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# The Relationship Between Initial Understanding of Flat Builds and the Ability to Determine the Height of a Triangle

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**Abstract**

This study explores how students' understanding of plane figures relates to their ability to determine triangle altitudes at the junior high school level. Understanding altitude determination is crucial for various math tasks. The aim is to gauge how students' initial understanding influences their ability to apply altitude concepts in math learning at the junior high school level. Data were collected from 28 eighth-grade students through a preliminary ability test (PAT) and non-routine challenge questions to determine the altitudes of right and obtuse triangles. Descriptive analysis, cross-tabulation, and chi-square tests were conducted to assess the relationship between students' initial abilities in plane figures and their ability to determine triangle altitudes. The chi-square test results show that there is no significant relationship between students' initial abilities and skills in solving PAT questions and their ability to determine the altitudes of right-angled or obtuse triangles. These findings suggest that the ability to answer PAT questions does not always mean meaning only sometimes means the ability to solve problems related to applying these concepts.

**Keywords:** plane figures; triangle; initial understanding; triangle altitude concept; mathematics in junior high school

## 1. Introduction

In mathematics learning, a deep understanding of basic concepts is the foundation for developing critical thinking and problem-solving skills (Jannah, et al., 2020). One of the concepts that is the main focus in flat wake learning at the Junior High School (SMP) level is to determine the height line of the triangle. In this paper, we will explore the importance of student understanding in determining the height line of a triangle and its relationship with students' initial understanding of flat shapes that they obtained at the previous level.

One of the subdisciplines of mathematics is geometry, which is very important in forming student reason (Hidayah & Fitriani, 2021). In addition, everyday life is closely related to geometry (Ayuningrum, 2017), so it needs to be introduced early (Lengkong, 2022). Geometry is also an important and widely discussed subject in school mathematics, including at the junior high school level (Naja &; May, 2023). Understanding the direct objects of mathematics—facts, concepts, principles, and skills, as well as their applications—is an important goal of teaching mathematical geometry in schools (Nadjib, 2014). However, geometry is still considered the most elusive subdiscipline compared to other subdisciplines, as evidenced by the fact that there are still many students who are too weak to absorb geometry material (Nur'aini et al., 2017).

One of the things that is the basic material in geometry is triangles (Amelia, 2021). This flat build is considered an essential topic that forms the basis for understanding various other mathematical concepts. Building a triangle has been taught from pre-school (Tsamir, et al., 2015) to college. However, Prabawanto & Mulyana's (2017) research shows that teachers often face difficulties in developing effective learning models for triangular topics, as well as in integrating mathematical concepts into practical problem-solving activities. What's more, prospective math teachers are also expected to understand the concept of triangles well to improve their teaching skills. From the students' point of view, their understanding of triangular material is still considered inadequate due to the difficulty of connecting various mathematical concepts (Nursaadah & Amelia, 2018). Another proof of this is the findings of Turian et al. (2020), which show that only 61% of all students have succeeded in mastering triangular material, and the average score is still below the minimum completeness criteria. Therefore, students' initial understanding of flat wakes, especially triangles, is a concern in this study, focusing on its relationship with students' ability to determine the height of a triangle (Rahaju, et al., 2018).

The definition of the high line of a triangle is a segment of line drawn from a point on the triangle to the opposite side so that it is perpendicular to that side (Alexander &; Koeberlein, 2020). The height line can also lie outside the triangle, especially in an obtuse triangle, by drawing a perpendicular line from a point on the triangle to the extension of the side that does not pass through it. In a right triangle, if the upright side is the base of the triangle, then the other side is the height of the triangle.

Understanding the determination of the height line on a triangle is very important in learning mathematics in junior high school. This is because the height line is also an element that will be used to determine the area of a triangle. In addition, studying the concept of triangular height is important because it helps understand the geometric structure of triangles, solve geometry problems, and prepare understanding for further mathematical concepts such as the Pythagorean theorem and trigonometry (Guy, 2019; Hilf, 2021).

