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Student's Mathematics Ability in Written Communication Based on Van Hiele's Theory and Gender

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Abstract

The student's ability to express and understand mathematical ideas in writing; Whether in tables, formulas, diagrams, drawings, or demonstrations, is called the student's written mathematical communication skills. Van Hiele's theory divides students' development in learning geometry into five levels, namely from level 0 to level 4. The purpose of this study is to find out students' mathematics ability in written communication based on Van Hiele's theory which is reviewed from gender differences. This research is a qualitative descriptive research. Students' mathematical communication skills at level 4: (1) can visually classify flat shapes, (2) can describe flat shapes visually, (3) can show the characteristics of flat shapes through pictures, (4) can write the relationships of concepts on flat shapes well, (5) can write how to determine the area and circumference of flat shapes, (6) can use terms and notation to present data. Meanwhile, level 1 students are still not able to describe the shapes of flat buildings visually well and are not able to write down the relationship of concepts on flat buildings well. In addition, related to gender, some aspects are superior to men and others are superior to women.

Keywords: written mathematical communication, van hiele theory, gender

INTRODUCTION

Mathematics is one of the subjects taught from elementary, junior high to university levels (Risalah & Hodiyanto, 2022; Rosyadi & Sa'dijah, Cholis; Susiswo; Rahardjo, 2022). Mathematics itself is a science that studies numbers, formulas, and symbols in the language of mathematics (Ummah, 2021). Mathematics is taught at different levels because mathematics is an integral part of everyday life (Mahendra et al., 2020). From simple calculations to complex problem-solving, mathematical concepts are used in a variety of fields, including finance, science, and Engineering (Tampubolon et al., 2019). Learning itself is a learning communication between the teacher as the recipient of the message, and the student as the recipient of the message that can determine the learning outcome. So that mathematics learning can be interpreted as a communication activity between teachers and students in conveying mathematical ideas in the form of numbers, formulas, and symbols. However, often in learning mathematics at school, students have difficulty receiving and processing information. So that the mathematical concepts taught are not well understood by students (S. Yanti, 2016) .The purpose of mathematics learning in schools is to prepare students to face dynamic changes in life by maturing logical, rational, and critical reasoning skills, as well as honing students' skills to be able to use mathematical concepts in solving problems in daily life and in studying other fields of science (Hadi, 2017)

Communication is an important process in learning mathematics. With communication, students will be able to understand and learn a mathematical concept and be able to connect concepts contained in mathematics so that students become more precise, more convincing, and clearer in using mathematical language. The ability of students to express and understand mathematical ideas orally and in writing; Whether in the form of tables, formulas, diagrams, drawings, or demonstrations, is also called students' mathematical communication skills. One of the causes of students' difficulties in mathematics is that students are less able to relate a problem to real life (Hodiyanto, 2017; Munandar, 2023; Wahyuni, 2023). Therefore, students still do not understand the learning objectives and difficulties in expressing an idea. So it can be concluded that students' low mathematical communication skills can lead to misconceptions of concepts that can be fatal to students' academics, especially in Mathematics subjects, especially geometry.

Six aspects of mathematics learning are interrelated with each other. These aspects are: Statistics and Chance, Algebra, Logic, Calculus, Trigonometry, and Geometry (Ministry of National Education, 2006). Geometry is one of the aspects of mathematics that studies about shapes and spaces. Geometry at the elementary level, discussing points, lines, planes, and spaces. Henceforth, the discussion of geometry will be connected with abstract concepts with the help of symbols. Some of the abstract concepts in geometry are formed by elements that are not defined based on a deductive system (Mufti et al, 2020; Bird, 2021). Sutama (2014) also said that the results of students' mathematics tests in geometry aspects were still lower than students' mathematics test results in other aspects. One of the reasons that make it difficult for teachers to teach geometry is that teachers do not know the level of students' ability to understand geometry concepts. According to Van de Walle (2019), Van Hiele's theory was developed to assist students in optimizing the thought process when studying geometry.

