



Matrix Concept Understanding Ability: A Quantitative Descriptive Study on Grade XI Vocational High School Students

Maria Delastrada Fallo, Aloisius Loka Son*, Talisadika S. Maifa

Mathematics Education, Universitas Timor, Indonesia

*aloisiuslokason@unimor.ac.id

Article Info	Abstract
Received November 3, 2022	Understanding and completing a basic mathematical concept is often faced by students. This problem is fundamental to mathematical ability. This ability is part of the competency to understand mathematical concepts. Therefore, this study was conducted to describe the students' ability to understand matrix concepts. This study is a quantitative descriptive, be held on grade XI students from Multi Media I of a vocational high school at Kefamenanu. The number of participants in this study was 26 students. The instrument used is a test of the ability to understand the concept of the matrix and interviews. The results of this study indicate that the ability to understand the matrix concept of grade XI Multi Media I students is in the medium category with a percentage of 56.6%, with details of 7 students in the high category, 13 students in the medium category, and 6 students in the low category. There are 96% of students can restate a concept, 46% of students can classify objects according to the concept, 57% of students can give examples and non-examples of concepts, 61% of students can present concepts in various forms of mathematical representation, and 23% of students can use, utilize and select settlement procedures.
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INTRODUCTION

Mathematics is one of the branches of science that plays an important role in everyday life. In accordance with the fact that mathematics is already taught in schools from elementary school to college. This shows that mathematics has an important role in the world of education and technological developments today (Khamidah, 2013). Learning mathematics takes the most time to recall the material already taught. Mathematics learning in schools aims to enable students to understand mathematical concepts, explain the relationship between concepts, use reasoning on patterns and properties, and be able to explain mathematical ideas and statements (Astriani, 2017; Sudirman et al., 2020). The purpose of learning mathematics according to Permendiknas No. 22 of 2006 is to understand mathematical concepts, explain the relationship between concepts and apply concepts or algorithms in a flexible, accurate, efficient and precise way in problem solving (Depdiknas, 2006).

The Minister of National Education above shows that the ability to understand mathematical concepts is one of the objectives of learning mathematics in schools.

The ability to understand this concept is important in mathematics learning. Understanding mathematical concepts is one of the mathematical abilities that must be mastered by students. According to Arifah and Saefudin (2017), the ability to understand concepts is an important point in the mathematics learning process. If students have good concept understanding skills, students will achieve mathematics learning goals. Students who have a good understanding of mathematical concepts will be able to create relationships between concepts that have been studied (Pratiwi, 2016), and be able to deduce information in their own words used in solving a problem (Alam, 2012). Students who already understand the concept correctly will be able to develop thinking skills in solving everyday problems, and the learning process in the classroom will be more meaningful (Murnaka & Dewi, 2018).

One of the mathematics learning materials that must be mastered by grade XI students is matrix. Matrix material is one of the mathematical materials used to measure students' concept comprehension ability. Therefore, the matrix material needs to be mastered by students. However, the reality in the field, the results of learning student matrices have not been satisfactory (Nuritasari, Hasanah, & Sholeludin, 2017). Many students have difficulties both in the learning process, and in solving matrix questions during daily tests or exams, although the questions are related to simple matrix concepts. Based on the results of an interview with a teacher of mathematics subjects at one of the vocational high schools in Kefamenanu, that there are problems during the mathematics learning process at school. Many students do not understand mathematical concepts, are less thorough in the use of formulas, less thorough in the use of symbols and less thorough in calculations and problem solving. In relation to matrix materials, there are many students whose understanding is still low. During interviews, math teachers said that they often find students who solve matrix multiplication problems using how to add matrices or vice versa.

Some of the problems above show that students' ability to understand matrix concepts is still low. This is supported by the results of research by Fadzillah and Wibowo (2016) that there are still many students who have difficulty in understanding mathematical concepts. Mathematics concepts including matrix has been taught in schools are still poorly understood by students. Many previous researchers have researched students' understanding of concepts. Some of them are by Effendi (2017) who concluded that students' understanding of the concept of cube material is still low. Another research by Mawaddah and Ratih (2016) shows that students' mathematical concept comprehension ability is in the good category. These two studies provide contrasting results. The contrast of the results of previous studies is the basis for researchers to conduct this research. The difference between this study and previous researchers is that this research focuses more on the ability to understand matrix concepts, with the aim of describing the ability to understand the matrix concepts of grade XI students of a vocational high school at Kefamenanu.

RESEARCH METHODS

This research is a descriptive study of quantitative. The quantitative descriptive research method is to aim to make an image or descriptive about a state

objectively using numbers, without making generalizations (Siyoto & Sodik, 2015). The type of data used is primary data, which is data obtained directly from research participants. Participants in this study were grade XI Multi Media I students on a Vocational High School at Kefamenanu, totaling 26 people. The participant retrieval technique uses purposive sampling.

