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Retreival Strategies in Students' Analogical Thinking Processes in Geometry Problem Solving

Yunita Setiyaningsih[1], Yulia Maftuhah Hidayati[2*]

[1,2] Elementary School Teacher Education, Universitas Muhammadiyah Surakarta, Surakarta, Indonesia

Abstract

Purpose: This study aims to analyze the retrieval strategies used by elementary school students in the process of analogical thinking when solving geometry problems. This study specifically focuses on how students retrieve prior knowledge as a basis for forming analogies in the context of solving geometry problems.
Methodology: This study used a descriptive qualitative approach with 24 sixth-grade students from SDN 2 Kemasan as subjects. Data were collected through geometry problem-solving tests, semi-structured interviews, and documentation, then analyzed using Miles and Huberman's interactive model, which includes data reduction, data presentation, and conclusion drawing.
Results: The results showed that there were three main strategies used by students in retrieval, namely: (1) spontaneously remembering formulas or properties of flat shapes, (2) drawing flat shapes as a trigger for visual memory, and (3) relating problems to concrete everyday experiences. These strategies indicate that retrieval does not occur in isolation but is influenced by the strength of memory, learning experiences, and the thinking styles of each student.
Applications/Originality/Value: The novelty of this study lies in the retrieval stage in analogical reasoning, which has not been widely studied in previous studies. This study analyzes the retrieval strategies used by students, thereby providing new insights into how memory works in solving geometry problems.

Keywords : *retrieval, analogical thinking, geometric problem solving*

Introduction

Thinking is a cognitive process that involves processing information to understand the relationships between concepts and form solutions logically, systematically, and creatively (Gouvea, 2023; Hidayati et al., 2020). Thinking skills play a very important role in the process of solving mathematical problems (Kholid et al., 2022). One way of thinking that students need to achieve learning outcomes in mathematics is through analogical thinking. In mathematics learning, analogical thinking is an important part because it allows students to map similarities between known problems and new problems in order to find solutions (Mutia, Kartono, Dwijanto, & Wijayanti K., 2023; Nuridah & Amir, 2023). Through analogy, students can recognize similar patterns or structural relationships, which enables the transfer of solutions from familiar contexts to previously unencountered problems (Tzuriel, 2024). Analogical thinking skills can strengthen mental representations and facilitate the transfer of knowledge from one context to another (Kholid et al., 2024; Nurroini et al., 2023). Therefore, analogical thinking is an essential cognitive skill for students to achieve optimal learning outcomes in mathematics.

Analogical thinking plays a very important role in the problem-solving process, especially when students are faced with mathematical problems that require creativity and deep understanding, not just memorization of procedures. This approach requires students to identify similar structures between problems they have solved before and new problems (Kholid et al., 2024; Mulyani, 2024; Westerberg et al., 2024). The explicit application of analogy strategies in problem solving improves students' ability to understand mathematical structures (Ärlebäck & Frejd, 2025). In the context of mathematical problem-solving, analogical thinking helps students develop new strategies through previous learning experiences, thereby increasing problem-solving efficiency (Nuridah & Amir, 2023; Risma Yunita & Amir, 2023). Thus, analogical thinking not only enriches students' cognitive skills but also becomes an important pedagogical strategy in mathematics learning.

[*] Corresponding author: a510220113@student.ums.ac.id

Analogical thinking has various functions in the learning process, particularly in building conceptual understanding and improving problem-solving skills. The main function of analogical thinking is to help students connect new information with prior knowledge, thereby making the learning process more meaningful and lasting (Kholid et al., 2024). The use of analogies in learning encourages students to recognize patterns and structures, rather than simply memorizing procedures. This has a positive impact on students' critical thinking skills and flexibility in solving math problems (Cangiotti & Nappo, 2023; Liang et al., 2022; Nappo et al., 2024). Through analogies, students can see the connections between concepts and apply them in various problem-solving contexts.

The analogical thinking process consists of five sequential cognitive stages that support each other. First, *retrieval*, which is the recall of relevant concepts or experiences from memory when faced with a new situation (George & Wiley, 2021; Richland et al., 2023; Trench & Minervino, 2020). Second, *mapping*, which is the process of matching important parts between two situations so that students can understand the similarities in how different concepts work or their basic principles (Cangiotti & Nappo, 2023). Third, *abstraction*, which is the process of extracting and filtering more general relational patterns from the analogies formed so that they can be applied in a broader context (Kholid et al., 2024; E. J. H. Mulyani, 2024; Mutia, Kartono, Dwijanto, & Wijayanti, 2023). Fourth, *analogy transfer*, which is the application of the structure from the source problem to the target problem (Valle et al., 2020). Fifth, *evaluation*, which is a reflective step to assess whether the analogy used has been effective and relevant. Individuals evaluate the suitability between the structure of the source problem and the target problem (Richland et al., 2022). These five stages form a systematic and critical analogy thinking framework, which is very important in supporting a deep understanding of mathematical concepts at the elementary school level.

