dikumpulkan dengan pemberian angket dominasi otak dan pengerjaan soal tes kemampuan pemecahan masalah matematis dengan tipe soal Matematika Nalaria Realistik. Hasil penelitian menunjukkan bahwa peserta didik dengan dominasi otak kiri memiliki kemampuan pemecahan masalah matematis yang baik dalam menyelesaikan tipe soal Matematika Nalaria Realistik (MNR) dan peserta didik dengan dominasi otak kanan memiliki kemampuan pemecahan masalah matematis yang kurang baik dalam menyelesaikan tipe soal Matematika Nalaria Realistik (MNR).
Kata Kunci: Kemampuan Pemecahan Masalah Matematika; Matematika Nalaria Realistik (MNR); Dominasi Otak; Pembelajar Sekolah Menengah Atas

Introduction

Mathematics is one of the fundamental sciences that plays a crucial role in human life. This discipline is not only related to numbers and calculations, but also encompasses patterns, structures, and logical relationships that can be applied in various fields such as science, technology, and economics. In the context of education, mathematics is not only about understanding basic concepts and mastering computational techniques (Minangkabau et al., 2024), but also holds a strategic position as a subject. Bernard (2015) stated that the goal of mathematics education is to equip students with the ability to think logically, analytically, and systematically, enabling them to make appropriate decisions in complex situations. Mathematics helps in understanding the world through reasoning and problem-solving processes, and trains critical thinking skills.

Problem-solving ability is one of the essential mathematical skills that students need to learn and apply. This skill includes the ability to understand problems, which are often presented as word problems, formulate mathematical models from the given problems, devise a solution plan, and handle non-routine questions (Zahuroh & Khotimah, 2021). According to Polya in Mairing (2018), the indicators of mathematical problem-solving skills include understanding the problem, planning a solution, solving the problem, and reviewing the obtained result. However, students' mathematical problem-solving abilities in Indonesia still require special attention. Based on the results of two international studies, namely the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA), Indonesia's performance in mathematical problem-solving remains low and below international standards (Hanggara et al., 2022).

The low level of students' mathematical problem-solving abilities is closely related to the mathematics learning process (Arofah & Noordyana, 2021; Muslihah & Suryaningrat, 2021; Szabo et al., 2020). So far, mathematics instruction has tended to lack emphasis on problem-solving aspects (Chen et al., 2024). Students are more often taught to memorize mathematical concepts, which limits their ability to solve problems (Damianti & Afriansyah, 2022; Verschaffel et al., 2020). Ideally, mathematics learning should begin with problems that are relevant to everyday life (Sriwahyuni & Maryati, 2022), as these real-life issues can form the basis of students' knowledge construction (Latifah & Luritawaty, 2020). One approach that has been gaining traction in mathematics education is Realistic Numerical Mathematics (Matematika Nalaria Realistik/MNR). This approach is designed to help students connect mathematical concepts to real-life situations, enabling them to solve problems in a more contextual and meaningful way. MNR does not only emphasize computational procedures but also focuses on conceptual understanding and the development of mathematical reasoning and logic. Realistic Numerical Mathematics is a concept of mathematics that emphasizes the use of reasoning in learning mathematics (Setyowati et al., 2021).

In addition to learning approaches, brain dominance also plays a significant role in mathematics education. The human brain is divided into two hemispheres, namely the left and right brain, each with different functions. According to Kadir (2010), the left brain has the capacity for logical, linear, rational, systematic, and detail-oriented thinking, as well as language (speaking, reading, writing) and analytical skills. In contrast, the right brain is associated with creativity, art, color, and characteristics such as intuitive, visual, holistic, spatial, irregular, and abstract thinking (Shichida, 2013). In every human activity, both hemispheres of the brain work together, but individuals may have a dominant side—either the left or the right brain. As stated by Pedak and Maslichan in Kadir (2010), although both hemispheres serve different functions, individuals tend to use the dominant hemisphere more frequently in dealing with life and work challenges. This brain dominance preference influences how students process information and solve mathematical problems (Marwah et al., 2024). Students with left-brain dominance tend to excel in analytical and computational problems, while those with right-brain dominance are better at solving problems that require creative thinking.