Van Hiele's theory is a theory that discusses the process of student development in learning geometry (Mulyadi & Muhtadi, 2019). Van Hiele's theory divides student development into several levels. The Thinking Level in Van Hiele's theory consists of 5 levels, namely Level 0, or Visualization, Level 1, or Analysis, Level 2, or Abstraction, Level 3, or Deduction, and Level 4, or Rigor. This leveling can demonstrate students' ability to understand mathematics learning in the field of geometry. However, in Van Hiele's theory, it is said that the highest level of geometric thinking ability of high school students is at Level 3, most of which are at Level 1. Because Level 4 requires a complex and complicated level of thinking. So, high school students rarely reach that level. Meanwhile, the ability to think about geometry in junior high school students is between Level 0 to Level 2. Also states that there are indicators of achievement of a level in Van Hiele's theory, namely: (1) Armah & Kissi (2019); Amidu & Nyarko (2019); Mensah et al., (2023)At Level 0 students only recognize an object visually, such as distinguishing triangles and squares. At this level, students have not paid attention to the characteristics of an object to distinguish a classification, for example, such as rectangles and parallelograms are generally squares. (2) At Level 1, students recognize or identify objects through their visual appearance. Students recognize the building by its shape in the "whole" and compare it to a prototype or surrounding objects. At this level, students begin to get used to using the basic vocabulary of geometry. Students use visual considerations without explicitly noticing geometric properties. Students could describe a particular flat figure. (3) At Level 2, students can analyze and mention the characteristics of a flat building. Students can begin to generalize about their form and properties. For example, students could say that all the ribs of a square are congruent and perpendicular to the parallel-facing ribs. Students can classify the shape of a building based on its characteristics. At this level, students are not yet able to analyze the properties of a flat building. For example, they have not been able to conclude that a square is a rectangle based on its properties. (4) At Level 3, students can build relationships between traits both in flat and between buildings. For example, in a rectangle, the facing sides are parallel, the facing angles must be the same size, or all squares are rectangles because squares have all the properties of a rectangle. Students can use definitions as justifications in informal arguments. At this level, students have not been able to build evidence. (5) At level 4, students can think and understand concrete and continuous mathematical rules. According to (Armah et al., 2017) The geometric thinking level of van Hiele's theory has rules, namely: (1) the student's thinking level will be passed gradually, starting from level 0. When students move up from a level, it means that students have experienced a way of thinking about geometry according to the previous level and the thinking at the next level has been formed. (2) age and maturity factors do not affect the level of thinking in Van Hiele's theory, but the content, methods, and learning media that have been obtained have more influence on the level of students' geometric ability. (3) Geometry experience is the greatest influence on the development of students' geometry level. By applying Van Hiele's theory in this study, it can know the level of students' understanding of geometric materials.

Humans are created differently, human differences based on gender are divided into two, namely men and women. Men and women also have differences in terms of ability, especially mathematical ability. The statement is supported by Poeschl (2021) who states that Mathematical ability in men is superior to mathematical ability in women. So in learning mathematics in school, male students are easier to understand and process mathematical information than female students (Lubienski & Pinheiro, 2020; Rodriguez et al., 2020). Likewise with his mathematical communication skills. If the mathematical skills of male students are superior to female students, then it can show that the mathematical communication skills of male students are also superior to female students. If so, then female students must study harder than male students to gain an understanding and mathematical ability equivalent to men.

This research combines two important aspects of mathematics education. The aspect in question is the level of geometric thinking based on Van Hiele's theory and the influence of gender differences. Both aspects are associated with students' written mathematical communication skills. This research is important because mathematical communication skills are an essential competency in the 21st-century education era, while gender factors are often a sensitive issue that affects learning. By identifying patterns of mathematical communication skills based on Van Hiele's theory and gender differences, the results of this study can provide practical guidance for educators in designing inclusive and effective learning strategies, to improve the quality of geometry learning in higher education.

Some studies are relevant to this study. The intended research is the research conducted Mulyadi & Muhtadi (2019) The study aims to find out the thinking process of students in solving geometry problems based on Van Hiele's Theory reviewed from gender. The results of the study showed that in terms of gender, high-ability male students were at level 2 (informal deduction), moderately capable male students were at level 1 (analysis), and low-ability male students were at level 0 (visualization). Meanwhile, female students with high and medium abilities are at level 1 (analysis), and female students with low abilities are at level 0 (visualization).

This study analyzes students' written mathematical communication skills based on Van Hiele's theory and gender. The purpose of this study is to find out the level of geometric thinking of students based on Van Hiele's theory. In addition, another purpose of this research is to determine the mathematical communication skills of students written based on Van Hiele's theory. Meanwhile, the main purpose of this study is to find out the mathematical communication skills of students' written mathematics based on Van Hiele's theory which is reviewed from gender differences. It is hoped that this research can motivate teachers to better understand students and be able to adjust teaching to be more effective.

METHODS

This study uses a type of descriptive research using a qualitative approach. Qualitative descriptive research is a research approach that aims to describe and understand social or cultural phenomena from the point of view of the subject being researched (Rosyadi, 2023). This study aims to determine students' written mathematical communication skills reviewed from van Hiele's theory and gender. Van Hiele's theory is a theory that divides students' levels of geometric thinking into 5 levels, namely from level 0 to level 4. This research was carried out on December 26-27, 2024. The subjects in this study are 20 students of the University of Muhammadiyah Malang in the final 1st semester who were randomly selected from the undergraduate class of mathematics education.