Each stage in the analogy thinking process has a strategic role in helping students understand and solve mathematical problems, but special attention needs to be given to the initial stage, namely *retrieval*. This stage is the basis of the entire analogy thinking process because it is directly related to students' ability to remember and recognize relevant problems from previous experiences (Goldwater & Jamrozik, 2020). Without effective retrieval, the analogy process cannot take place because students do not have a reference or experience that can be used as a starting point for problem solving (Nuridah & Amir, 2023).

Retrieval is the initial cognitive process in analogical thinking that refers to an individual's attempt to retrieve relevant information or previous experiences from long-term memory. This process is very important in the context of education because it determines whether students are able to relate new problems to previous experiences that have a similar structure (Nurroini et al., 2023; Smith et al., 2021). If students are able to recognize structural similarities between new problems (targets) and previous experiences (sources), they can more quickly form meaningful analogical connections. (Richland et al., 2022) shows that working memory capacity and diverse learning experiences significantly influence retrieval success in the context of mathematics learning. Additionally, consistent retrieval practice can significantly improve analogical problem-solving abilities (Corral et al., 2023). In mathematical problem-solving, retrieval facilitates access to previous strategies or solutions that can be reapplied, and without success in this stage, mapping and analogical transfer will not occur optimally (Risma Yunita & Amir, 2023).

Geometry is a field of mathematics that is closely related to everyday life. Concepts such as shape, size, and position are often found in various real-life situations, providing students with opportunities to apply their prior knowledge in new contexts. The use of analogies can help students recognize similar structures between new problems and their previous experiences (Calì, 2020; Grande Montana, 2024). This is especially true when using analogical retrieval thinking, which involves recalling what they have learned previously and then using it as a basis for solving new problems (George & Wiley, 2021; E. J. H. Mulyani, 2024). The retrieval stage allows students to recognize that two geometry problems have similar structures even though they differ in context or presentation, making the solving process more effective and efficient (Kholid et al., 2024). Therefore, geometry is an appropriate context for developing analogical thinking skills, especially at the retrieval stage, which is the main focus of this study (Lu et al., 2021; Nappo et al., 2024).

State of the Art

Researchers have examined various studies on analogical thinking, particularly at the retrieval stage. Recent research by Nuridah and Amir (2023) shows that elementary school students are able to solve indirect geometry problems through the stages of analogical reasoning, including representation, mathematical modeling, mapping, application, and verification, although not all students are able to activate all stages effectively. In the context of developing problem-posing skills, Yunita and Amir (2023) identified four main characteristics of analogical thinking, namely reformulation, reconstruction, reproduction, and imitation, which show how knowledge retrieval can generate new problems similar to the structure of the initial problem.

Further research by Rochman and Amir (2023) emphasizes the importance of strengthening analogical reasoning in the context of open-ended questions, where students' success in retrieval depends on the similarity in structure between familiar problems and new problems. Additionally, Kristayulita (2021) maps the components of analogical thinking not only to encoding and mapping but also to modeling and verification, highlighting the complexity of retrieval in the context of indirect problems. Finally, Mulyani (2024) states that students' thinking styles according to Sternberg's theory influence the effectiveness of retrieval in analogical thinking, with legislative and executive type students showing a more complete and accurate retrieval process in solving analogical geometry problems.

After reviewing various studies on analogical thinking, it is known that most studies still discuss the analogy process in general without specifically highlighting the retrieval stage, which is the process of retrieving information from previous experiences. The novelty of this study lies in the retrieval stage in analogical reasoning, which has not been widely studied in previous studies. This study analyzes the retrieval strategies used by students, thereby providing new insights into how memory works in solving geometry problems. This study not only enriches our understanding of how analogical thinking works in children, but also provides a basis for learning strategies that can help students more easily connect previous experiences with new situations. Thus, this study aims to analyze the retrieval strategies used by elementary school students in the process of analogical thinking when solving geometry problems. This study specifically focuses on how students access their prior knowledge as a basis for forming analogies in the context of solving geometry problems.

Method

Type and Design

This study uses a qualitative approach. This approach was chosen because it can help researchers analyze retrieval strategies in the process of analogical thinking in solving geometry problems by elementary school students. Through this approach, researchers can analyze in depth the process of students in reactivating their prior knowledge and using it as a basis for building analogies in the context of solving new problems. The qualitative approach allows researchers to explore retrieval strategies that arise naturally without manipulating variables, so that students' thinking processes can be understood comprehensively and as they are.

