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Visual Representation Ability of Junior High School Students on Quadrilateral Material

Sabila Mukhlishonisa[1], Al Jupri[2], Jarnawi Afgani Dahlan [3]

[1,2,3] Departemen Pendidikan Matematika, Universitas Pendidikan Indonesia, Bandung, Indonesia

A B S T R A K

Kemampuan representasi visual merupakan kompetensi penting dalam pembelajaran matematika, terutama dalam geometri. Representasi visual membantu siswa mengubah konsep abstrak menjadi bentuk konkret, sehingga memudahkan proses pemecahan masalah. Penelitian ini bertujuan untuk menggambarkan kemampuan representasi visual siswa SMP dalam menyelesaikan masalah bangun datar segiempat. Penelitian ini menggunakan pendekatan kualitatif dengan metode deskriptif. Subjek penelitian adalah siswa kelas VIII SMP. Penelitian dilakukan dengan memberikan lima soal esai tentang materi bangun datar empat sisi. Data dianalisis berdasarkan rubrik penilaian representasi visual, yang diwakili oleh hasil lima siswa yang dipilih dari dua kelas. Hasilnya menunjukkan bahwa satu siswa memiliki kemampuan representasi visual sedang, sementara empat siswa lainnya berada dalam kategori tinggi. Temuan ini menunjukkan bahwa kemampuan representasi visual memainkan peran penting, kesalahan dalam representasi visual cenderung berdampak langsung pada kesalahan dalam pemecahan masalah. Oleh karena itu, kemampuan representasi visual perlu dikembangkan secara sistematis dalam pembelajaran matematika.

Kata Kunci :
Representasi Visual, Geometri, Segiempat

A B S T R A C T

Visual representation ability is an important competency in mathematics learning, especially in geometry. Visual representation helps students transform abstract concepts into concrete forms, thereby facilitating the problem-solving process. This study aims to describe junior high school students' visual representation ability in solving quadrilaterals problems. This study used a qualitative approach with a descriptive method. The research subjects were eight-grader junior high school students that were given five essay questions about quadrilateral material. The data were analyzed based on a visual representation scoring rubric. The results represented by five students who were purposely selected. It showed that one student had moderate visual representation ability, while four students were in the high category. These findings indicate that visual representation ability play an important role, errors in visual representation tend to have a direct impact on errors in problem solving. Therefore, visual representation ability needs to be developed systematically in mathematics learning.

Keywords:
Visual Representation, Geometry, Quadrilaterals

1. INTRODUCTION

The National Council of Teachers of Mathematics (NCTM, 2000) stipulates that there are five process skills that students need to acquire through mathematics learning, which are covered in the process standards, namely: (1) problem solving; (2) reasoning and proof; (3) communication; (4) connection; and (5) representation. Mathematical representation is one of the process skills that students need to have in mathematics learning that allows students to organize, record, and communicate mathematical ideas, as well as select and use appropriate representations in problem solving (Farokhah et al., 2019). The various representations used in mathematics learning include visual, symbolic, and verbal representations. Among these various forms of representation, visual representation plays a very important role, especially in geometry learning, even visual representations in the form of geometric shapes also help students understand other material (Jupri et al., 2020). Visual representation helps students transform abstract concepts into concrete forms through pictures or diagrams to clarify problems and facilitate resolution (Fauziyah & Jupri, 2020). This is particularly relevant in geometry learning because geometric objects have properties and relationships that are easier to understand