The procedures used in this study are: (1) Preliminary Activities, (2) Determination of Subjects, (3) Making Research Instruments, (4) Instrument Validity Test, (5) Data Analysis from Validation Results, (6) Data Collection, (7) Data Analysis of Test Results, (8) Determination of Students' Geometric Thinking Level, (9) Test of Students' Written Mathematical Communication Skills, (10) Interview, (11) Drawing Conclusions.

The instruments in this study consist of 2 types of test questions. The first test is a test of the student's geometry ability level and the second test is a test of the student's written mathematical communication ability. The first test question is quoted from Sunardi (2000) which is a translation of the main reference Usiskin (1982) which consists of 25 multiple-choice questions. The questions are arranged in order according to the level of van Hiele and in each level there are 5 questions. Students can be said to be at a level if they do at least 3 out of 5 questions correctly at each level tested. Students are said to be at level n+1 if they have graduated at level n. After obtaining the level of thinking of each student, then the students are grouped according to their level of thinking, and 1 male student and 1 female student are selected from each grouping. Then the selected students will take the second test. Then the results of the second test will be analyzed to determine students' written mathematical communication skills based on the grid in Table 1.

Table 1 Grid of Written Mathematical Communication Skills

Aspects of Mathematical Communication	Indicators	Question Number
Ability to express mathematical ideas through writing, oral, and demonstrating and visually describing	Students can visually classify flat shapes	1
	Students can visually describe flat shapes	2
Ability to understand, interpret, and evaluate mathematical ideas both orally, in writing, and other visual forms.	Students can demonstrate the features of flat builds through pictures	2
	Students can write an analysis of the relationship of concepts to flat shapes	3
	Students can write down how to determine the area and circumference of a flat building	4, 5
Ability to use terms, mathematical notations, and their structures to present ideas and describe relationships and models of situations.	Students can use terms and notation to present data	3, 4, 5

RESULTS AND DISCUSSION

The first test is the geometry ability test. The test stated the level of students' geometry ability based on Van Hiele's theory. From the results of the first test, it was found that out of 20 students, 8 students were at level 1 and 12 other students were at level 4. The first test result is illustrated in Table 2.

Table 2 Percentage of Geometry Ability of Students

Geometry Ability Level	Number of Students	Percentage
Level 0	0	00,00%
Level 1	8	40,00%
Level 2	0	00,00%
Level 3	0	00,00%
Level 4	12	60,00%
Total	20	100,00%

Van Hiele stated that students at level 1 or Analysis can already get acquainted with the properties of geometric structures. However, it has not been able to relate or connect between geometric shapes. While students at level 4 or Rigor already know how important the accuracy of the basic principles that underlie a proof is, students already understand the use of evidence and why something is used as a postulate and can write a formal description of geometric systems without the help of a concrete flat building model as a reference.