Data and Data Sources

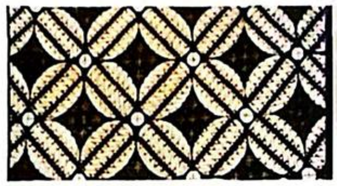
The subjects in this study were 24 sixth-grade students at SD Negeri 2 Kemasan. This grade level was chosen based on the assumption that students at this age are in the stage of concrete operational cognitive development towards formal operational development, where they begin to be able to reason more abstractly, including using analogical thinking to solve problems (Nisa et al., 2025). At this stage, students are capable of initial logical reasoning and begin to show the ability to recognize structural relationships between concepts, making it more relevant to examine retrieval strategies, which are the initial stage of analogical thinking. In addition, sixth-grade students have gained more diverse learning experiences in geometry than lower grades, enabling researchers to analyze retrieval strategies more clearly and comprehensively in solving geometry problems. Subject selection was carried out using purposive sampling, which is the deliberate selection of samples based on their relevance to the research objectives. Subjects were selected based on three criteria, namely (1) active participation in mathematics learning, (2) having studied the concepts of area and properties of flat shapes, and (3) willingness to participate in tests and interviews. However, after conducting the research on 24 students as initial subjects, a selection was made based on their suitability to the established criteria. From this process, three students were found to best meet the criteria and were considered capable of representing retrieval strategies in accordance with the research objectives, so the three of them were designated as the main subjects in this study.

Research Instrument

Original Version:

Bacalah soal di bawah ini dengan seksama!

Raka sedang membantu ibunya menata pakaian di lemari. Sebelumnya, di sekolah Raka sudah belajar tentang bangun datar persegi dan persegi panjang. Saat Raka merapikan beberapa pakaian di lemari, Ia menemukan selembar kain batik berbentuk persegi panjang dengan panjang 25 cm dan lebar 9 cm.



9 cm

25 m

1. Apa saja persamaan sifat pada persegi dan persegi panjang?
2. Tuliskan rumus untuk menghitung luas persegi dan persegi panjang!
3. Berapa luas kain batik persegi panjang yang ditemukan Raka?

Translated Version:

Read the questions in this section carefully!

Raka was helping his mother organise the cupboards. Previously, at school, Raka had learned about the difference between a square and a rectangle. When he was organising some items in the cupboard, he found a piece of batik cloth in the shape of a rectangle with a length of 25 cm and a width of 9 cm.

9 cm

25 m

1. What are the similarities between a square and a rectangle?
2. Explain how to calculate the area of a square and a rectangle!
3. What is the area of the rectangular batik cloth found by Raka?

Figure 1. ***Test instrument***

Data Collection Technique

The data collection techniques used in this study consisted of tests**,** semi-structured interviews, and documentation. Tests were used to elicit students' strategies in retrieval or recalling previous similar experiences or knowledge, then using them to solve new problems. Interviews were conducted after the tests to explore more deeply the strategies used by students in completing the tests. Documentation in the form of observation notes and interview transcripts was used to support the analysis results and ensure that the retrieval process could be completed using several strategies.

Data Validity

The researcher applied source triangulation and technique triangulation to ensure the validity of the data obtained. Source triangulation involved several students as participants. Meanwhile, technique triangulation involved three data collection methods, namely written questions and answer sheets, direct observation while students were working on the questions, and interviews with students. Through this approach, the researcher was able to obtain comprehensive data, strengthen the validity of the findings, and fully describe how students applied retrieval strategies in the process of analogical thinking in solving geometric mathematics problems.

Data Analysis

This study applied the interactive analysis method as proposed by Miles and Huberman, which consists of three main stages: data reduction, data presentation, and conclusion drawing and verification. In the reduction stage, data obtained from tests, interviews, and documentation were filtered and simplified to remain relevant to the research focus. The data was then presented in the form of descriptive narratives and direct quotes from students. The process of drawing conclusions was carried out by identifying students' analogical thinking strategies, which were then verified using triangulation techniques. This analysis was carried out continuously during the data collection process and afterwards (Miles, M. B. 1994).

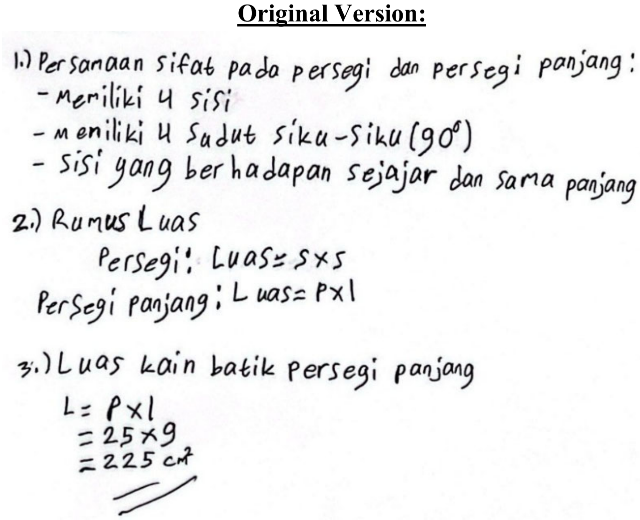
Results

This study was conducted by administering tests to 24 sixth-grade students at SDN 2 Kemasan. Based on the test results and interviews conducted with the students, most students used three main methods of retrieval, namely spontaneously remembering formulas, using strategies of drawing flat shapes to aid memory, and associating with previous experiences. These findings show that although the retrieval strategies used varied, all three played an important role in helping students connect old knowledge with new geometry problem solving.