The instruments used to collect data in this study were tests and interviews. The test is used to measure students' comprehension. The form of the test is in the form of a description test of a matrix of 5 questions. The 5 items of the matrix question represent 5 indicators of the ability to understand the concept, namely 1) restating a concept (P_1), 2) classify the object according to the concept (P_2), 3) giving examples and non-examples (P_3), 4) presenting concepts in various forms of mathematical representations (P_4), 5) using, utilizing and choosing procedures (P_5). Indicator P_1 is measured through questions about the definition of matrices, indicator P_2 is measured through questions about understanding of identity matrix, indicator P_3 is measured through questions about matrix examples and not matrix, indicator P_4 is measured through questions that ask the matrix form of a story question, and indicator P_5 is measured through questions about matrix addition and subtraction.

After the test, 6 students were selected to be interviewed. The purpose of this interview is to confirm the student's concept comprehension ability with the test results in writing. The 6 students consist of 2 students representing the level of ability to understand matrix concepts in the high category, 2 students in the medium category, and 2 students in the low category.

The value of understanding the concept of the student's matrix is obtained using equation 1.

$$\text{Value} = \frac{\text{Student score}}{\text{Ideal score}} \times 100 \quad (1)$$

Students' matrix comprehension ability scores will be grouped by high, medium, and low categories. The categorization is based on the criteria for understanding students' concepts in Table 1.

Table 1. Criteria for Understanding Student Concepts

Value Range	Criterion
$x \geq 70$	High
$55 \leq x < 70$	Medium
$x < 55$	Low

The criteria in Table 1 above are used to determine the category of students' mathematical concept learning ability adopted from the student's grade criteria according to Nursaadah and Amelia (2018).

In addition to calculating the scores obtained by students, it is also analyzed the percentage of fullness of the achievement of each indicator of understanding the matrix concept, which is calculated using Equation 2.

$$P_i = \frac{Q_i}{r} \times 100\% \quad (2)$$

P_i means persentase achievement of i -th concept understand indicators, Q_i means the number students who meet i -th concept comprehension indicators, and r means the number of participants.

RESULTS AND DISCUSSION

The data of this study were obtained through tests and interviews. Therefore, in this section the results of the study will be described both in the form of te result data and interview result data.

Research Results.

Based on the results of the test, the scores of students' matrix concept understanding ability (MCUA) were obtained in the high category as many as 7 people, the medium category as many as 13 people, and in the low category as many as 6 people. The percentage of students' comprehension ability in the high, medium, and low categories can be seen in Table 2.

Table 2. Percentage of student MCUA criteria

	Category		
	High	Medium	Low
Percentage of MCUA category	27%	50%	23%

Table 2 indicates that most students have MCUA in the moderate category at 50%, while the lowest category is the lowest percentage at 23%.

The MCUA indicators in this study were 5 indicators expressed in P_1 , P_2 , P_3 , P_4 , and P_5 . The percentage of achievement of each indicator is seen in Table 3.

Table 3. Percentage of achievement of the indicator

	Score of Each Question				
	P_1	P_2	P_3	P_4	P_5
Percentage of achievement of the Indicator	96%	46%	57%	61%	23%

Table 3 shows that as many as 96% of students are able to restate a matrix concept, 46% of students are able to classify the objects of a matrix, 57% of students are able to provide examples and non-examples, 61% of students are able to present concepts in various forms of mathematical representation, and 23% of students are able to use, utilize and select procedures and complete matrix concepts.

The MCUA data above is the result of data analysis based on test results and interviews. Interviews were conducted with 6 people, but in this section, the author only showed data on the results of work and interviewed 1 person representing each category.

Students who have high MCUA

One of the subjects who had MCUA in the high category was ADT students. The results of tests and interviews show that ADT students are able to meet indicator 1, indicator 2, indicator 3, indicator 4, and indicator 5. In this section, the researcher only displays the results of work and excerpts of interviews with ADT students on the answers to question number 1. Answer number 1 of ADT students as in Figure 1.



Figure 1. ADT student answer

Figure 1 above is the ADT student's answer to question number 1. To convince the correctness of this student's answer, the researcher conducted an interview as the following.

- Researcher* : What do you know about matrix definition?
ADT : A matrix is a collection of numbers containing rows and columns and expressed in shapes such as square or square long.
Researcher : Are you sure your answer is correct?
ADT : Yes, sure mom.

The results of the interview above show that the subject of ADT is able to define the matrix. The interview results of the answers to questions number 2, 3, 4, and 5 are also the same as the answers in the written test.

Students who have medium MCUA

One of the subjects who has MCUA in the moderate category is MJM students. The results of tests and interviews show that MJM students are able to meet indicator 1, indicator 3, and indicator 5, but have not met indicator 2, and indicator 4. In this section, the researcher only displays the results of work and excerpts of interviews with MJM students on the answers to question number 3. Answer number 3 MJM students as in Figure 2.