*Corresponding author
E-mail addresses: sabilamukh@upi.edu

through visualization (Schoenherr et al., 2024; Susilawati et al., 2021). However, in reality, not all students have good visual representation ability (Saputra et al., 2024). Several studies show that students still have difficulty representing geometric concepts visually, especially when it comes to problems related to quadrilaterals (Khoerunnisa & Maryati, 2022). Quadrilaterals are an important topic in geometry learning (Demirel & Simsekler Dizman, 2025). There are various types of flat shapes that are classified as quadrilaterals. Various types of quadrilaterals have different characteristics as well as certain similarities. Each quadrilateral has its own characteristics that distinguish it from other shapes, but each shape also has similar properties that cause them to be classified as quadrilaterals. In fact, a quadrilateral can be formed by other quadrilaterals. However, not all junior high school students can identify this. As stated by Jupri (2016) that in the visualization level, a student can identify geometric shapes according to general appearance without attention to properties of the shapes. For example, the student recognizes the form of a rectangle and considers it as a different shape from a parallelogram. However, some students still identify quadrilaterals based solely on their visual appearance without considering their properties (Demirel & Simsekler Dizman, 2025). This condition shows the importance of visual representation ability in helping students understand quadrilateral concepts more deeply. Based on this description, this study aims to describe junior high school students' visual representation ability in solving geometry problems on quadrilateral material.

2. METHOD

This study used a qualitative approach with a descriptive method. This approach was chosen to obtain an in-depth description of students' visual representation abilities in solving geometry problems. The research was conducted at a junior high school in Bandung. The research subjects were five eighth-grade students who were purposively selected from two different classes. The selection of subjects was based on the completeness of their answers and the representativeness of their abilities.

The research instrument consisted of a five-item essay test designed to measure students' visual representation abilities on quadrilateral material, with a time allocation of 40 minutes. The questions included activities such as drawing, cutting, and constructing quadrilaterals, as well as solving contextual problems related to area and perimeter, included in Table 1.

Table 1. Visual Representation Question Test

No.	Questions in Bahasa	Questions in English
1	Potong-potonglah sebuah persegi menjadi 4 buah trapesium siku-siku yang sama besar!	Cut a square into 4 equal right-angled trapezoids!
2	Jika terdapat sebuah layang-layang yang digunting sesuai kedua diagonalnya, apakah layang-layang tersebut dapat dibentuk menjadi sebuah persegi panjang? Jika ya, coba gambarkan prosesnya!	If a kite is cut along both diagonals, can it be formed into a rectangle? If so, try to draw the process!
3	Pak Rio akan membuat sebuah lapangan basket di halaman belakang rumahnya. Jika panjang lapangan tersebut adalah 12 meter dan ukuran lebarnya 2/3 dari ukuran panjangnya, berapakah luas lapangan basket yang akan dibuat oleh Pak Rio?	Mr. Rio is going to build a basketball court in his backyard. If the length of the court is 12 meters and the width is 2/3 of the length, what is the area of the basketball court that Mr. Rio will build?
4	Diketahui sebuah jajar genjang ABCD dengan sisi miring AD dan BC. Panjang AB adalah 8 cm. Sisi BC tepat berimpitan dengan salah satu sisi belah ketupat yang panjang sisinya adalah 5 cm. Hitunglah keliling gabungan dari kedua bangun datar tersebut!	Given a parallelogram ABCD with slanted sides AD and BC. The length of AB is 8 cm. Side BC is exactly adjacent to one side of a rhombus with a side length of 5 cm. Calculate the combined perimeter of the two flat shapes!
5	Sebuah rumah difoto dari arah depan, sehingga dalam foto tersebut terlihat bahwa atap rumah berbentuk trapesium sama kaki. Panjang sisi sejajar pada atap dalam foto	A house is photographed from the front, so that the roof of the house appears to be an isosceles trapezoid in the photo. The lengths of the parallel sides of the roof in the photo

	tersebut adalah 12 cm dan 6 cm, dan tinggi atap dalam foto adalah 4 cm. Jika seorang siswa diminta untuk menempelkan tali pada sekeliling atap pada foto yang sudah dicetak, berapa panjang minimum benang yang dibutuhkan oleh siswa tersebut?	are 12 cm and 6 cm, and the height of the roof in the photo is 4 cm. If a student is asked to attach a string around the roof in the printed photo, what is the minimum length of string needed by the student?