Spontaneous Recall

A total of 15 students were able to recall the formulas for the area of a square and a rectangle spontaneously. They were able to write down the formulas correctly immediately after reading the questions, without the need for additional strategies such as drawing or linking to previous experiences. This condition shows that the area formulas have been strongly stored in the students' long-term memory because they are often taught by teachers, repeated in various practice questions, and used in daily learning activities. Some students even explained that they remembered the formula when they saw keywords such as area or rectangle in the question, triggering quick and accurate recall. This pattern of spontaneous retrieval makes it easier for students to solve problems more efficiently and increases their confidence in answering.

Original Version:


1.) Persamaan sifat pada persegi dan persegi panjang:
- Memiliki 4 sisi
- memiliki 4 sudut siku-siku (90°)
- sisi yang berhadapan sejajar dan sama panjang

2.) Rumus Luas
Persegi: Luas = s×s
Persegi panjang: Luas = p×l

3.) Luas kain batik persegi panjang
L = p×l
= 25×9
= 225 cm²

Translated Version:

1. Similarities between squares and rectangles:
   - Have 4 sides
   - Have 4 right angles (90°)
   - Opposite sides are parallel and equal in length
2. Area formula
   Square: Area = s × s
   Rectangle: Area = p x l
3. Area of a rectangular batik
   cloth L = p x l
   = 25 x 9
   = 225 cm²

Figure 2. ***Students' answers using spontaneous retrieval strategies***

Figure 2 shows that students are able to spontaneously recall relevant concepts and formulas. In the first question, students immediately wrote down the correct equation for the properties of squares and rectangles, namely that they have 4 sides, 4 right angles, and opposite sides that are parallel and equal in length. Next, in the second question, students wrote down the formulas for the area of squares and rectangles. In the third part, students used the formula for the area of a rectangle to calculate the area of the fabric correctly. This pattern of work shows that students did not need additional strategies such as drawing shapes or relating them to real-life experiences, but instead directly recalled the formulas stored in their memory. Thus, it can be concluded that these students used spontaneous retrieval in solving the problems. The following are the results of interviews conducted with S1.

Subject 1

P: "Take a look at question number 3. How did you solve this problem?"

S1: "I immediately remembered the area formula, Ma'am."

P: "Which formula did you recall?"

S1: "The area of a rectangle is length times width, Ma'am."

T: "How come you remembered it right away?"

S1: "Because I've used it many times, ma'am, so when I read the word 'area,' I immediately remembered the formula."

P: "So you don't need a picture or any other method?"

S1: "No, ma'am. After reading the question, I immediately wrote down the formula and calculated the area."

P: "Does that make it faster to do?"

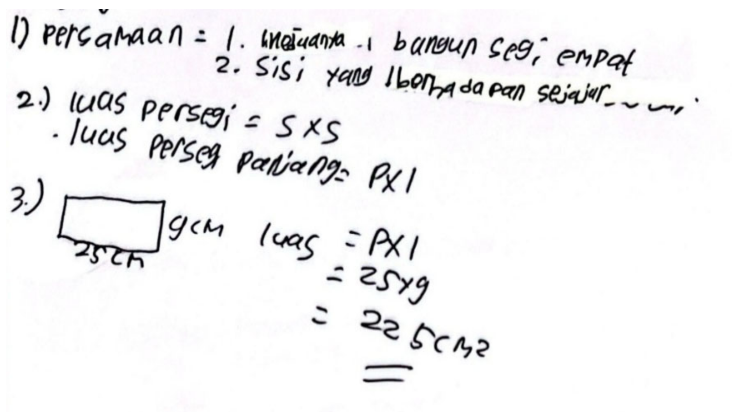
S1: "Yes, ma'am. It's faster, and I'm sure the answer is correct because I remember the formula very well."

The interview with S1 shows that he is able to remember the formulas for the area of a square and a rectangle spontaneously. Upon reading the question, S1 immediately remembered the formula without needing to draw or use other methods. The habit of frequently using the formula makes it easy for him to remember when he encounters the word "area" in a question. This allows S1 to work on the question more quickly and be confident in his answer.

