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How is Math Problem-Solving Skills in Terms of Learning Style?

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ABSTRACT

Learning style is one of the critical factors influencing the development of problem-solving skills. This study aims to examine mathematical problem-solving abilities in relation to students' learning styles. The research involved 32 eleventh-grade students from SMAN Banyuasin III. Data were collected through problem-solving tests and learning style questionnaires. A qualitative analysis was conducted to evaluate the students' problem-solving skills based on their learning styles. The findings revealed significant variations in problem-solving skills among the different learning style groups. Students with a visual learning style performed better on geometry problem-solving tasks, particularly when aided by visual elements. Conversely, auditory learners faced difficulties in comprehending the problems and often required additional verbal explanations from the teacher. Kinesthetic learners, however, struggled the most, exhibiting very low problem-solving skills. These results underscore the importance of tailoring instructional strategies to accommodate diverse learning styles.

Kata kunci : problem-solving skills, learning style

ABSTRAK

Salah satu faktor penting yang memengaruhi peningkatan kemampuan pemecahan masalah adalah gaya belajar siswa. Penelitian ini bertujuan untuk menganalisis kemampuan pemecahan masalah matematika berdasarkan gaya belajar siswa. Penelitian melibatkan 32 siswa kelas XI di SMAN Banyuasin III. Data dikumpulkan melalui tes pemecahan masalah dan angket gaya belajar. Analisis kualitatif dilakukan untuk mengevaluasi kemampuan pemecahan masalah siswa sesuai dengan gaya belajar mereka. Hasil penelitian menunjukkan adanya variasi signifikan dalam kemampuann pemecahan masalah di antara kelompok gaya belajar yang berbeda. Siswa dengan gaya belajar visual menunjukkan kinerja yang lebih baik pada tugas pemecahan masalah geometri, terutama dengan bantuan elemen visual. Sebaliknya, siswa dengan gaya belajar auditori kesulitan memahami soal dan sering membutuhkan penjelasan tambahan dari guru secara lisan. Siswa dengan gaya belajar kinestetik menghadapi tantangan terbesar, dengan kemampuan pemecahan masalah yang sangat rendah. Temuan ini menekankan pentingnya menyesuaikan strategi pengajaran untuk mengakomodasi beragam gaya belajar.

Keywords : kemampuan pemecahan masalah, gaya belajar

INTRODUCTION

The rapid technological advancements of the modern era demand a diverse set of skills tailored to evolving needs. Mathematics plays a pivotal role in both technological development and daily life, serving as a cornerstone for progress. In the

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21st century, the importance of mathematical problem-solving skills has grown significantly. As the need for these skills expands, it becomes crucial to enhance and improve problem-solving capabilities to address the demands of today's rapidly evolving world (Radia et al., 2024).

Problem-solving skills are considered the foundation of the mathematics curriculum, as they enable students to think critically, reason logically, and develop the ability to solve real-life problems (Susanti & Hartono, 2019). In Indonesia, the independent curriculum, also known as *Kurikulum Merdeka*, emphasizes the importance of nurturing these skills to prepare students for the demands of an increasingly competitive and globalized world (Yustitia & Kusmaharti, 2024). This approach aligns with the broader educational goals of fostering independence, creativity, and resilience in students so that they are better equipped to adapt to dynamic challenges in various domains, including academics, careers, and daily life.

Polya (Polya, 2004) outlines four critical stages of problem-solving that serve as a systematic framework to tackle mathematical and other analytical problems. These stages are: understanding the problem, which involves identifying the key components and constraints; devising a solution plan, where strategies are formulated to solve the problem; executing the plan, which requires applying the chosen strategy; and reviewing the solution, which involves reflecting on the process and evaluating the accuracy and efficiency of the solution. These stages not only provide structure to problem-solving processes but also cultivate metacognitive skills, encouraging learners to monitor and adjust their thinking.

However, the level of problem-solving proficiency varies significantly among individuals due to differences in cognitive abilities, experience, and exposure to problem-solving tasks. While some individuals can navigate complex and challenging situations effectively, demonstrating persistence and creativity, others may struggle with identifying appropriate strategies or maintaining confidence when faced with setbacks (Dermawan et al., 2021). This disparity highlights the need for instructional approaches that provide targeted support, encourage collaborative problem-solving, and develop a growth mindset in learners. By addressing these differences, educators can foster an inclusive learning environment where all students can progressively enhance their problem-solving skills.

