

## **Analysis of The Ability to Understand Mathematical Concepts of High School Students in Class X on Vector Material**

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### **Abstract**

*The purpose of this study is to produce a study of the ability to understand mathematical concepts of Class X students on Vector material. This study uses a qualitative approach with a descriptive type of research. The subjects of this study were students of Class X MIA2 Christian High School 2 Soe even semester of the 2021/2022 school year as many as 30 people. Data collection techniques using mathematical concept comprehension ability tests, semi-structured interviews, and documentation. The data analysis technique follows the Miles and Huberman model with a validity test of data using the triangulation technique. The results showed that the ability to understand mathematical concepts of students is still relatively low with the median age being 55.56%. The results of the Student Work analysis showed that there were students who did not understand the concept and used it in solving problems, students who mistakenly in choosing and applied algorithms, incorrectly restated concepts, and associated various mathematical concepts internally and externally. Some students are also still in a hurry to work on the problem, less thorough reading and understanding of the problem, resulting in students making mistakes in solving the problem.*

**Keywords:** *The Ability To Understand Mathematical Concepts, Vector*

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## **INTRODUCTION**

Mathematics is generally known as an abstract subject but in addition, it departs from the reality of human life. Therefore mathematics is introduced to everyone at all levels of Education. Mathematics is also a learning that has more benefits in everyday life. Many people see mathematics as a difficult subject, but everyone is obliged to learn it. The definition of mathematics according to the Great Indonesian Dictionary is the science of numbers, relationships between numbers, and operational procedures used in solving problems regarding numbers. A lot of mathematical material, demands more serious and thorough thinking to be able to find out the meaning contained in the material being studied. A person who studies mathematics must be able to understand facts, concepts, principles, and skills in solving problems. Suherman et al (Rismawati & Hutagaol, 2018) stated that, mathematical concepts arranged in a hierarchical, structured, logical, and systematic start from the simplest concept to the most complex. Therefore, the ability to understand mathematical concepts is important in learning mathematics. In learning mathematics students must be able to understand mathematical concepts to be able to solve problems.

Concept understanding is one of the abilities or skills to understand and explain a situation or action of a class or category that has general properties that it knows in mathematics (Rismawati & Hutagaol, 2018:5). Understanding the concept according to Hiebert is the power associated between the information contained in the concept understood and the Schemata that have been previously owned (Hoiriyah, 2019). According to Kilpatrick et al., the ability to understand mathematical concepts is about understanding comprehensive and functional mathematical ideas. The Indicators of the ability to understand mathematical concepts are (1) restating concepts that have been learned (2) classifying objects based on mathematical concepts,

(3) applying concepts algorithmically, (4) providing examples or counter-examples of mathematical concepts, (5) presenting concepts in various representations, (6) associating various concepts mathematics internally and externally (Lestari & Yudhanegara M. R, 2015:81).

The ability to understand the concept of students in SMA Kristen 2 Soe is still relatively low. Based on the results of interviews with mathematics teachers, it is known that students have not been able to repeat the concepts that have been learned so students find it difficult to classify objects based on existing mathematical concepts and apply concepts algorithmically.

In learning mathematics, if students understand well the mathematical concepts then students will be able to define a topic with their language but lead to the same purpose, and eventually students will become easier to remember without having to memorize. In line with the opinion of (Sanjaya, 2009) that understanding the concept is the ability of students who are realized by mastering several subject matters, where students not only know or remember some concepts learned, but students are also able to re-express the concept in other forms that are easy to understand, provide data interpretation, and can apply the cognitive structure it has.

## RESEARCH METHODS

This study uses a qualitative approach with a descriptive type of research. Qualitative research is research that focuses on describing and analyzing phenomena, events, social activities, beliefs, attitudes, perceptions, and thoughts of a person both individually and in groups (Sukmadinata, 2009:2019). The subjects of this study were students of Class X MIA2 Christian High School 2 Soe even semester of the 2021/2022 school year as many as 30 people. Data collection techniques using mathematical concept comprehension ability tests, semi-structured interviews, and documentation. Data analysis techniques are performed interactively and continuously until complete until the data becomes saturated. Activity in data analysis is data reduction, presentation of data, and conclusion/verification, with data validity test using triangulation technique (Sugiyono, 2017:337).

## RESULT AND DISCUSSION

Analysis of the results of students ' work in solving the problems of understanding the concepts given showed that the average ability to understand mathematical concepts of students from 3 test questions given there are 55.56% of students who do not understand the concept and use it in solving problems. Some students have not understood the problem and have not been able to work correctly, especially for indicators to restate vector concepts into images and associate various mathematical concepts internally and externally. In general, the percentage of student work is shown in Table 1.