Not many recent studies explicitly discuss students' ability to determine the high line of a triangle. In reality, students' ability to determine the height line on a triangle is still low (Leonino, 2014). In addition, students have more difficulty determining the height lines of right and obtuse triangles (Şengün &; Yılmaz, 2021). This is because students have difficulty defining and explaining the concept of high lines, lack practical practice, and low understanding of basic geometry. In addition, research by Nurhasnah et al. (2017) also explained that some students still face challenges in identifying the base and height sides of the triangle when the build is positioned unusually for them, resulting in low student learning outcomes.

Based on the above, this study aims to investigate the relationship between students' initial understanding of flat wake and their ability to determine the height line of a triangle at the junior high level. The results of this study are expected to reveal the extent to which students' initial understanding affects their ability to apply the concept of triangular high lines, an important aspect of mathematics learning at the junior high level.

## 2. Method

This research was conducted at the UM Laboratory Junior High School in Malang City during PPL activities, namely January – April 2024, with the research subjects being 28-grade VIII-E students.

The initial ability test (TKA) is carried out through the Wordwall application which contains 16 questions about the type, area, and perimeter of flat wakes. The time given to take the test is 10 minutes. Students only need to match the questions that appear one by one with all the answer choices below. If you answer the wrong question three times, it will be void. The predicate of test scores is given based on the accuracy of students' answers. Students who answer all questions correctly will be given the letter A in the assessment column. If students still make mistakes in answering the questions, they will be given the letter B. Students who do not complete or do not answer all questions until the time runs out will be given the letter C.

After kindergarten, the teacher teaches about the elements of a triangle, including the height line of a triangle, by giving an example of a pointed triangle and explaining all the height lines. Then students are given a non-routine challenge to determine the height line on a right triangle if one of the upright sides is a base. Students are instructed to draw or mark the high line on the triangle within five minutes. Furthermore, the teacher gave a similar challenge with the example of an obtuse triangle if one side at an obtuse angle is a triangular base. Students who can answer correctly within the specified time will be given the title of capable. The challenge questions used are as follows:

1. It is known as the right triangle ABC in Figure 1(a), right angle in B. If BC is the base of the triangle, determine the height of the triangle!
2. The obtuse triangle DEF is known in Figure 1(b). If EF is the base of a triangle, determine the height of the triangle!

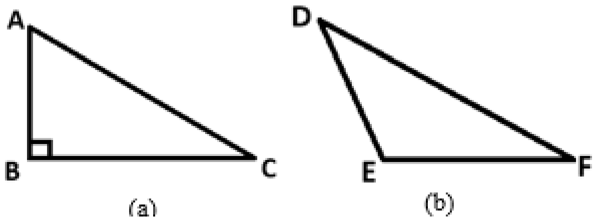


**Figure 1. Non-Routine Challenge Problem**

This research is a quantitative research type. The data collected consisted of three variables, namely the results of TKA (TKA) with letter labels (A, B, and C), students' ability to find the height of a right triangle (S), and student's ability to find the height of a blunt triangle (T). All variables contain categorical data, so the statistical test that can be used to determine the relationship between variables is the chi-square test (Daniel &; Cross, 2018). The relationship between students' initial ability to get up flat was assessed using *the chi-square* test with a real level of 5 percent described in the following two cases:

1. Case 1 (TKA and S)

   H0: Students' initial ability is not related to their ability to determine the height line on a right triangle

   H1: Students' initial abilities relate to their ability to determine the height line on a right triangle

2. Case 2 (TKA and T)

   H0: Students' initial ability is not related to their ability to determine the height line on an obtuse triangle

H1: Students' initial abilities relate to their ability to determine the height line on an obtuse triangle

## 3. Results and Discussion

### 3.1. Research Data

The data obtained in the study are presented in Table 1. In the table it is also presented that students are able (M) or unable (TM) to determine the height of the triangle.