Success in problem-solving enables students to apply mathematical concepts to real-world scenarios (Khoirunnisya et al., 2024). Teachers play a crucial role in fostering students' engagement and encouraging active participation in solving posed problems. By providing step-by-step guidance, teachers help students identify and address challenges, equipping them with the skills needed to overcome obstacles (Habibi et al., 2020). To refine each student’s problem-solving abilities, it is essential to implement effective and appropriate teaching strategies (Setiawan et al., 2024). Such strategies not only address individual learning differences but also enhance students' understanding and retention of knowledge (Ridwan et al., 2016).

Effective problem-solving education requires teachers to acknowledge and accommodate individual differences among students. Several variables impact the development of these skills, including learning styles and cognitive habits (Ismet et al., 2021; Marlina & Aini, 2023;. Khoo et al., 2024). Learning style is one of the most important factors influencing how students approach learning (Jaleel & Thomas, 2019).

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Previous studies, such as those by Bhat (2014) and Juniati & Budayasa (2022), emphasize the significant influence of learning styles on students' problem-solving strategies. Consequently, it is essential for teachers to adapt their instructional methods to align with the learning styles of their students. Learning styles are commonly categorized into three types: 1) Visual, 2) Auditory, and 3) Kinesthetic. Visual learners excel when reasoning with graphs, diagrams, and pictures, while auditory learners benefit from understanding problems through listening. Kinesthetic learners, in contrast, acquire information more effectively through movement, touch, and interaction with their environment. These learners tend to thrive in practical settings, such as hands-on classes, problem-solving exercises, case studies, and demonstrations (Dantas & Cunha, 2020).

To achieve effective mathematics education, teachers must design instructional methods tailored to students' diverse learning styles (Rahayu et al., 2024). By recognizing and addressing these differences, teachers can foster greater student engagement and develop strategies that support academic success and enhance problem-solving abilities (Bhat, 2014).

Building on this foundation, several studies have specifically analyzed students' problem-solving skills across various mathematical topics. Results indicate that geometry consistently yields the lowest average scores in problem-solving performance (Hasna et al., 2022; Lutfiya et al., 2021). A key factor influencing this outcome is students' learning styles, which can provide valuable insights into improving problem-solving skills. This connection has led researchers to investigate how students' learning styles affect their mathematical problem-solving skills, particularly in difficult subjects such as geometry.

METHOD

This study aims to explore the relationship between mathematical problem-solving abilities and students' learning styles. The research involved 32 eleventh-grade students from a high school in Banyuasin Regency. Participants were selected through purposive random sampling, with one of the researchers serving as their teacher, facilitating deeper insights into the required data.

The problem-solving test consisted of two essay questions focusing on Geometry Transformation. These questions were modified from (Setiyowati et al., 2023), and validated by two mathematics education lecturers from Sriwijaya University to ensure reliability and content accuracy. The indicators for each stage of problem solving are as in Table 1.

Table 1. Stages of problem solving

No.	Stages of Problem Solving	Indicator
1	Understanding the Problem	Students can write or mention the information contained in the problem
2	Developing a Completion Plan	Students can make a problem solving plan
3	Implementing the Completion Plan	Students can make a solution using the predetermined strategy correctly
4	Rechecking Completion	Students can conclude and recheck their answers

To assess learning styles, students completed a questionnaire with 24 closed-ended questions. Their responses were used to categorize them into three groups: auditory, visual, or kinesthetic learners. Additionally, the questionnaire results

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provided insights into whether students exhibited left-brain or right-brain thinking tendencies.

RESULTS AND DISCUSSION

The students' mathematical problem-solving skills were assessed using Polya's four problem-solving indicators, as outlined in the methodology. The findings highlight the performance levels for each indicator, which are illustrated in Figure 1.