Chart 1. The results of the percentage of students ' ability to understand concepts classically

Answers	Number of Questions			Average Percentage
	1	2	3	
True	7 students = 23,33%	26 students = 86,67%	7 students = 23,33%	44,44%
Wrong	23 students = 76,67%	4 students = 13,33%	23 students = 76,67%	55,56%

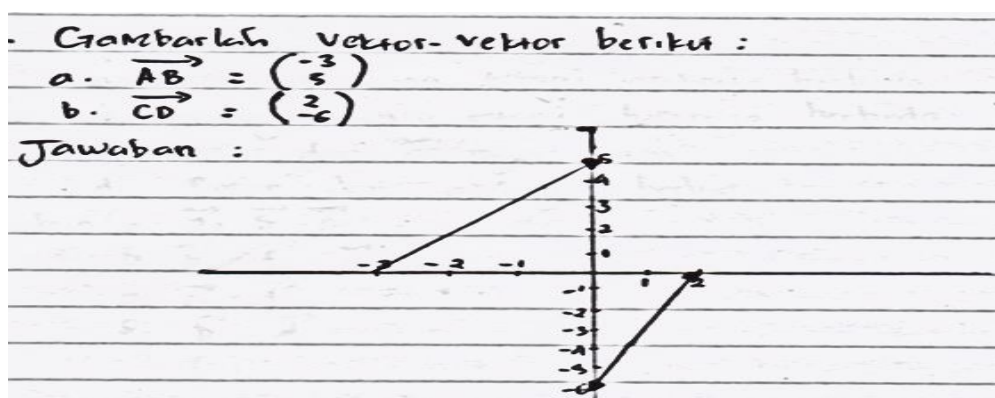
Description: Questions number 1-3 in the form of questions related to Vector materials

Problem number 1 measures the ability of students to understand mathematical concepts related to restating concepts that have been learned, classifying objects based on mathematical concepts where students are asked to describe vectors by previously having to be able to determine the point correctly, then connecting the points and making lines/drawings correctly. In question number 1, 23.33% of students were able to answer correctly, while the remaining 76.67% of students were still wrong in answering. Problem number 2 measures students' ability to understand concepts related to indicators by applying concepts algorithmically and providing examples or non-examples of the concepts learned, where students are asked to determine the difference between two vectors. For this problem, 86.67% of students were able to answer the question correctly and only 13.33% of students were wrong in answering. Problem number 3 measured indicators presenting concepts in various representations and associating various mathematical concepts internally and externally, 23.33% of students were able to answer correctly, while the remaining 76.67% of students were still wrong in answering.

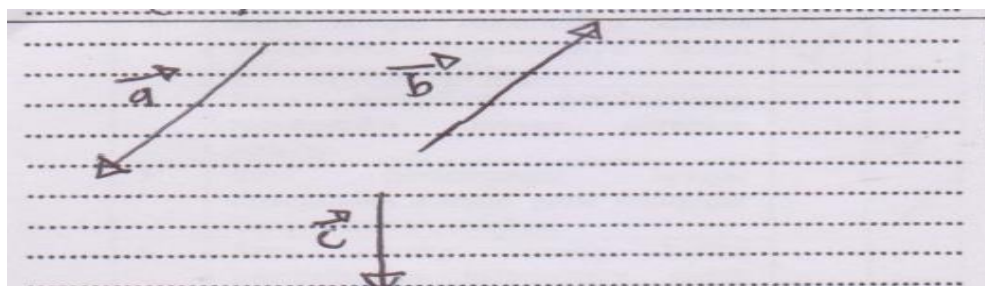
### Analysis Of Students' Answers Based On The Ability To Understand Mathematical Concepts