Considering the intersection of these three aspects mathematical problem-solving skills, Realistic Numerical Mathematics (MNR) problems that are contextualized with real-life scenarios, and brain dominance with its distinct functions it becomes an intriguing topic for deeper investigation. Hence, a study titled "An Analysis of Senior High School Students' Mathematical Problem-Solving Skills in Solving Realistic Numerical Mathematics (MNR) Problems Viewed from Brain Dominance" is proposed.

Method

This type of research is qualitative with a descriptive research method. Qualitative research is a method based on post-positivist or interpretative philosophy, which is applied to examine objects in natural settings (Sugiyono, 2022). The subjects of this research are focused on Grade XI senior high school students in one of the schools in Tasikmalaya Regency. The students were given a brain dominance questionnaire to determine the research subjects. The selection of subjects was carried out using purposive sampling, with the consideration that the selected subjects represented each category of brain dominance and were able to provide complete and clear information as expected by the researcher.

The data collection techniques used include administering a brain dominance questionnaire to categorize students into either left-brain or right-brain dominance groups. Then, to assess students' mathematical problem-solving ability, a test with Realistic Nalaria Mathematics (MNR) type questions was given. Furthermore, to strengthen the data, the researcher conducted interviews with the research subjects. The data obtained during the interviews were recorded using a voice recorder. The data in this study were collected

through brain dominance questionnaires, mathematical problem-solving ability tests using MNR-type questions, and interviews.

Result

This research was conducted on 38 Grade XI senior high school students. Based on the results of the brain dominance questionnaire, 4 students were selected as the sample from the 38 participants. The sample consisted of 2 students with left-brain dominance and 2 students with right-brain dominance, who were further examined in the study. Based on the analysis of the students' answers and the interviews conducted with the four research subjects, the following results were obtained:

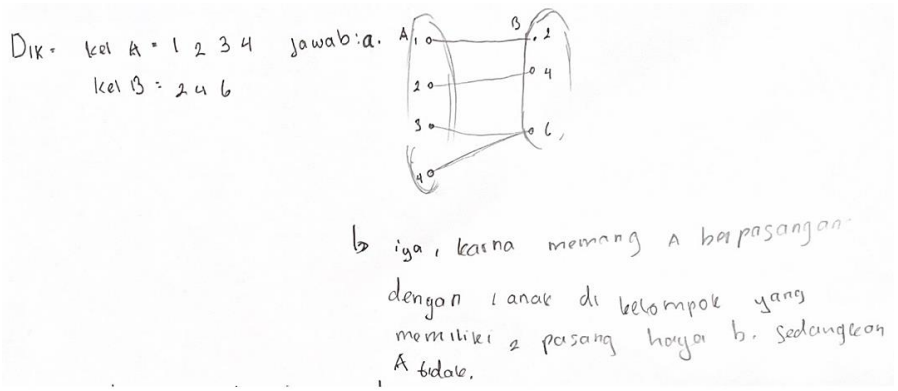

Figure 1. Analysis Result of Subject 1

Figure 1 show that Subject 1, who has left-brain dominance, was able to solve the problem well and thoroughly, fulfilling all indicators of mathematical problem-solving ability. Subject 1 was able to understand the problem accurately, plan the solution appropriately, solve the problem correctly, and recheck the results effectively. This indicates that Subject 1 has a good understanding of mathematical concepts and is capable of applying them in more complex situations.

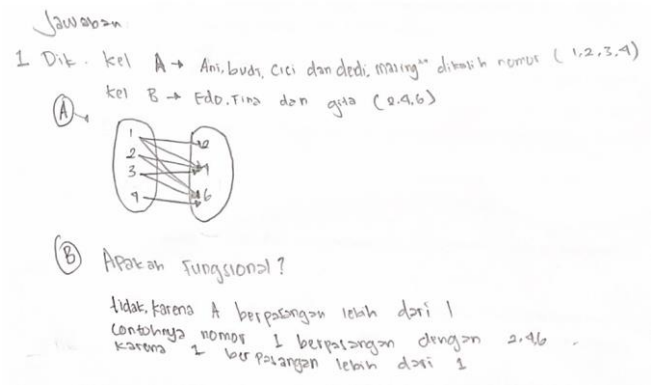

Figure 2. Analysis Result of Subject 2

Figure 2 show that Subject 2, who has left-brain dominance, was able to solve the problem well and thoroughly, fulfilling all indicators of mathematical problem-solving ability. Subject 2 was able to understand the problem accurately, plan the solution appropriately, solve the problem correctly, and effectively review the obtained results. This indicates that Subject 2 has a strong understanding of mathematical concepts and is capable of applying them in more complex situations.