The data were analyzed using a visual representation ability scoring rubric with a score range of 1–5. The analysis was conducted by assessing the accuracy of the images, the suitability of the representations with geometric concepts, and the use of visual representations in problem solving, it shown in Table 2. The scores obtained were then converted into percentages and categorized into levels of visual representation ability.

Table 2. Visual Representation Ability Scoring Rubric

Visual Representation Ability Score				
1	**2**	**3**	**4**	**5**
Not creating geometric figures to explain problems and facilitate solutions	Creating geometric shapes, but still not accurately and not using them to explain problems and facilitate solutions.	Creating geometric shapes that are not yet accurate, but using them to explain problems and facilitate solutions Creating geometric patterns that are almost accurate, but not using them to explain problems and facilitate solutions	Creating almost accurate geometric patterns and using them to explain problems and facilitate solutions Creating accurate geometric patterns, but not using them to explain problems and facilitate solutions	Creating accurate geometric patterns and using them to explain problems and facilitate solutions

After the results being scored, researchers calculate the percentage of the score by the formula:

$$Percentage\ of\ Score = \frac{Total\ Score}{25} \times 100\% \qquad (1)$$

Then, for the level of students' ability in creating visual representations, the researcher adapted the categorization of representation abilities based on the scores obtained from (Aryanti, D, 2013), so that the researcher created the following categories, shown in Table 3.

Table 3. Categories of Visual Representation

No.	Category	Score Percentage (x)
1	Very High	$x \geq 80\%$
2	High	$60\% \leq x < 80\%$
3	Moderate	$40\% \leq x < 60\%$
4	Low	$20\% \leq x < 40\%$
5	Very Low	$x < 20\%$

3. RESULT AND DISCUSSION

Result

This study aims to determine junior high school students' visual representation abilities in quadrilateral material. Therefore, a test instrument was administered to a number of junior high school students. Five students' work results were then selected to represent the subjects in this study and were named S, M, G, A, and W. An analysis was then conducted on the work results of the five subjects, and the results are shown in Table 4.

Table 4. Students' Visual Representation Ability

Subject	Score for each question					Total Score	Score Percentage	Visual Representation Category
	No.1	No.2	No.3	No.4	No.5			
S	3	2	3	2	2	12	48%	Moderate
M	4	4	4	2	5	19	76%	High
G	5	3	4	3	4	19	76%	High
A	3	3	4	4	5	19	76%	High
W	3	3	4	4	4	18	72%	High

The results of the analysis showed that students' visual representation abilities varied. Of the five research subjects, one student was in the moderate visual representation ability category, while the other four students were in the high category. The average percentage of students' visual representation abilities reached 70%.

The results for each question of the visual representation test can be analyzed as follows. The first question was designed to assess students' ability to describe a square and construct it into other quadrilaterals. The Figure 1 shows the findings from the subject W, where it was the most frequently answered by students.

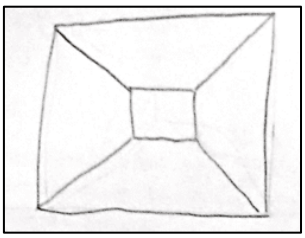

Figure 1. Test Result Number 1 by Subject W

Almost all students were able to draw the geometric pattern of a square almost correctly, but when asked to cut the square into four equal right-angled trapezoids, they began to struggle. In Figure 1, what is drawn is not even a right-angled trapezoid, but an isosceles trapezoid, thus forming another shape that is not desired in the question in the middle of the original square. This means that students still misrepresent the visual form of right-angled trapezoids. Therefore, such answers are given a score of 3 because they draw geometric patterns that are almost correct, but do not use them to explain the problem and facilitate its solution.