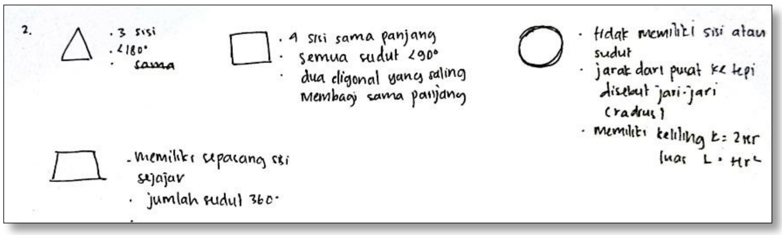
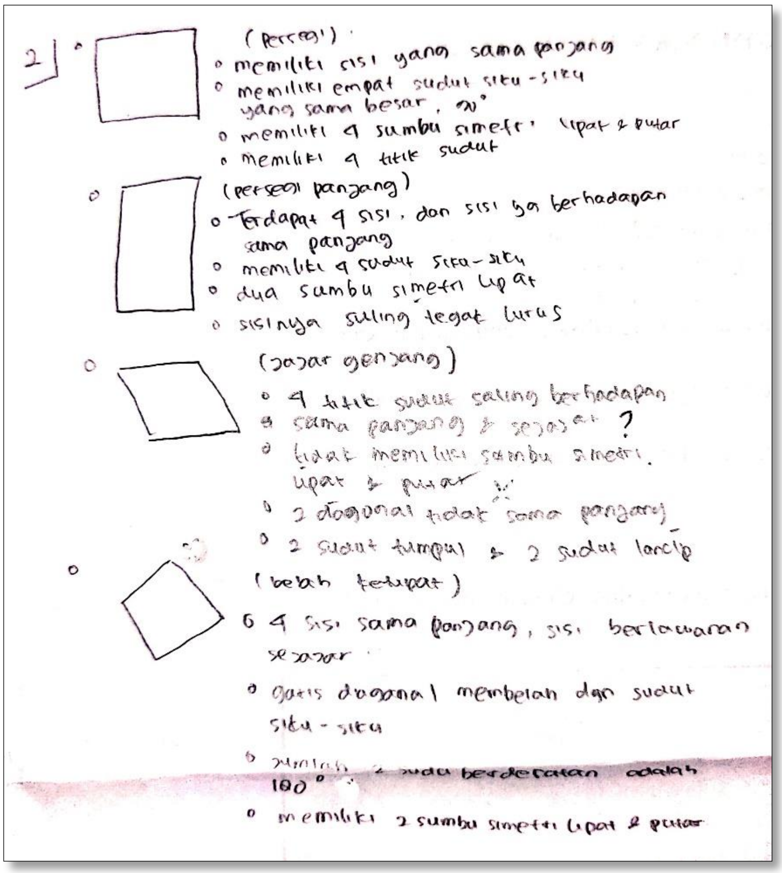
The next test is a test of mathematical communication skills. This test demonstrates the student's mathematical communication skills. From the results of the second test, question number 1 obtained the results as shown in Table 3. The results of the second test question number 2 are shown in Table 4. The results of the second test question number 3 are shown in Table 5. The results of the second test question number 2 are shown in Table 6.

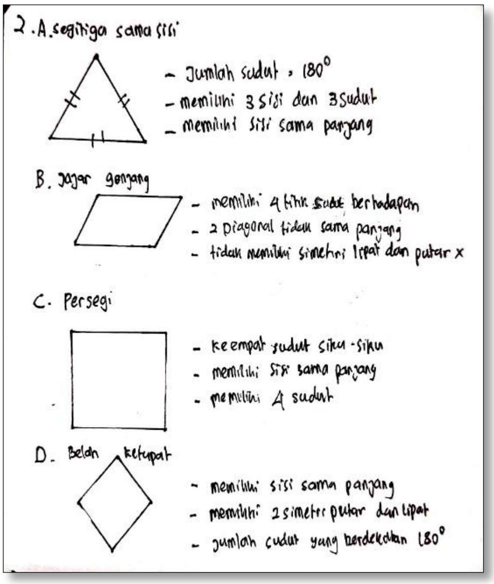
Table 3 Truth of Test Question 2 Number 1 Answers

Picture Number	Picture	Value (B/S)			
		1		4	
		LK	PR	LK	PR
1	Trapezoid	B	B	B	B
2	Kite	B	B	B	B
3	Arbitrary rectangle	S	S	S	S
4	Square	B	S	S	B
5	Parallelogram	B	B	B	B
6	Pentagons	S	S	S	S
7	Parallelogram	B	B	B	B
8	Square	B	B	B	B
9	Trapezoid	B	S	S	S
10	Triangle	B	B	B	S
11	Split	B	B	B	B
12	Pentagons	B	B	B	B
13	Pentagons	S	B	B	B
Total True		10	9	9	9

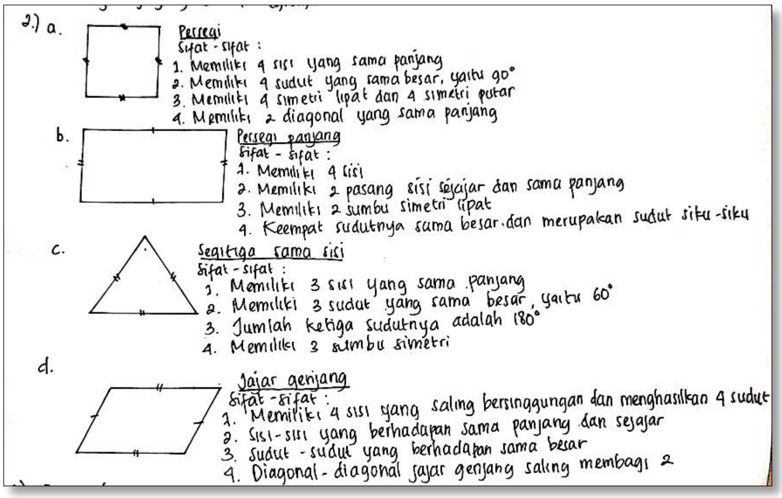
From number 1 of Test 2 with the interviews, it can be seen that all subjects still do not understand the concept of arbitrary rectangles and do not understand the concept of pentagons. From the figure of Figure 9, it can be seen that all subjects still have difficulty determining the figure seen from different angles.