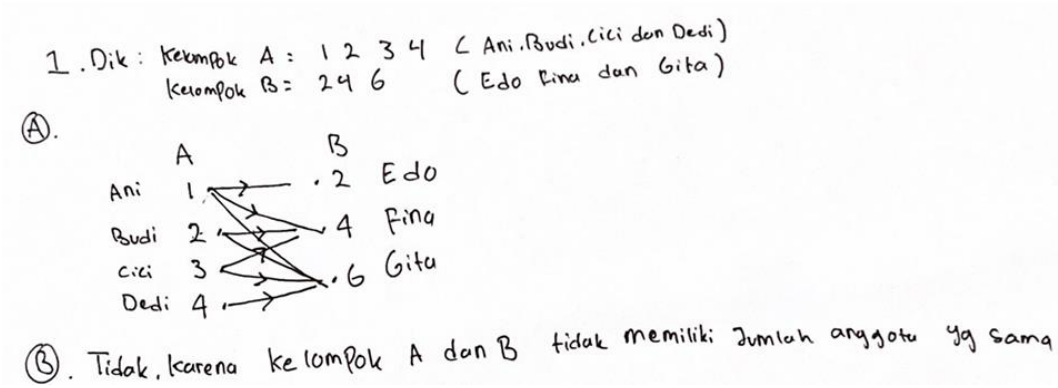

Figure 3. Analysis Result of Subject 3

Figure 3 show that Subject 3, who has right-brain dominance, was unable to solve the problem well and thoroughly, and only fulfilled some indicators of mathematical problem-solving ability. Subject 3 was able to understand the problem accurately, but planned the solution less accurately, solved the problem incorrectly, and reviewed the results inaccurately. This indicates that Subject 3 has a limited understanding of mathematical concepts and is unable to apply them in more complex situations.

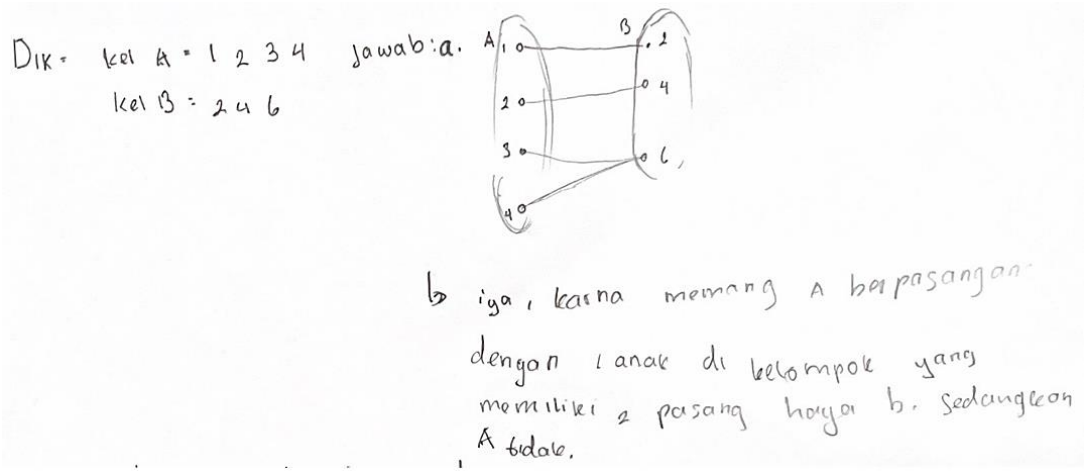

Figure 4. Analysis Result of Subject 4

The analysis results show that Subject 4, who has right-brain dominance, was unable to solve the problems well and thoroughly, and only met several indicators of mathematical problem-solving ability. Subject 4 showed an inaccurate understanding of the problem, planned the solution less accurately, solved the problem incorrectly, and

reviewed the results inaccurately. This indicates that Subject 4 has a limited understanding of mathematical concepts and is unable to apply them in more complex situations. Based on the analysis of the four subjects above, it was found that subjects with left-brain dominance demonstrated good mathematical problem-solving abilities, while those with right-brain dominance showed lower performance in this area. Interview results with the teacher revealed that Realistic Numerical Mathematics (MNR) type questions are rarely given during the learning process. Teachers tend to focus more on conventional problems, which results in students being less accustomed to questions that require critical thinking and the application of real-life concepts.