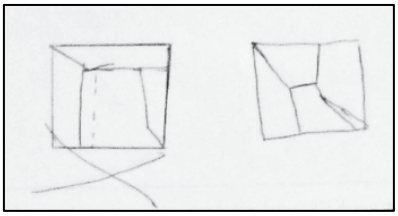

Figure 2. Test Result Number 1 by Subject S

Furthermore, there are also those who have tried to draw a square cut into four right-angled trapezoids, except that the sizes of the right-angled trapezoids are not the same, as shown in Figure 2.

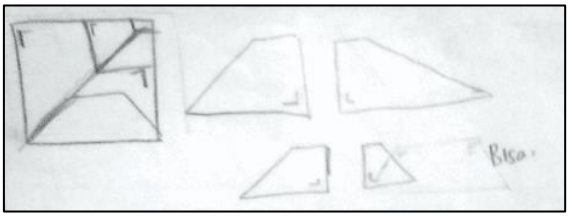

Figure 3. Test Result Number 1 by Subject A

Even in Figure 3, subject A made the initial square into a remainder after cutting it. Thus, subjects S and A were given a score of 3 because they made geometric patterns that were almost correct, but did not use them to explain the problem and facilitate its solution.

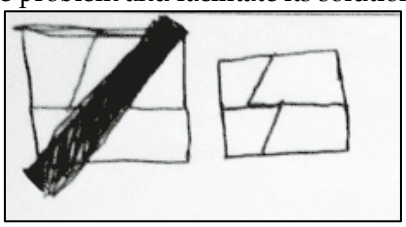

Figure 4. Test Result Number 1 by Subject M

Meanwhile, in Figure 4, subject M almost correctly depicted the representation even though the sizes were only in pairs, so they received a score of 4 for creating geometric patterns that were almost accurate and using them to explain the problem and facilitate its solution.

The second question was designed to assess students' ability to describe a kite and construct the square into other quadrilaterals. The Figure 5 shows the findings from the subject S.

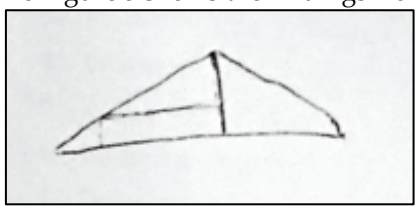

Figure 5. Test Result Number 2 by Subject S

From Figure 5, it can be seen that subject S has drawn the geometric patterns from the given question. However, subject S did not draw a kite, but a triangle. Furthermore, subject S did not solve the problem asked in the question, so he was given a score of 2 for drawing a geometric shape that was still inaccurate and not using it to explain the problem and facilitate its solution.

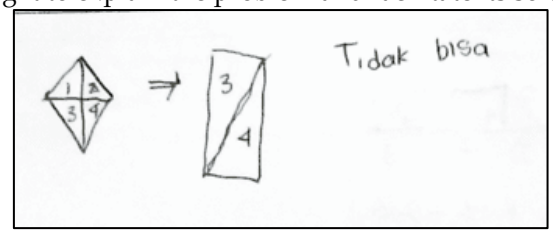

Figure 6. Test Result Number 2 by Subject M

Meanwhile, from Figure 6, it can be seen that subject M has already drawn the geometric patterns from the given problem. Subject M has drawn a kite cut along its diagonal and constructed it into a rectangle, but only two pieces of the kite, numbered 3 and 4, while pieces 1 and 2 cannot be seen as a rectangle when combined with pieces 3 and 4, which he has already formed into a rectangle. As a result, in the final answer, subject M stated that the kite, when cut along its diagonal, could not be made into a rectangle, even though the visual representation he drew had formed a rectangle, albeit not a complete one. Subject M was therefore given a score of 4 for drawing the geometric patterns correctly but not using them to explain the problem and facilitate its solution.