Table 4 Test Results 2 Number 2

Subject Level	Subject Gender	Test 2 Number 2 Answer
1	Man	 Translate:  . 3 sides . $\angle 180^0$  . doesn't have sides or corners . The distance from the center to the edge is called the radius. . has a perimeter $k = 2\pi r$. $Area\ L = \pi r^2$  . 4 sides of equal length . all angles $\angle 90^0$. two diagonals that divide evenly  . has a pair of parallel sides . numbers of angles 360^0
	Woman	

<table>
<tr><th colspan="2">Subject</th><th rowspan="2">Test 2 Number 2 Answer</th></tr>
<tr><th>Level</th><th>Gender</th></tr>
<tr><td></td><td></td><td>Translate:
1. Square
has sides of equal length, has four right angles, has 4 axes of symmetry for folding and rotating, has 4 corner points
2. rectangle
It has 4 sides and opposite sides are of equal length, It has 4 right angles, two axes of symmetry, The sides are perpendicular to each other
3. parallelogram
4 vertices opposite each other,equal length and parallel, does not have an axis of symmetry for folding and rotation,2 diagonals are not of equal length, 2 obtuse angles and 2 acute angles
4. diamond shape
4 sides of equal length, opposite sides are parallel, diagonal lines bisect at right angles, the sum of adjacent angles is 180, it has 2 axes of symmetry, both folding and rotational.</td></tr>
<tr><td>4</td><td>Man</td><td>


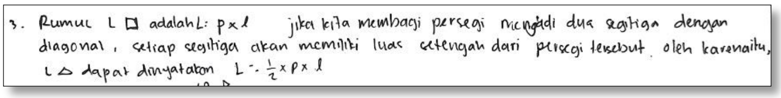
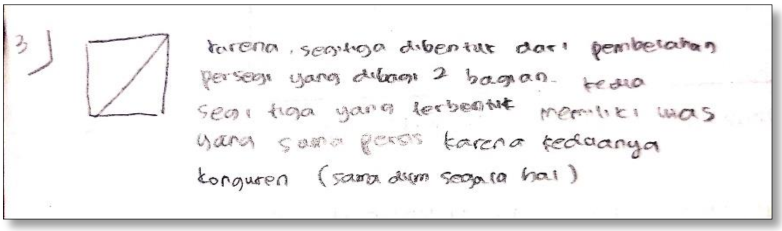
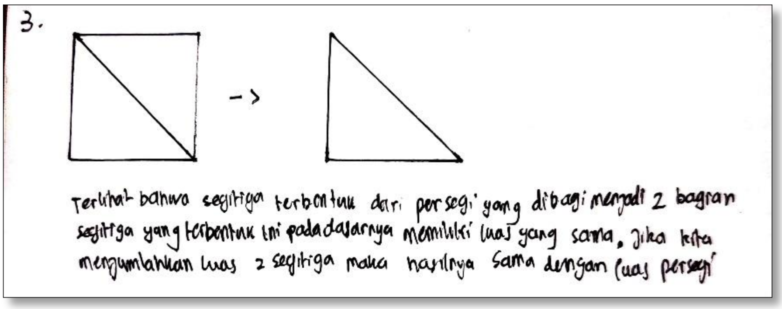
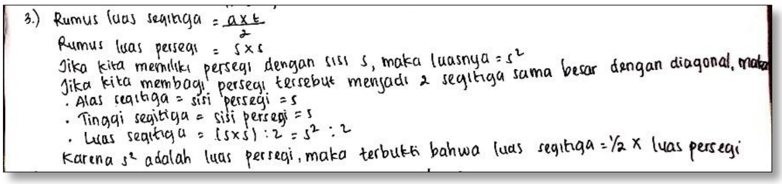
Translate
A. equilateral triangle.
Sum of angles 180, has 3 sides and 3 angles, has sides of the same length.
B. Parallelogram
Has 4 opposite corners, 2 diagonals of unequal length, does not have fold and rotational symmetry.
C. Square
Four right angles, has equal length sides, has 4 corners
D. Diamond shape.
Has equal side lengths, has 2 rotational and reflective symmetries, the sum of adjacent angles is 180.</td></tr>
</table>