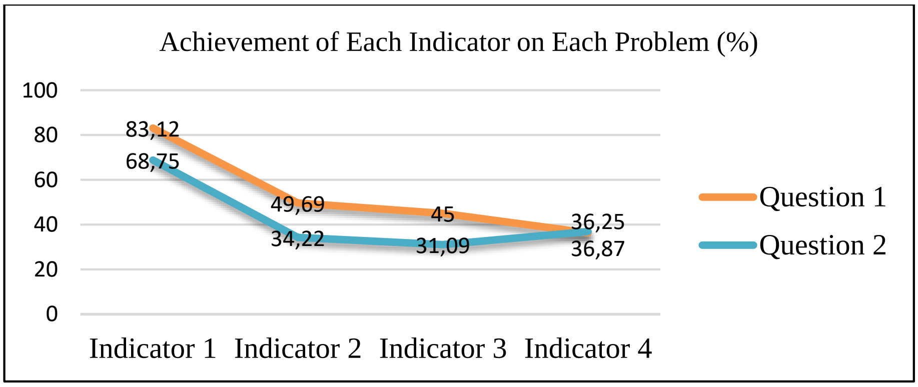

Figure 1. Diagram of problem-solving indicator achievement for each problem

Based on Figure 1, the average achievement gradually declines from the first to the fourth indicator. The highest percentage of achievement is observed in the first indicator, which involves understanding the problem. This indicates that more than 50% of students demonstrated a strong ability to comprehend and articulate the problem, providing a solid foundation for progressing to subsequent stages (Susanti & Hartono, 2019). The second indicator, developing a solution plan, showed lower achievement, with fewer than 50% of students able to effectively outline their approach to solving the given math problems. For the third indicator, implementing a solution using a predetermined strategy, the average achievement dropped further to 38.05%. The lowest performance was recorded in the fourth indicator, re-examining the answer results, with an average achievement of 36.56%.

In general, the results of students' problem solving skills for each category are obtained as shown in Table 2.

Table 2. Percentage of students' problem solving skills

No	Category	Interval	Frequency	Percentage
1	Very Good	$x > 90$	4	13%
2	Good	$75 < x \leq 90$	2	6%
3	Fair	$60 < x \leq 75$	1	3%
4	Poor	$45 < x \leq 60$	7	22%
5	Very Poor	$x \leq 45$	18	56%
Total of Students			32	
Average Value			43,25	
Category of Average Value			Very Poor	

The results showed that students in one class had different levels of problem solving skills. The average score is in very poor. This is because students who fail to

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understand the problem automatically also fail the next problem solving skill indicator (Susanti & Hartono, 2019). These results show that teachers need special attention to support the improvement of students' problem solving skills. Different levels of ability require different strategies in improving them (Khoirunnisya et al., 2024). In addition, this study also shows that students in one class have different learning styles, which are more dominant students with visual learning styles. This result is in line with Toyiba (2016) research which found students predominantly with visual learning styles.

The learning style questionnaire given to students was categorized into three categories: auditory, visual, and kinesthetic. The results obtained are as in Table 3.

Table 3. Percentage of students' learning styles

No.	Category	Frequency	Percentage
1	Auditory	7	22%
2	Visual	18	56%
3	Kinesthetic	7	22%
	Total	32	100%

Table 3 shows that the majority of students, 56%, fall into the visual learning style category, while both the auditory and kinesthetic categories account for 22% each. Generally, visual learners find it easier to process information through visual aids such as graphs, diagrams, and pictures, which help them better understand concepts. Auditory learners, on the other hand, grasp information more effectively by listening. Meanwhile, kinesthetic learners rely on movement, touch, and physical interaction with their surroundings to acquire and process knowledge.

It is important to use the right method in learning mathematics that adapts to the needs of students. This includes adjusting to students' learning styles. When viewed from the number of research subjects from each learning style such as students with a visual style of 18 people, as well as auditory and kinesthetic learning styles of 7 people each. We can still see in the data discussed earlier, that each learning style is able to solve problems in a very good category or some are still in a very poor mathematical problem solving category (Imama & Caswita, 2023; Rahayu et al., 2024).

As mentioned earlier, the results of students' problem-solving skills are dominantly in the very poor. While students' learning styles are dominantly in the visual category. Furthermore, students' problem-solving skill in terms of learning style is shown in Table 4.