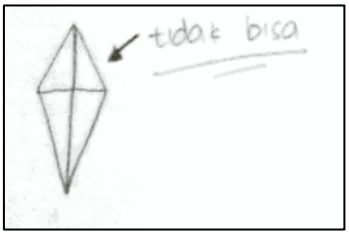

Figure 7. Test Result Number 2 by Subject G

For Figure 7, it can be seen that subject G has described the geometric patterns of the given problem. Subject G describes a kite with cuts on both diagonals that are almost exact. However, they were unable to construct a kite cut along both diagonals into a rectangle. This type of answer was the

most common, as subjects A and W gave similar answers. Therefore, this type of answer was given a score of 3 because it depicted geometric patterns that were almost accurate, but did not use them to explain the problem and facilitate its solution.

For the third until fifth questions were designed to see students' ability to visually represent problems in word problems and use these representations to help students solve problems. The example of the result for number 3 shown in Figure 8.

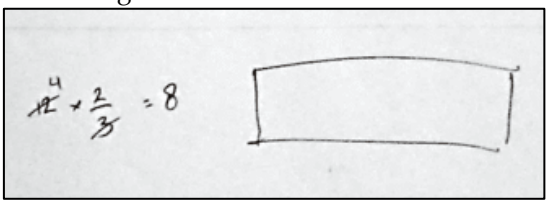

Figure 8. Test Result Number 3 by Subject S

The Figure 8 shown that subject S has described the geometric pattern of the question, but without any explanation, thus receiving a score of 2 for drawing a geometric shape but not accurately and not using it to explain the problem and facilitate its solution.

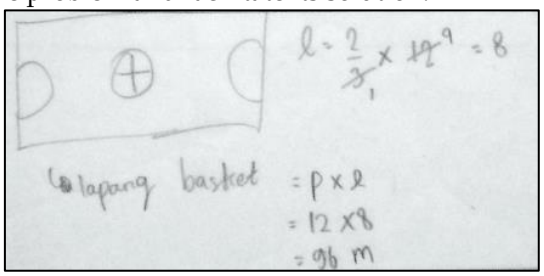

Figure 9. Test Result Number 3 by Subject A

Meanwhile, Figure 9 shows that subject A has created a visual representation of the problem given, even though the 12-meter length is not written on the side in the picture. Subject A solved the problem using standard calculations. This answer is the same as that given by subject W. Therefore, a score of 4 was given, because the subject created accurate geometric patterns, but did not use them to explain the problem and facitilate its solution.

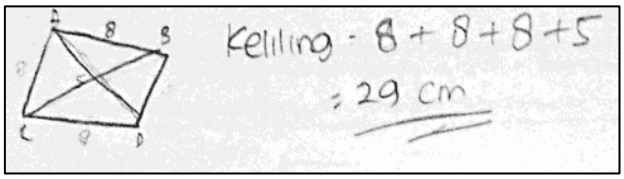

Figure 10. Test Result Number 4 by Subject G

Then, for the result of number 4 by Subject G in Figure 10 showed that he drew a parallelogram with both diagonals. And from the results of solving the given problems, he was not calculated based on the visual representations he made. So, it was scored 3 for drawing geometric patterns that were almost accurate, but not using them to explain the problem and facilitate the solution.

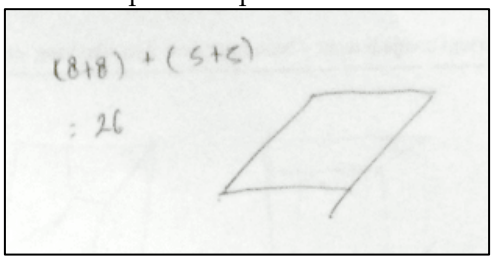

Figure 11. Test Result Number 4 by Subject S

From Figure 11, it can be seen that subject S only visually represents the geometric pattern of a parallelogram, so to solve the problem, they only calculate the perimeter of the parallelogram. Therefore, this answer is given a score of 2 because it draws a geometric shape but is still inaccurate and does not use it to explain the problem and facilitate its solution.