Remembering by Drawing

A total of 6 students used the strategy of drawing flat shapes when solving geometry problems. They did not immediately remember the area formula, but by drawing a square or rectangle first, the area formula then came back to their memory. This method shows that visual representation can help students retrieve concepts that they have forgotten. The drawing strategy also makes it easier for students to understand the relationship between the shape of the plane figure and the formula used, so that the process of solving the problem becomes more focused. Thus, drawing serves as a bridge between the students' concrete experiences and abstract concepts in mathematics.

<u>Original Version:</u>



<u>Translated Version:</u>

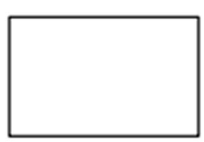
1. Equations: 1. Both are quadrilaterals

2. Opposite sides are parallel

2. Area of a square = s x s

Area of a rectangle = p x l

3.



9 cm

25 cm

Area = p × l

= 25 x 9

= 225 cm^2

Figure 3. ***Student answers using the drawing retrieval strategy***

Figure 3 shows the use of the strategy of drawing flat shapes to aid the retrieval process. Students draw a rectangle along with its length and width before calculating the area. Through this drawing, students can more easily recall the formula for area, which is length times width, enabling them to solve the problem correctly. This drawing strategy helps students connect visual representations with abstract concepts and serves as a memory trigger when the formula does not immediately come to mind. The following are the results of an interview conducted with S2.

Subject 2

P: "Take a look at problem number 3. How do you solve this problem?"

S2: "I draw the rectangle first, Ma'am."

P: "Then after drawing it, what do you do?"

S2: "After that, I look at the drawing, Ma'am. From the drawing, I can see the length and width, so I start to remember the formula for the area, which is length times width."

P: "So you draw first and then write down the formula?"

S2: "Yes, ma'am. I need to draw it first so I can remember the formula. After remembering it, I write down the formula and then I calculate it."

P: "Does this method make you solve problems faster?"

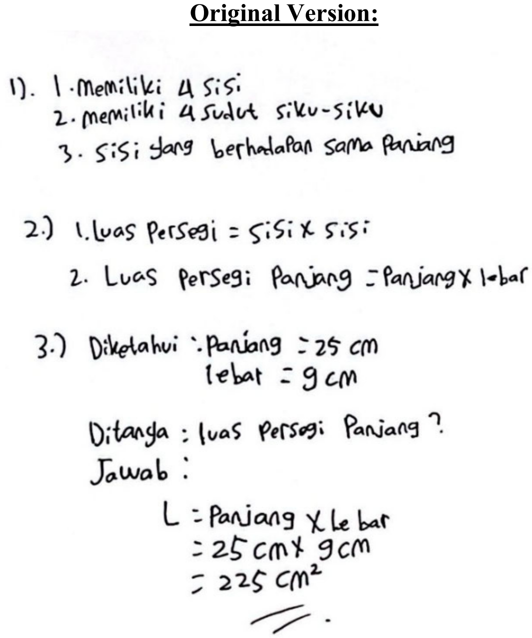
S2: "Not as fast as if I remembered it directly, Ma'am. But I understand it better and am more confident in my answer."

The interview with S2 shows that he uses a drawing strategy to help him remember the formula for the area of a rectangle. Before writing down the formula, S2 first draws a flat shape according to the question, then from the drawing he remembers that the area is calculated by multiplying the length and width. This method makes S2 more confident in his answer, even though it is not as fast as remembering the formula directly. The drawing strategy used by S2 shows that visual representation can facilitate the retrieval process and provide confidence in solving problems.

Remembering by Connecting to Previous Experiences

Three students were able to remember by connecting the question to their daily experiences. When reading questions about rectangles, they immediately remembered activities such as measuring fabric, paper, blackboards, or tables. These real-life experiences made it easier for them to remember the formula for area and the properties of flat shapes. This shows that everyday experiences can be an important bridge in remembering lessons that have been learned. In this way, students find it easier to understand questions, find steps to solve them, and feel more confident about their answers.

Original Version:


1). 1. memiliki 4 sisi
2. memiliki 4 sudut siku-siku
3. sisi yang berhadapan sama panjang

2.) 1. luas persegi = sisi x sisi
2. Luas persegi panjang = panjang x lebar

3.) Diketahui : panjang = 25 cm
lebar = 9 cm

Ditanga : luas persegi panjang ?
Jawab :
L = panjang x lebar
= 25 cm x 9 cm
= 225 cm^2

Translated Version:

1. 1. Has 4 sides
2. Has 4 right angles
3. Opposite sides are equal in length

2. 1. Area of a Square = side x side
2. Area of a Rectangle = length x width

3. Given: Length = 25 cm
Width = 9 cm
Question: What is the area of the rectangle? Answer:
L = length × width
= 25 cm x 9 cm
= 225 cm^2

Figure 4. ***Student answers using the retrieval strategy of linking to previous experiences***

Figure 4 shows students' answers who solved the problem through retrieval based on previous experiences. Students wrote down the properties of flat shapes, the formulas for the area of squares and rectangles, and then calculated the area by multiplying the length and width. This process is not only based on memorization, but also arises because students remember real experiences when they measured fabric or rectangular objects. These experiences trigger students to remember the area formula so they can solve the problem correctly. The following are the results of interviews conducted with S3.