Subject Level	Subject Gender	Test 2 Number 2 Answer
	Woman	 Translate: a. Square properties: 1. has 4 sides of equal length 2. has 4 angles of equal measure which is 90 3. has 4 lines of symmetry and 4 rotational symmetries 4. has 2 diagonals of equal length b. Rectangle properties: 1. has 4 sides 2. Has 2 pairs of parallel and equal length sides 3. Has 2 axes of symmetry 4. All four angles are equal in size c. equilateral triangle properties: 1. has 3 sides of equal length 2. has 3 angles of equal size which are 60 degrees 3. the sum of the three angles is 180 degrees 4. has 3 lines of symmetry

From the number 2 results of Test 2 with the interviews, all level 1 subjects have been able to provide flat building characteristics. However, female level 1 subjects still have some inappropriate characteristics. Meanwhile, all level 4 subjects have been able to provide flat building characteristics well.

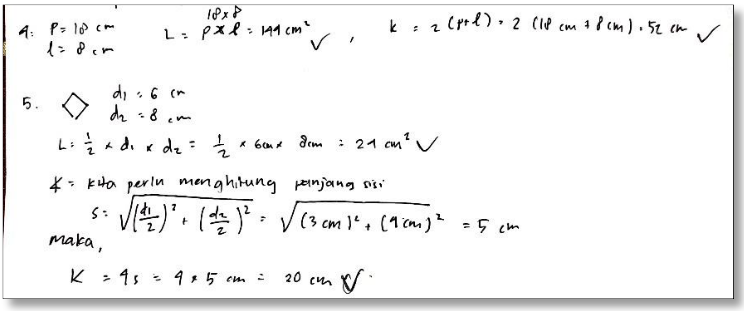
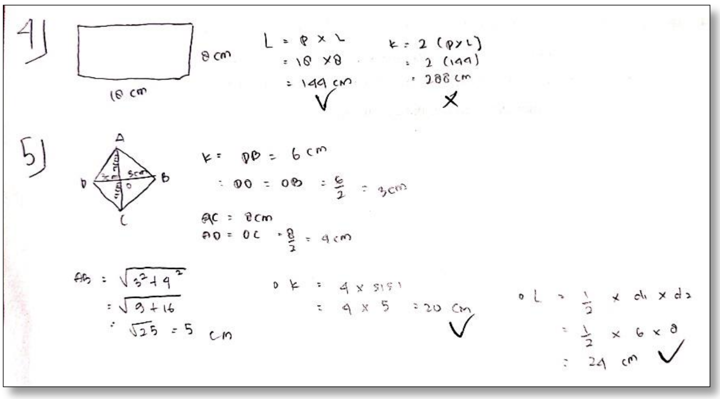
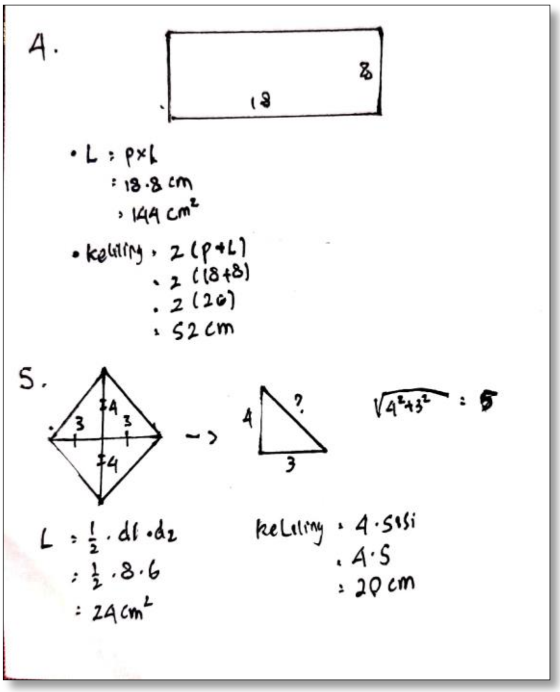
From the number 2 results of Test 2 with the interviews, it can also be seen that the subject of level 1 can describe a flat wake. However, subject level 1, is still not able to describe the awakening well. Meanwhile, the level 4 subject has been able to describe waking up well.