#### Problem Number 1

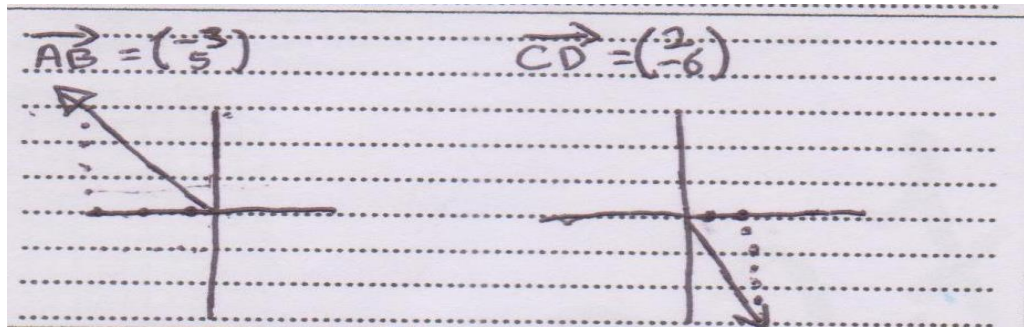
Problem number 1 aims to measure students' ability to understand concepts by restating concepts that have been learned and classifying objects based on mathematical concepts. In the problem, students are asked to draw a vector according to the given point. Based on Table 1, 7 students were able to answer/ draw correctly, while 23 students were still wrong in the drawing. The results of student work are shown in Figure 2.



(a)



(b)



(c)

Figure 2. Results of Student Work On Problem Number 1

Students' answers to the problem of describing vectors are mostly still wrong. To be able to draw a vector correctly, students must know the value and direction of the vector. In Figure 2a, students have determined the point correctly, but are still wrong in determining the direction of the vector so the image is less precise. While Figure 2B students are not able to describe correctly because it does not determine the vector point in advance so wrong in determining the value and direction of the vector. Students in Figure 2C understand and work correctly so that the picture is also appropriate.

Based on the results of interviews with students, it is known that students are still wrong and do not understand how to determine the direction of the vector, students are also in a hurry and less thorough in working on the problem so they forget to determine the point and incorrectly determine the direction of the vector. After being guided again and allowed to work again on existing problems, finally students can work on existing problems correctly.

Problem number 2 measures students' ability to apply algorithmic concepts and provide examples or non-examples of the concepts learned, where students are asked to determine the difference between two vectors by giving examples of proper vector naming. 26 students were able to answer correctly and 4 students still answered incorrectly. The results of student work are shown in Figure 3.

Diketahui titik A (-2,5) dan B(2,-1). Jika  $\vec{a}$  merupakan vektor posisi dari titik A dan  $\vec{b}$  merupakan vektor posisi dari titik B. tentukan :  $2\vec{a} - \vec{b}$

Jawab:

$$2\vec{a} - \vec{b} = \begin{pmatrix} 2 \\ 1 \end{pmatrix} - \begin{pmatrix} 2 \\ 1 \end{pmatrix}$$

$$= \sqrt{2^2 - 2^2}$$

$$= \sqrt{1^2 - 1^2}$$

$$= \sqrt{1+1}$$

$$= \sqrt{1+1}$$

$$= 5+5$$

$$= 10$$

(a)

4.  $\vec{a} = \begin{pmatrix} 2 \\ 5 \end{pmatrix}$   $\vec{b} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$

$$= 2 \begin{pmatrix} -2 \\ 5 \end{pmatrix} - \begin{pmatrix} 2 \\ -1 \end{pmatrix}$$

$$= \begin{pmatrix} -4 \\ 10 \end{pmatrix} - \begin{pmatrix} 2 \\ -1 \end{pmatrix}$$

$$= \begin{pmatrix} -6 \\ 11 \end{pmatrix}$$

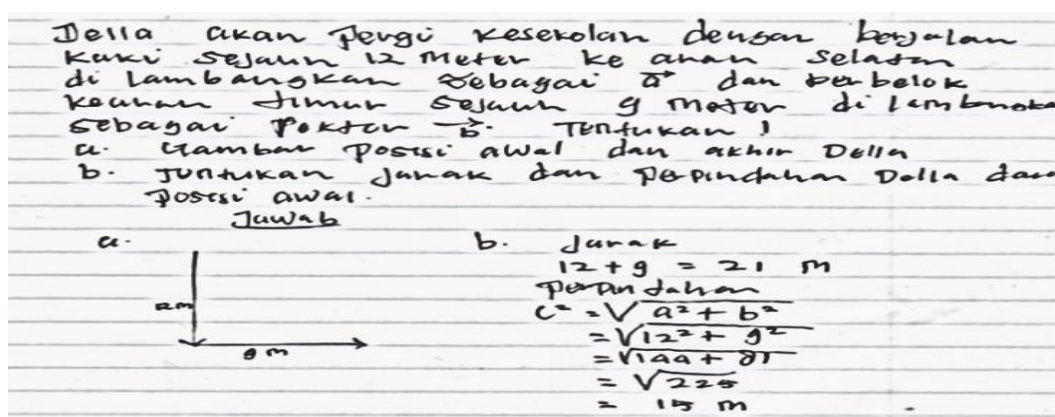
(b)