Subject 3

P: "Take a look at question number 3. How did you solve this problem?"

S3: "I remember measuring the area of the blackboard during math class, ma'am."

P: "What do you remember?"

S3: "I remember that the formula for the area of a rectangle is to multiply the length by the width, as explained by the teacher when calculating the area of the blackboard."

P: "Why did you remember that experience?"

S3: "Because at that time the teacher said that to calculate the area of a rectangle, for example a blackboard, you multiply the length by the width, so it directly connects to this question."

P: "So you didn't just write down the formula?"

S3: "No, ma'am. I remembered that experience first, then wrote down the formula."

P: "Does this method make you solve problems faster?"

S3: "Yes, ma'am. Because I felt this problem was similar to my experience, so it was easier to understand."

The interview with S3 revealed that he used a strategy of linking previous experiences to help him remember the formula for the area of a rectangle. Before writing down the formula, S3 first recalled when the teacher explained how to calculate it on the blackboard. From that experience, he remembered that the area of a rectangle is calculated by multiplying the length and width. This method made it easier for S3 to understand the problem because it was similar to a real-life situation he had experienced. The strategy of linking previous experiences used by S3 shows that concrete contexts can trigger retrieval and help students feel more confident in solving problems.

Discussion

This study analyzes the analogical thinking process of elementary school students, particularly at the retrieval stage in solving geometry problems. The results show that students use three main methods in *retrieval*, namely spontaneous recall, drawing flat shapes, and relating to previous experiences. These findings are in line with Wong et al., (2019), which confirms that retrieval is the main foundation in the analogy thinking process, because it is from this stage that relevant information is recalled from memory to be used in a new context. The results of this study reinforce the view that successful retrieval greatly determines the success of the next analogy stages, such as mapping and transfer.

Based on the analysis of test results and interviews, students who performed spontaneous retrieval quickly and accurately were able to recall formulas and properties of two-dimensional shapes immediately after reading the question without requiring additional assistance. This condition shows that certain geometric concepts have been strongly stored in long-term memory through habituation. This is in line with Mutia, Kartono, Dwijanto, & Wijayanti (2023), who found that students with high mathematical creativity were able to go through most of the stages of analogical thinking more smoothly. Thus, repeated practice and mastery of concepts can strengthen retrieval success.

Meanwhile, students who use the strategy of drawing flat shapes first aim to trigger recall of formulas or geometric concepts. This strategy shows that visual representation serves as a bridge between concrete experiences and abstract concepts. The classic study Beveridge & Parkins (1987), shows that visualization can act as an effective retrieval cue in analogical thinking. Although this process is not as fast as spontaneous retrieval, the drawing strategy helps students understand the structural relationships between concepts so that they are more confident in their answers. Therefore, the visualization strategy confirms its role in strengthening retrieval.

Unlike the previous retrieval strategy, students who use the retrieval strategy by linking previous experiences rely on everyday experiences to recall geometric concepts. Students tend to associate problems with concrete experiences, such as calculating the area of a blackboard or cloth. This strategy shows that real contexts can act as retrieval triggers, especially when abstract concepts are difficult to remember (Risma Yunita & Amir, 2023). However, although concrete experiences can help recall memories, the results are often situational and do not always show flexibility in dealing with variations in questions (Nuridah & Amir, 2023).

The findings of this study confirm that differences in students' retrieval strategies are influenced by memory strength, learning style, and previous experience. Inadequate control of the memory process in the retrieval process can actually hinder analogical thinking (Valle et al., 2020). Therefore, in mathematics learning, teachers need to provide varied learning experiences so that students can build more diverse retrieval pathways, whether through repeated practice, visualization, or linking to real-life experiences. Teachers' understanding of the diversity of students' retrieval strategies is key to creating more adaptive and effective learning.

In addition, this study also has important implications for mathematics learning practices in elementary schools. Teachers should not only emphasize memorization of formulas, but also encourage students to use various methods of *retrieval*, for example by providing visual-based exercises, contextual questions, and discussions that emphasize the similarities in structure between problems. Students' thinking styles in solving geometry problems influence the successful use of analogies (E. Mulyani et al., 2024). Thus, strengthening retrieval skills through varied learning is key to developing students' analogical thinking skills from an early age.