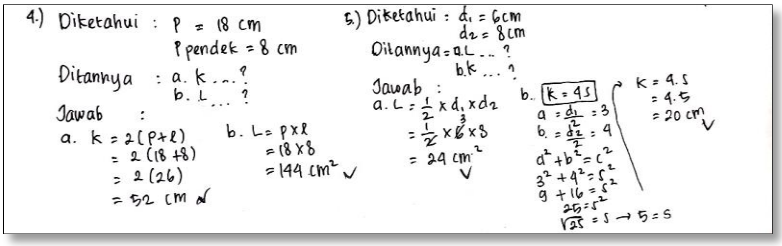
Table 5 Test Results 2 Number 3

Subject Level	Subject Gender	Test 2 Number 3 Answer
1	Man	 3. Rumus L □ adalah L: $p \times l$ jika kita membagi persegi menjadi dua segitiga dengan diagonal, setiap segitiga akan memiliki luas setengah dari persegi tersebut, oleh karenaitu, L△ dapat dinyatakan $L = \frac{1}{2} \times p \times l$ Translate: The square area formula is $L = p \times l$. If we divide the square into two triangles diagonally, each triangle will have an area of half that square. Therefore, the area of a triangle can be expressed .$L = \frac{1}{2} \times p \times l$
	Woman	 3) karena, segitiga dibentuk dari pembelahan persegi yang dibagi 2 bagian. kedua segitiga yang terbentuk memiliki luas yang sama persis karena keduanya konguren (sama dlm segala hal) Translate: Because a triangle is formed from the division of a square that is divided into two parts. The two triangles that are formed have exactly the same area because they are congruent (equal in every way)
4	Man	 3. Terlihat bahwa segitiga terbentuk dari persegi yang dibagi menjadi 2 bagian segitiga yang terbentuk ini pada dasarnya memiliki luas yang sama, Jika kita mengumlahkan luas 2 segitiga maka hasilnya sama dengan luas persegi Translate: it can be seen that a triangle is formed from a square that is divided into two parts. This triangle that forms is basically the same area. If we add up the area of the two triangles then the result is equal to the square area
	Woman	 3.) Rumus luas segitiga = $\frac{a \times t}{2}$ Rumus luas persegi = $s \times s$ Jika kita memiliki persegi dengan sisi s, maka luasnya = s^2 Jika kita membagi persegi tersebut menjadi 2 segitiga sama besar dengan diagonal, maka · Alas segitiga = sisi persegi = s · Tinggi segitiga = sisi persegi = s · Luas segitiga = $(s \times s) : 2 = s^2 : 2$ Karena s^2 adalah luas persegi, maka terbukti bahwa luas segitiga = ½ × luas persegi Translate: the formula of the area of a triangle is $\frac{a \times t}{2}$, the formula of square area is $s \times s$. If we have a square with sides s then the area is s^2. If we divide the square into two triangles equal to the diagonal, then: (1) the base of the triangle is equal to the side of the square, namely s; (2) the height of the triangle is equal to the square side, namely s; (3) The area of the triangle is equal to $(s \times s): 2 = s^2: 2$. Since s^2 is a square area, it is evident that the area of a triangle is equal to half the area of the square

From the number 3 results of Test 2 with the interviews, it can be seen that all subjects have been able to analyze a geometric concept. However, only level 4 subjects are able to write with good geometry concepts. Meanwhile, in level 1 subjects, they are still not able to write with geometry concepts well.

Figure 6 Test Results 2 Numbers 4 and 5

Subject Level	Subject Gender	Test 2 Answers Number 4 and 5
1	Man	
	Woman	
4	Man	

Subject		Test 2 Answers Number 4 and 5
Level	Gender	
	Woman	

Understanding of Student Concepts Based on Van Hielle's Theory

From the number 4 results of test 2 with the interviews, it can be seen that the conceptual understanding of the level 1 subject is clearly below the level 4 subject. And from the results of test 2 numbers 4 and 5, it can be seen that all subjects can write with good mathematical notation. However, from answer number 5 of the level 1 subject, it can be seen that the mathematical notation writing ability of male subjects is better than that of female subjects.

From Test 1, number 1 of Test 2 with the interviews, it can be seen that all subjects can be said to be able to classify flat shapes visually. From the level 1 subject, it can be seen that the ability to classify visually flat shapes is superior to that of women. This is because men have visual-spatial skills that are superior to women (Firmanti, 2017; Maccoby & Jacklin, 1974; Naja et al., 2021). Krutetskii (1976) also conveyed that men are superior in the concept of space to women.

From Test 1, number 2 of Test 2 with the interviews, it can be seen that the level 1 subject has not been able to describe flat shapes visually well. Meanwhile, the level 4 subject can already describe flat shapes visually well. However, it can be seen from the level 4 subject that the ability to visually describe flat shapes is superior to men. This is because women's drawing skills are superior to men's (Fitri, 2024; Nugraha & Pujiastuti, 2019). In addition, from Test 1, number 2 of Test 2 with the interviews, it can also be seen that all subjects can show the characteristics of flat buildings through pictures.