Figure 3. Results of Student Work On Problem Number 2

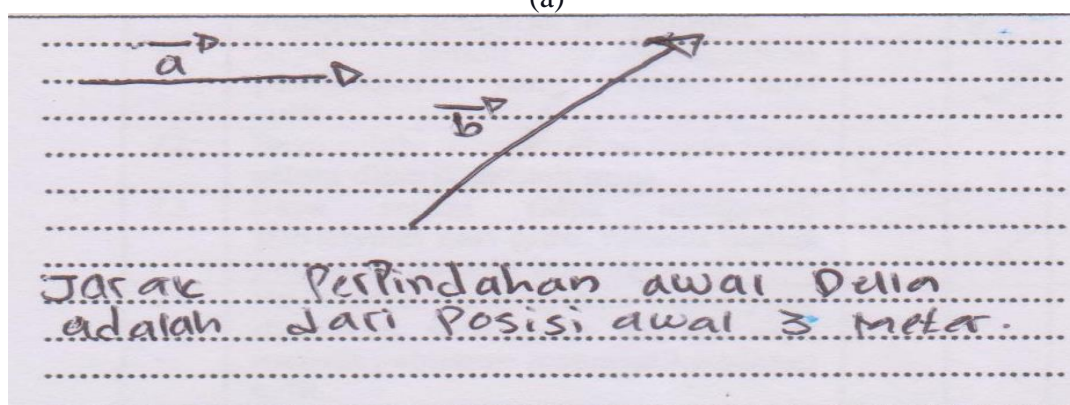
Figure 3 shows the work of students on the problem of vector multiplication operations with scalar and Vector subtraction, where most students have done well, but there are still some wrong students. Based on the results of the analysis of student work, it is known that almost all students make the same mistakes as those made by Student A where students do not read and understand well the existing problem, so wrong in entering the value and not multiplying the vector by the scalar first but squared two and wrong in the concept of still got it wrong.

The results of interviews with students are known that students are in a hurry to work so the wrong writing point and Vector a should be multiplied by two but the students squared two. When solving the problem, students do not check the answer again so they only realize after collecting the results of work and discussing with friends. While the results of interviews with student 3B known that students understand the problem well and have no difficulty in solving the existing problems.

Problem number 3 measures indicator present concept in various representations and relate various mathematical concepts internally and externally. 7 students were able to answer correctly, while 23 students were still wrong in answering. The results of student work are shown in Figure 4.



(a)



(b)

Figure 4. Results of Student Work On Problem Number 3

The results of student work on Problem Number 3 show that there are still many students having difficulty solving existing problems. To solve the problem of the story, it will be very easy for students if they describe the starting position and the end position (right triangle) so that to determine the distance between two vectors, while for the displacement using the Pythagorean

Theorem. In working on the problem, students in Figure 4a have done well. However, students in Figure 4b have been wrong in determining the starting point and end point images, so students are wrong in determining the distance and displacement.

The results of interviews with students, known information that 4A students understand the problem so that they can solve the problem correctly. While 4B students do not understand the meaning of the problem, they still feel confused with the concept that will be used to solve the problem, so they do their best without being sure the answer is right or wrong.

Based on the analysis of students' work, it was found that the understanding of the concept of high school students in Class X is still low. The low understanding of the concept of students is because students still have difficulty using the right concept in solving problems, working according to what is understood, and have not found out the truth of the use of the concept. Students are also often in a hurry to solve the problem, not re-examine the answer, resulting in there being still many mistakes in understanding the concept. The results of research conducted both on Junior High School students and on students also found that students' understanding of mathematical concepts is also still low. Research ((Kartika, 2018); (Fajar et al., 2018); (Suraji et al., 2018); (Yufentya & Roza, 2019)) concluded that the ability to understand mathematical concepts of Junior High School students is still low and has not reached the minimum completeness criteria set by the school. Likewise, the results of research on students, namely research ((Rismawati & Hutagaol, 2018); (Hoiriyah, 2019)) also concluded that the ability of students to understand mathematical concepts is still relatively low as evidenced by the percentage of achievement of each indicator is still low.

## CONCLUSION

Based on research results it can be concluded that the ability to understand mathematical concepts of students is still relatively low with the median age being 55.56%. The results of the Student Work analysis showed that there were students who did not understand the concept and used it in solving problems, students who mistakenly in choosing and applied algorithms, incorrectly restated concepts, and associated various mathematical concepts internally and externally. Some students are also still in a hurry to work on the problem, less thorough reading and understanding of the problem, resulting in students making mistakes in solving the problem so that the answer is still not right.

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