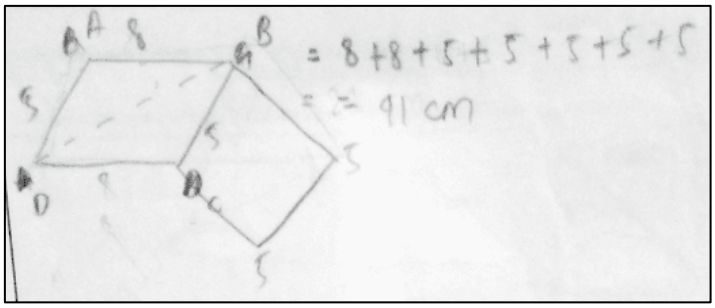

Figure 12. Test Result Number 4 by Subject A

Meanwhile, Figure 12 shows that subject A correctly drew a parallelogram geometric pattern with one side overlapping one side of the rhombus. However, when solving the problem, he added up all the side lengths of the quadrilateral. In fact, the overlapping side does not need to be counted. Therefore, a score of 4 was given because the subject drew the geometric patterns correctly, but did not use them to explain the problem and facilitate its solution.

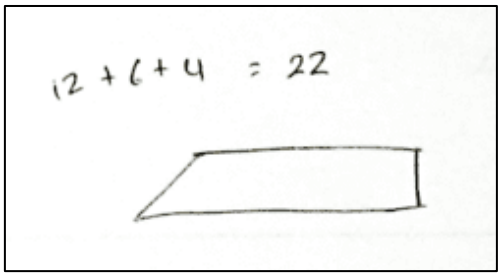

Figure 13. Test Result Number 5 by Subject S

From Figure 13 it can be seen that subject S has drawn a geometric pattern in the form of a trapezoid, but what he drew was not an isosceles trapezoid, but an arbitrary trapezoid. In solving the problem, he only added up the known measurements in the question, without using a visual representation. Therefore, he was given a score of 2 because he drew a geometric shape but it was not accurate and he did not use it to explain the problem and facilitate its solution.

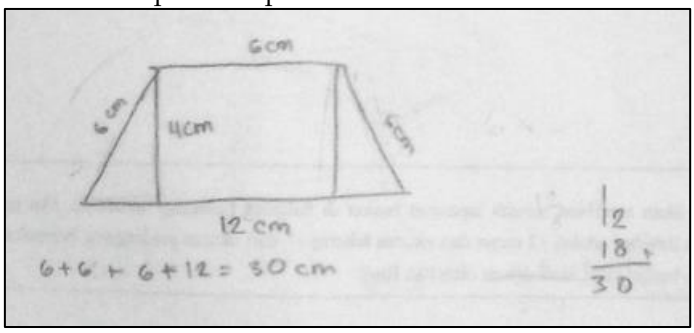

Figure 14. Test Result Number 5 by Subject W

Figure 14 shows that subject W has drawn an isosceles trapezoid, but for the size of the slanted sides, he followed the size of the other known sides, when he should have used the Pythagorean theorem. So, the calculation of the perimeter of the trapezoid is still not correct, because some of the side measurements are still wrong. Therefore, a score of 4 is given for drawing geometric patterns that are almost correct and using them to explain the problem and facilitate its solution.

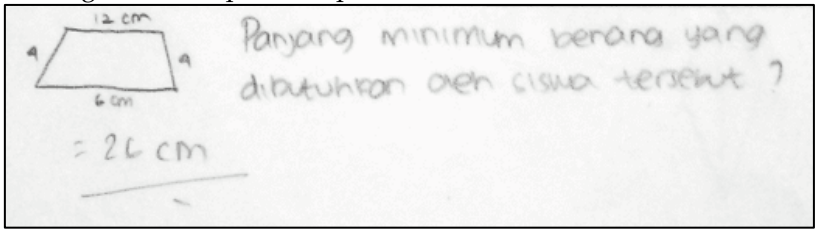

Figure 15. Test Result Number 5 by Subject G

From Figure 15, it can be seen that subject G has drawn an isosceles trapezoid, but for the size of the slanted side, he has written down the height of the trapezoid instead. He used visual representation to facilitate the solution, but because of the incorrect measurement, his answer is not correct. Therefore, a score of 4 is given because the subject drew geometric patterns that were almost correct and used them to explain the problem and facilitate the solution.