**Table 1. TKA Predicate Table and Ability to Determine Triangular Height**

| Subjek | TKA | S | T | Subjek | TKA | S | T |
|---|---|---|---|---|---|---|---|
| S1 | A | TM | M | S15 | C | M | M |
| S2 | A | TM | M | S16 | A | TM | TM |
| S3 | C | TM | TM | S17 | C | TM | TM |
| S4 | A | TM | TM | S18 | A | M | M |
| S5 | A | TM | M | S19 | A | M | M |
| S6 | A | TM | M | S20 | A | TM | TM |
| S7 | A | TM | TM | S21 | C | M | M |
| S8 | A | TM | M | S22 | B | TM | M |
| S9 | C | TM | TM | S23 | A | TM | TM |
| S10 | C | M | M | S24 | C | TM | TM |
| S11 | A | M | M | S25 | A | TM | TM |
| S12 | A | M | TM | S26 | A | M | M |
| S13 | C | TM | TM | S27 | B | TM | TM |
| S14 | A | M | M | S28 | C | M | TM |

### 3.2. Examples of Student Work

There are some students who still draw high lines incorrectly. Figure 2 is an example of a mistake that occurs often to students in drawing a high line on a right triangle, which is not perpendicular to the side of the base mentioned in the problem. In addition, there are students who draw high lines to sides other than those required, as shown in Figure 3. The errors shown in Figure 2 and Figure 3 align with Hilf's (2021) research which falls into the category of ignoring the properties of the height lines of triangles.


**Figure 2. Sample Student Answers**

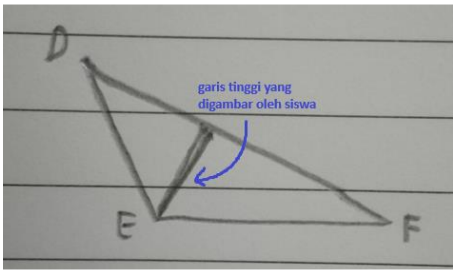


**Figure 3. Sample Student Answers**

## 3.3. Descriptive Analysis and Cross-Tabulation

Descriptive analysis and cross-tabulation are described in Table 2

**Table 2. Descriptive Analysis and Cross-Tabulation**

| TKA | Total | S | | T | |
|---|---|---|---|---|---|
| | | M | TM | M | TM |
| A | 17 | 6 | 11 | 10 | 7 |
| B | 2 | 0 | 2 | 1 | 1 |
| C | 9 | 4 | 5 | 3 | 6 |
| Total | 28 | 10 | 18 | 14 | 14 |

Based on Table 2, as many as 17 students could answer all TKA questions correctly, 2 still made mistakes, and 9 did not finish or did not do it. In addition, 10 people were able to determine the height of a right triangle, and 14 people were able to determine the height of an obtuse triangle within 5 minutes. The results in Table 2 align with Şengün & Yılmaz's (2021) statement that students still have difficulty determining the height line of a right and obtuse triangle.

## 3.4. Uji Chi-Square

Table 3 presents the *chi-square* and *p-value* obtained from each case.

**Table 3. *Chi-square* value and *p-value***

| Case | Chi-square value | Free Degrees | p-value | Results |
|---|---|---|---|---|
| Case 1 | 1,4112 | 2 | 0,4938 | Receive H0 |
| Case 2 | 1,5294 | 2 | 0,4655 | Receive H0 |

The P-value in Case 1 is 0.4938, greater than the real level. It receives an H0, meaning that the student's initial ability is not related to their ability to determine the height line on a right triangle. In case 2, the p-value reaches 0.4655, exceeding the real level set. This indicates acceptance of H0, which concludes that there is no relationship between students' initial abilities and their ability to determine the height of a blunt triangle. Based on the results of this test, teachers can notice that although students can answer TKA questions well, it does not mean that they will automatically be adept at solving problems related to the application of these concepts, such as determining the height of a right triangle or an obtuse triangle.

## 4. Conclusion

Based on the findings and results of the study, it can be concluded that students' ability to answer TKA questions is not significantly correlated with their ability to determine the height of a right or blunt triangle. Although most students could answer TKA questions well, the chi-square test results showed no significant relationship between students' initial abilities and their ability to solve problems related to the application of these concepts. This study suggests that teachers realize that students' ability to answer TKA questions does not always reflect their ability to apply mathematical concepts in different contexts. Teachers need to develop more comprehensive learning strategies, which not only focus on understanding concepts theoretically but also involve applying concepts in a variety of contexts. It is important for teachers to provide opportunities for students to practice solving real problems related to the mathematical concepts being studied. Thus, students can improve their ability to apply such concepts in appropriate contexts and deepen their understanding. To that end, teachers can use a problem-based learning approach, which allows students to be actively involved in solving problems and developing a deeper understanding of the concepts.

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