Conclusion

This study shows that elementary school students use three main strategies in retrieving information during the analogy thinking process, namely spontaneous recall, drawing flat shapes, and associating with previous experiences. Spontaneous retrieval allows students to quickly recall formulas or properties of flat shapes, while the drawing strategy helps through visual representation as a bridge between concrete experiences and abstract concepts, and the strategy of associating real experiences triggers memories of geometric concepts. The variation in these strategies confirms that retrieval does not occur in a single way, but is influenced by the strength of memory, learning style, and experience of the student. Therefore, mastery of geometric concepts cannot rely solely on memorization, but also on diverse learning experiences, so that practice, visualization, and contextual questions need to be integrated to strengthen retrieval. These findings confirm that students' success in building analogies depends heavily on their ability to accurately and relevantly access prior knowledge. Thus, mathematics learning, especially geometry, needs to be designed to strengthen memory activation through repeated practice, the use of visual representations, and the presentation of real contexts. Through a varied learning approach, students can develop more flexible retrieval abilities, thereby encouraging an increase in the quality of analogical thinking from the elementary school level.

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References

Ärlebäck, J. B., & Frejd, P. (2025). Exploring Swedish secondary students' mathematical models of fairness in ranking real-life, multi-faceted heptathlon outcomes. *ZDM - Mathematics Education*, 425–440. https://doi.org/10.1007/s11858-025-01678-z

Beveridge, M., & Parkins, E. (1987). Erratum to: Visual representation in analogical problem solving. *Memory & Cognition*, *15*(5), 461. https://doi.org/10.3758/BF03197736

Calì, C. (2020). *Analogy* (pp. 29–31). https://doi.org/10.1007/978-3-030-51324-5_3

Cangiotti, N., & Nappo, F. (2023). Reasoning by Analogy in Mathematical Practice. *Philosophia Mathematica*, *31*(2), 176–215. https://doi.org/10.1093/philmat/nkad003

Corral, D., Carpenter, S. K., & St. Hilaire, K. J. (2023). The effects of retrieval versus study on analogical problem solving. *Psychonomic Bulletin and Review*, *30*(5), 1954–1965. https://doi.org/10.3758/s13423-023-02268-4

George, T., & Wiley, J. (2021). Forgetting of competing solutions as a consequence of analogical problem-solving attempts. *Memory*, *29*(8), 1058–1075. https://doi.org/10.1080/09658211.2021.1959615

Goldwater, M. B., & Jamrozik, A. (2020). Can a relational mindset boost analogical retrieval? *Cognitive Research: Principles and Implications*, *4*(1). https://doi.org/10.1186/s41235-019-0198-8

Gouvea, J. (2023). Processing misconceptions: dynamic systems perspectives on thinking and learning. *Frontiers in Education*, *8*(August), 1–12. https://doi.org/10.3389/feduc.2023.1215361

Grande Montana, P. (2024). The Cognitive Power of Analogies in the Legal Writing Classroom. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4799617

Hidayati, Y. M., Ngalim, A., Sutama, Arifin, Z., Abidin, Z., & Rahmawati, E. (2020). Level of combinatorial thinking in solving mathematical problems. *Journal for the Education of Gifted Young Scientists*, *8*(3), 1231–1243. https://doi.org/10.17478/JEGYS.751038

Kholid, M. N., Fadhilah, H., Loc, N. P., & Magdas, I. C. (2024). Classifying analogical thinking for mathematical problem-solving. *Journal on Mathematics Education*, *15*(3), 793–814. https://doi.org/10.22342/jme.v15i3.pp793-814

Kholid, M. N., Swastika, A., Ishartono, N., Nurcahyo, A., Tin Lam, T., Maharani, S., Ikram, M., Murniasih, T. R., Majid, M., Wijaya, A. P., & Pratiwi, E. (2022). Hierarchy of Students' Reflective Thinking Levels in Mathematical Problem Solving. *Acta Scientiae*, *24*(6), 24–59. https://doi.org/10.17648/acta.scientiae.6883

Kristayulita, K. (2021). Indirect Analogical Reasoning Components. *Malikussaleh Journal of Mathematics Learning (MJML)*, *4*(1), 13. https://doi.org/10.29103/mjml.v4i1.2939

Liang, Z., Zhang, J., & Zhang, X. (2022). Analogical Math Word Problems Solving with Enhanced Problem-Solution Association. *Proceedings of the 2022 Conference on Empirical Methods in Natural Language Processing, EMNLP 2022*, 9454–9464. https://doi.org/10.18653/v1/2022.emnlp-main.643

Lu, P., Gong, R., Jiang, S., Qiu, L., Huang, S., Liang, X., & Zhu, S. C. (2021). Inter-GPS: Interpretable geometry problem solving with formal language and symbolic reasoning. *ACL-IJCNLP 2021 - 59th Annual Meeting of the Association for Computational Linguistics and the 11th International Joint Conference on Natural Language Processing, Proceedings of the Conference*, 6774–6786. https://doi.org/10.18653/v1/2021.acl-long.528

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis : An expanded sourcebook* (2nd ed.). Thousand Oaks, CA : Sage Publications

Mulyani, E. J. H. (2024). *Analogical Reasoning in Geometric Problem Solving : A Cognitive Analysis*. *1*(2), 102–109.