Beside the incorrect answers, there were also correct answers provided by students, as shown in Figure 16.

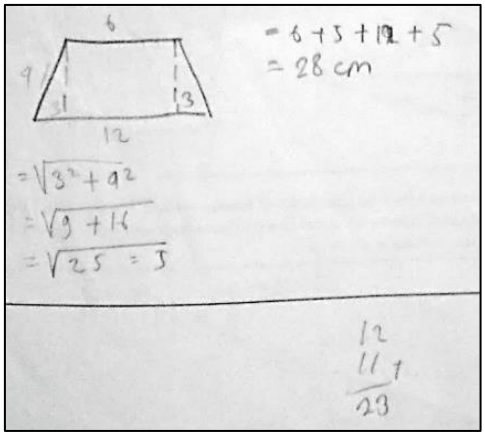

Figure 16. Test Result Number 5 by Subject A

It is known that subject A has accurately depicted the geometric pattern, and the size of the slanted side of the trapezoid was first calculated using Pythagoras' theorem. Therefore, because the visual representation is accurate, the solution to the problem is also correct. For Subject A score 5 was given for accurately drawing geometric patterns and using them to explain the problem and facilitate its solution.

Discussion

Visual representations in the form of images have been proven to help students solve geometry problems (Hamidah et al., 2025). The students that can draw the visual representation of the problems can find the solution of the problems correctly. But there were some cases that the students drew a geometric shape accurately, but unfortunately, they did not use it to explain the problem and facilitate its solutions. It was because they did not understand how to use the visual representation to help them solve the problems.

An analysis of each question shows that most students are able to draw quadrilaterals according to the problems given. However, in some questions, students do not fully use the visual representations they have created to facilitate problem solving. Errors in drawing shapes or inaccuracies in determining side lengths result in errors in the final answers.

In questions that required the construction of quadrilaterals from cut pieces, students tended to have difficulty understanding the properties of the shapes formed. This shows that conceptual understanding and visual representation ability are closely related. Students who were able to create accurate visual representations tended to be more successful in solving problems (Hengki & Jamiah, 2024).

This finding is in line with previous research results which state that visual representation ability play an important role in solving geometry problems (Azizah et al., 2024; Utami et al., 2019). Visual representation not only functions as a tool, but also as a means of thinking to understand the relationship between geometric elements (Anwar et al., 2022).

4. CONCLUSION

Based on the results of the study, it can be concluded that junior high school students' visual representation ability in quadrilateral material are in the moderate to high category. Visual representations in the form of images have been proven to help students solve geometry problems. Errors in visual representation tend to cause errors in problem solving.

Therefore, it is recommended that the development of students' visual representation abilities, particularly in geometry, be given greater emphasis. Learning activities should be designed to actively engage students in drawing, constructing, and interpreting geometric forms. In addition, continuous and constructive feedback on students' visual representations is necessary to ensure that conceptual misunderstandings are identified and addressed promptly.

5. ACKNOWLEDGE

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6. REFERENCES

Anwar, A., Turmudi, T., Juandi, D., Wahyuni, R., & Muntazhimah, M. (2022). Visual Thinking Skills in Solving Geometry Problems Based on Learning Style: Grounded Theory Study. *European Online Journal of Natural and Social Sciences*, *11*(3), 635–642. http://www.european-science.com

Aryanti, D, et. all. (2013). Kemampuan Representasi Matematis Menurut Tingkat Kemampuan Siswa pada Materi Segi Empat di SMP. *Jurnal Pendidikan Dan Pembelajaran*, *2*.