Discussion

The results of this study show a difference in mathematical problem-solving abilities between students with left brain dominance and those with right brain dominance. The subjects with left brain dominance (Subject 1 and Subject 2) were able to meet all the indicators of mathematical problem-solving abilities, namely: (1) accurately understanding the problem, (2) planning the solution systematically, (3) solving the problem correctly, and (4) verifying the results obtained. This indicates that students with left brain dominance tend to think logically, analytically, and structurally, which is in line with the characteristics of mathematical thinking (Kadir, 2010; Shichida, 2013). This finding also aligns with previous research showing that students with left brain dominance excel in solving problems that require analytical and logical thinking (Marwah et al., 2024).

In contrast, students with right brain dominance (Subject 3 and Subject 4) showed suboptimal performance in solving the Realistic Mathematics Education (MNR) problems. These students were only able to meet some of the problem-solving indicators, and in some aspects, such as planning and solving the problem, they made errors. This finding is consistent with brain dominance theory, which suggests that the right brain is more dominant in creativity, imagination, and intuition but less systematic in solving logical and numerical problems (Kadir, 2010; Shichida, 2013). Research by Marwah et al. (2024) also indicates that students with right brain dominance excel in tasks involving creativity and intuition but tend to struggle with problems that require systematic planning and analysis.

From the interview with the teacher, it was revealed that students are not accustomed to facing MNR-type problems because the learning process has focused more on conventional problems, which are procedural in nature. This indicates that the learning environment, which does not support the development of critical thinking and the application of real-world concepts, influences students' abilities, especially those who tend to use intuitive thinking (right brain dominant) (Verschaffel et al., 2020). This finding supports previous research that shows that a learning approach that does not provide room for critical thinking can limit the development of students' problem-solving abilities (Chen et al., 2024).

The implications of these findings suggest the importance of varying the types of problems during the learning process. MNR-type problems, which are contextual and require critical thinking, should be consistently included in learning to develop students' problem-solving skills holistically, regardless of their brain dominance (Setyowati et al., 2021). This way, students can become accustomed to linking mathematical concepts with real-world situations and be helped in developing more flexible problem-solving strategies. Furthermore, teachers need to be aware of the different thinking styles of each individual. Understanding students' brain dominance can help teachers design more adaptive and inclusive learning approaches, which can optimize the potential of all students in mathematics learning (Szabo et al., 2020; Hanggara et al., 2022).

Conclusion

Based on the results of this study, it can be concluded that students with left brain dominance exhibit better mathematical problem-solving abilities compared to those with right brain dominance. The students with left brain dominance were able to meet all the indicators of problem-solving skills, including understanding the problem, planning the solution, solving the problem correctly, and verifying their results. On the other hand, students with right brain dominance showed difficulties in solving the problems systematically, and their solutions were less accurate, indicating a lack of deep understanding of mathematical concepts.

The findings suggest that the type of learning provided, particularly the use of Realistic Mathematics Education (MNR) problems, plays a significant role in developing students' problem-solving skills. The focus on conventional problem types in the classroom may limit students' ability to engage in critical thinking and apply mathematical concepts to real-world situations. Therefore, it is recommended that teachers incorporate a variety of problem types, especially MNR problems, into the learning process to support the development of mathematical problem-solving skills in all students, regardless of their brain dominance. Moreover, recognizing students' individual differences in brain dominance can help teachers design more personalized and effective teaching strategies. Understanding these differences may enhance the overall learning experience and improve students' mathematical abilities.

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Conflict of Interest

The researcher declares that there is no conflict of interest regarding the publication of this study. The research was conducted with full objectivity and integrity, and the results presented are based on impartial data and findings. No financial or personal relationships could have influenced the outcomes of the research.

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