Mulyani, E., Jailani, J., & Hartono, H. (2024). Analogical Reasoning in Geometric Problem Solving: A Cognitive Analysis Based on Sternberg's Thinking Styles. *International Journal of Geometry Research and Inventions in Education (Gradient)*, *1*(2), 102–109. https://doi.org/10.56855/gradient.v1i2.1234

Mutia, Kartono, Dwijanto, & Wijayanti K. (2023). *Analogical thinking of student in solving function problems based on mathematical disposition*. 070014. https://doi.org/10.1063/5.0105935

Mutia, Kartono, Dwijanto, & Wijayanti, K. (2023). Students' Analogical Reasoning in Solving Trigonometric Target Problem. *Malaysian Journal of Mathematical Sciences*, *17*(3), 425–440. https://doi.org/10.47836/MJMS.17.3.11

Nappo, F., Cangiotti, N., & Sisti, C. (2024). Confirming Mathematical Conjectures by Analogy. *Erkenntnis*, *89*(6), 2493–2519. https://doi.org/10.1007/s10670-023-00683-6

Nisa, D. A. F. ', Nurdiansyah, E. W., & Iswinarti, I. (2025). Psychoeducation: Improving Emotional Intelligence in Elementary School Children Through Traditional Snackes And Ladders Game. *International Journal of Research Publication and Reviews*, *6*(6), 3963–3969. https://doi.org/10.55248/gengpi.6.0125.0603

Nuridah, E. R., & Amir, M. F. (2023). Analogical Reasoning in Solving Indirect Problem-Based Area Problems. *Mathline : Jurnal Matematika Dan Pendidikan Matematika*, *8*(4), 1305–1320. https://doi.org/10.31943/mathline.v8i4.470

Nurroini, I. F., Amir, M. F., & Wardana, M. D. K. (2023). Analogy-Based Selective Problem-Solving Learning on the Skill to Solve Word Problems. *Edunesia: Jurnal Ilmiah Pendidikan*, *4*(3), 1357–1371. https://doi.org/10.51276/edu.v4i3.521

Richland, L. E., Holyoak, K. J., & Stigler, J. W. (2022). Analogy use in eighth-grade mathematics classrooms. *Cognition and Instruction*, *22*(1), 37–60. https://doi.org/10.1207/s1532690Xci2201_2

Richland, L. E., Zur, O., & Holyoak, K. J. (2023). Cognitive supports for analogies in the mathematics classroom. *Science*, *316*(5828), 1128–1129. https://doi.org/10.1126/science.1142103

Risma Yunita, S., & Amir, M. F. (2023). Analogy Problem Posing for Elementary School Students on Word Problems. *Jurnal Lebesgue : Jurnal Ilmiah Pendidikan Matematika, Matematika Dan Statistika*, *4*(1), 458–468. https://doi.org/10.46306/lb.v4i1.283

Rochman, E. A., & Amir, M. F. (2023). Enhancing Primary School Students' Analogical Reasoning in Solving Open-ended Word Problems. *Al Ibtida: Jurnal Pendidikan Guru MI*, *10*(2), 288. https://doi.org/10.24235/al.ibtida.snj.v10i2.13769

Smith, A. M., Elliott, G., Hughes, G. I., Feinn, R. S., & Brunyé, T. T. (2021). Acute stress improves analogical reasoning: examining the roles of stress hormones and long-term memory. *Thinking & Reasoning*, *27*(2), 294–318. https://doi.org/10.1080/13546783.2020.1819416

Trench, M., & Minervino, R. A. (2020). *Boosting Retrieval via Deliberate Search* (pp. 83–97). https://doi.org/10.1007/978-3-030-52545-3_6

Tzuriel, D. (2024). Analogical thinking modifiability and math processing strategy. *Frontiers in Psychology*, *15*. https://doi.org/10.3389/fpsyg.2024.1339591

Valle, T. M., Gómez-Ariza, C. J., & Bajo, M. T. (2020). Inhibitory control during selective retrieval may hinder subsequent analogical thinking. *PLoS ONE*, *14*(2), 1–18. https://doi.org/10.1371/journal.pone.0211881

Westerberg, C. E., Fickle, S. E., Troupe, C. E., Madden-Rusnak, A., & Deason, R. G. (2024). An afternoon nap facilitates analogical transfer in creative problem solving. *Journal of Sleep Research*, *November*, 1–10. https://doi.org/10.1111/jsr.14419

Wong, S. S. H., Ng, G. J. P., Tempel, T., & Lim, S. W. H. (2019). Retrieval Practice Enhances Analogical Problem Solving. *The Journal of Experimental Education*, *87*(1), 128–138. https://doi.org/10.1080/00220973.2017.1409185