Azizah, A. N., Kusmayadi, T. A., Fitriana, L., Nataliliana, C., & Hermansyah, B. (2024). The Ability Of Mathematical Representation On Junior High School Students In Rectangular And Triangle Based On Gender. *Trigonometri: Jurnal Matematika*, *1*(1), 39–49. https://doi.org/10.30599/trigonometri.v1i1.3258

Demirel, A. H., & Simsekler Dizman, T. (2025). Pre-Service Mathematics Teachers' Understanding of Quadrilateral Definitions and Hierarchical Relationships: A Van Hiele Perspective. *International Journal of Psychology and Educational Studies*, *12*(4), 255–270. https://doi.org/10.52380/ijpes.2025.12.4.1484

Farokhah, L., Herman, T., & Jupri, A. (2019). Students' ability of mathematical representation on statistics topic in elementary school. *Journal of Physics: Conference Series*, *1157*(3). https://doi.org/10.1088/1742-6596/1157/3/032110

Fauziyah, R. R., & Jupri, A. (2020). Analysis of elementary school students' ability on mathematical communication and mathematical representation. *Journal of Physics: Conference Series*, *1521*(3), 1–5. https://doi.org/10.1088/1742-6596/1521/3/032080

Hamidah, H., Kusuma, J. W., Chotimah, S., & Senjayawati, E. (2025). Evaluation of geometry skills: Integrating logic and drawing indicators through GeoGebra-based learning. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *10*(3), 182–199. https://doi.org/10.23917/jramathedu.v10i3.8802

Hengki, M., & Jamiah, Y. (2024). *Indonesian Journal of Science and Mathematics Education Enhancing senior high school students' visual imagery creativity in geometry through Geoboard Article Info ABSTRACT*. *07*(2), 361–372. https://doi.org/10.24042/ijsme.v5i1.22624

Jupri, A. (2016). Seeing the unseen in words and symbols: The role of visualization in writing geometry proofs. *Proceedings of International Conference on Education and Psychology 2016 (ICEduPsy16)*.

Jupri, A., Usdiyana, D., & Sispiyati, R. (2020). Peran Representasi Matematis dalam Pembelajaran Perkalian Bentuk Aljabar melalui Pendekatan Matematika Realistik. *Jurnal Elemen*, *6*(1), 89–98. https://doi.org/10.29408/jel.v6i1.1716

Khoerunnisa, R., & Maryati, I. (2022). Kemampuan Representasi Matematis Siswa SMP terhadap Materi Segiempat. *Plusminus: Jurnal Pendidikan Matematika*, *2*(1), 165–176. https://doi.org/10.31980/plusminus.v2i1.1583

NCTM. (2000). *Principles and Standards for Schools Mathematics*. Reston.V.A.

Saputra, A., Priatna, N., Laia, H. O., & Indonesia, U. P. (2024). *Al-Khwarazmi Journal of Mathematics*

Education and Learning. *8*(1), 80–87.

Schoenherr, J., Strohmaier, A. R., & Schukajlow, S. (2024). *schoenherr 1-s2.0-S1747938X24000484-main.pdf.crdownload*. https://doi.org/https://doi.org/10.1016/j.edurev.2024.100639

Susilawati, W., Suryadi, D., & Dahlan, J. A. (2021). The Improvement of Mathematical Spatial Visualization Ability of Student through Cognitive Conflict. *International Electronic Journal of Mathematics Education*, *12*(2), 155–166. https://doi.org/10.29333/iejme/607

Utami, C. T. P., Mardiyana, & Triyanto. (2019). The identification of visual representation ability of junior high school students in solving geometry problems. *Journal of Physics: Conference Series*, *1180*(1). https://doi.org/10.1088/1742-6596/1180/1/012014