Table 4. Students' problem-solving level based on learning style

No.	Category	Very Good	Good	Fair	Poor	Very Poor	Total
1	Auditory	1	0	0	3	3	7
2	Visual	2	2	1	4	9	18
3	Kinesthetic	1	0	0	0	6	7
	Total	4	2	1	7	18	32

Table 4 highlights that among the three learning style categories—auditory, visual, and kinesthetic—the dominant level of problem-solving skills is very poor. Of the seven students with auditory learning styles, one achieved a very good level of problem-solving skills, while three fell into the poor category and three into the very

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poor category. During the problem-solving test, some auditory learners struggled to understand the problems and sought verbal clarification from the teacher. With minimal verbal guidance, without directly providing answers, these students were able to better comprehend the problems through listening.

In contrast, students with visual learning styles demonstrated a wider range of problem-solving skills. Of the 18 visual learners, two were categorized as having very good problem-solving skills, while two others fell into the good category. The remaining students were distributed across fair, poor, and very poor levels. Although many visual learners were still in the very poor category, those in the good and very good categories were more prevalent in this group compared to others. This suggests that problem-solving test questions incorporating images effectively supported visual learners in understanding and solving problems.

Meanwhile, students with kinesthetic learning styles faced significant challenges in problem-solving. Observations during the test revealed behaviors such as moving their pens, sketching points in the air, or tracing diagrams on the problem sheets. These behaviors reflect their difficulty in comprehending the problems. Consistent with these observations, 85.71% (6 out of 7) of kinesthetic learners were classified as having very poor problem-solving skills.

Further analysis revealed significant differences in problem-solving skills based on learning styles, offering valuable insights for teachers. Students with visual learning styles demonstrated stronger problem-solving skills compared to their peers with other learning styles. This is likely because the problem-solving tasks included visualizations of the problems, which helped visual learners comprehend the material more effectively. These findings align with Muqarrabin et al. (2024).

Students with visual learning styles are characterized by their ability to easily recall visual information and quickly grasp concepts presented through images, graphs, and diagrams (Meilani & Warti, 2018). In contrast, students with kinesthetic learning styles exhibited physical gestures and movements during the problem-solving tests, such as moving their pens, sketching points in the air, or tracing problem diagrams on the test sheets.

These behaviors suggest that kinesthetic learners rely on physical interaction to understand problems, though they often struggle with the initial comprehension stage (Fadillah & Wahyudin, 2022; Soebagyo et al., 2022; Yuhani et al., 2018). This finding aligns with the general characteristics of kinesthetic learners, who tend to engage in physical activities while learning, retain information better through movement, prefer practical tasks, and exhibit certain behaviors like lowering their gaze when thinking (Meilani & Warti, 2018).

On the other hand, auditory learners required additional verbal explanations from the teacher to understand the problem. This aligns with the traits of auditory learning styles, where students recall information more easily when they hear it (Meilani & Warti, 2018).

These findings reinforce the unique characteristics of each learning style. Visual learners excel in understanding mathematical problems when supported by images and diagrams, auditory learners comprehend better through listening to explanations, and kinesthetic learners perform best when physical movement is integrated into the learning process.

Teachers can use these insights to better understand students' problem-solving abilities and tailor instructional strategies to match each learning style. By doing so,

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they can foster improved problem-solving skills across all types of learners. Similarly, (Supit et al., 2023) emphasized the importance of considering learning styles when selecting teaching aids and methods for classroom instruction.

CONCLUSION

The findings indicate that students with visual, auditory, and kinesthetic learning styles approach problem-solving in distinct ways. Visual learners, who constituted the majority, demonstrated stronger problem-solving skills, particularly when supported by visual aids such as diagrams and image. Auditory learners often required verbal explanations to fully understand the geometry problems, while kinesthetic learners (6 out of 7 students) faced notable challenges, resulting in very low problem-solving score.

This study concludes that learning styles play a significant role in shaping students' problem-solving abilities. The results emphasize the need for educators to adapt teaching methods to accommodate diverse learning preferences. These findings provide valuable insights for future research aimed at enhancing mathematics education.

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