From Test 1, number 3 of Test 2 with the interviews, it can be seen that all subjects can write the relationship of concepts on flat figures, but only level 4 subjects can write concept analysis on flat figures. From Test 1, number 4 of Test 2 with the interviews, it can be seen that female level 1 subjects still have difficulty understanding the concept of the circumference of the circle. This is because men have superior mathematical skills than women (Hanifah, 2018; Imamuddin, 2016). And from Test 1 and number 5 of Test 2 with the interviews, All subjects can answer all questions correctly.

Students' Mathematical Communication Skills

Students' mathematical communication skills have a close relationship with a person's critical thinking (Rosyadi et al., 2022; Taufik et al., 2020). The communication aspect can also be associated with understanding in solving a given mathematical problem (Effendi et al., 2024; Rahma et al., 2023). Therefore, mathematical abilities can arise when a person solves a problem and uses his or her critical reasoning (Lamina et al., 2023).

From Test 1, number 4 and 5 of Test 2 with the interviews, it can be said that all subjects can write how to determine the area and circumference of a flat building. However, the ability to write how to determine the area and circumference of a flat building is superior to that of men. This is because women have more critical thinking skills than men (E. D. Yanti et al., 2019).

From Test 1, numbers 3, 4, and 5 of Test 2 with the interviews it can be seen that all subjects can use terms and notations to present data. However, the ability to use terms and notation to present data for men is superior to that of women. This is because men's mathematical abilities are superior to women's (Hanifah, 2018; Imamuddin, 2016).

Gender and Mathematical Communication

These gender differences raise critical questions about the factors behind superiority in certain aspects. Whether this reflects inherent differences in how the genders think or process mathematical information, or rather communication styles influenced by socialization, cultural expectations or previous learning experiences (Fitri, 2024; Nugraha & Pujiastuti, 2019). For example, perhaps female students tend to be more detailed in narrative explanations or diagrams, while male students are more concise or focus on formulaic structures. The discussion should explore why these differences arise, whether there are consistent patterns at certain Van Hiele levels, and how this might affect teachers' understanding of students' abilities.

The implications of these findings are highly relevant for teaching practice. If there are indeed gender differences in aspects of written mathematical communication, educators need to consider more gender-sensitive instructional and assessment strategies. This means designing tasks and assessment rubrics that not only accommodate, but also encourage different styles of mathematical communication, so that all students, regardless of gender, have equal opportunities to demonstrate and develop their ability to express mathematical ideas in writing (Hanifah, 2018; Imamuddin, 2016). .

CONCLUSION

The geometry ability of students in this study is 40% at level 1 and 60% at level 4. Students at level 1 do not understand the concept of arbitrary rectangles, lack understanding of the concept of pentagons, still have difficulty determining shapes seen from different angles, cannot spread shapes well, and are not able to write with geometry concepts well. However, level 1 students have been able to provide flat building characteristics, although there are still some characteristics that are not appropriate for female students. Level 1 students are already able to analyze a geometric concept and can write down mathematical concepts with good mathematical notation. However, the mathematical notation writing ability of male level 1 students is better than that of female level 1 students. Students at level 4 also do not understand the concept of arbitrary rectangles and do not understand the concept of pentagons and still have difficulty determining shapes that are seen from different angles However, level 4 students have been able to provide the characteristics of flat buildings well, can describe buildings well, can analyze a geometric concept, can write with good geometric concepts and can write mathematical concepts with good mathematical notation.

The mathematical communication skills possessed by students at level 1 are already able to classify the shapes of flat buildings visually, cannot describe the forms of flat buildings visually, can show the characteristics of flat buildings through pictures, and are not able to write the relationships of concepts on flat buildings well, can already write how to determine the area and circumference of a flat building and can already use terms and notation to present data. Meanwhile, the mathematical communication skills possessed by students at level 4 are being able to classify flat shapes visually, being able to describe flat shapes visually, being able to show the characteristics of flat shapes through pictures, being able to write down the relationships of concepts on flat shapes well, can write down how to determine the area and circumference of a flat building, can use terms and notation to present data. Meanwhile, the influence of gender in students' mathematical communication skills is the ability to classify flat shapes visually as male superior to women, the ability to visually describe flat shapes as Women are superior to men, the ability to write how to determine the area and circumference of female flat shapes is superior to male and the ability to use terms and notation to present data is superior to the male of women.

From this study, several suggestions can be used as consideration for further research. First, it is hoped that future researchers will be able to identify similar research at other levels that do not yet exist. Second, it is hoped that future researchers will be able to develop indicators of mathematical communication skills to be more creative.

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