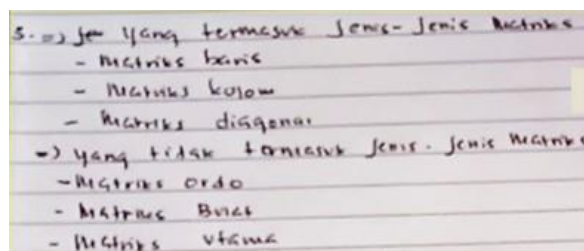


Figure 2. MJM student answer

Figure 2 is the MJM student's answer to question number 3. To convince the correctness of this student's answer, the researcher conducted an interview as the following excerpt.

- Researcher* : Can you name the types that belong to the matrix and which does not belong to the types of matrix?

MJM : Which includes the type of matrix, namely row matrix, column matrix, and the identity matrix, whereas those that do not include types-Types of matrices are order matrices, main matrix and spherical matrix.

Researcher : Are you sure?

MJM : I am sure, mom

The results of the interview above show that the MJM subject is able to distinguish between matrix and non-matrix examples. The interview results of the answers to questions number 1, 2, 4, and 5 are also the same as the analysis of the written test results

Students who have low MCUA

One of the subjects who had MCUA in the moderate category was NBK students. The test results and interviews showed that NBK students were able to meet indicator 1, and indicator 3, but did not meet indicator 2, indicator 4, and indicator 5. In this section, the researcher only displays the results of work and excerpts of interviews with NBK students on the answers to question number 5. Answer number 5 of NBK students as in Figure 3.

Handwritten student work for question 5. The student is given two matrices: $A = \begin{pmatrix} 5 & -2 \\ 3 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 4 & 2 \\ 5 & -6 \end{pmatrix}$. The student is asked to find $A+B$ and $A-B$. The student's work shows:

$$A = \begin{pmatrix} 5 & -2 \\ 3 & 1 \end{pmatrix} \quad B = \begin{pmatrix} 4 & 2 \\ 5 & -6 \end{pmatrix}$$

$$A+B = \begin{pmatrix} 9 & 0 \\ 8 & -5 \end{pmatrix}$$

$$A-B = \begin{pmatrix} 1 & -2 \\ 1 & -2 \end{pmatrix}$$

Figure 3. NBK student answer

Figure 3 is the answer of an NBK student who is one of the students who has MCUA in the low category. To convince the correctness of this student's answer, the researcher conducted an interview as the following excerpt.

Researcher : Let you explain how the steps in solved question number 5!

NBK : From the problem, it is known that matrix A and matrix B then which is asked matrix $A + B$ and matrix $A - B$.

Researcher : How is the procedure for adding up and subtracting two matrix?

NBK : Our $A + B$ matrix sums up, and our $A - B$ matrix subtract.

Researcher : Try to find the results of the $A + B$ matrix and the $A - B$.

NBK : Writes answers from matrix $A + B$ and matrix $A - B$, but the answer is still wrong.

Researcher : Are you sure your answer is correct?

NBK : Sure mom

The results of the interview above show that NBK subjects have not been able to use, utilize and select the right procedures to complete matrix addition and

subtraction operations. The interview results of the answers to questions number 1, 2, 3, and 4 are also the same as the analysis of the written test results.

Discussion

The results of the above study are described based on the ability to understand the concept of the matrix of students in the high, medium, and low categories. In this section will be discussed each of them according to this category.

The first, students who have high MCUA. Students who are in this category are able to define matrix concepts, are able to calibrate objects according to their concepts, are able to give examples and non-examples, are able to present concepts in various forms of mathematical representation, and are able to use, utilize and choose procedures. This suggests that students in the high category are able to master all indicators of the ability to understand mathematical concepts. This conclusion is in line with the results of research by Fajar et al. (2018) who said that students in the high category can master all indicators of mathematical conceptual understanding ability. Those who are in this category, have a good memory, have a good memory of storing previously learned mathematical concepts. Students have good conceptual skills because they are able to recall what has been learned (Mawaddah & Maryanti, 2016).

The second, students who have medium MCUA. Those who have MCUA in this category are able to define from the matrix correctly, have not been able to calibrate objects according to the matrix concept, are able to give examples and non-examples, have not been able to present concepts in various forms of mathematical representation, and are able to use, utilize and choose procedures. Indicators that have not been met do not mean that students are not capable. They can decipher the answer but there is still a fallacy in their answer. Their answers are still not quite right. This is supported by research conducted by Rosali (2019) that moderately capable students are able to meet every indicator even though it is not yet appropriate. This requires action from a mathematics teacher when teaching to make a breakthrough in facilitating students' understanding of concepts, because students in this category have the potential to meet all indicators of concept comprehension ability. This potential is supported by research by Fajar et al. (2018) that students in the medium category can master all indicators of the ability to understand mathematical concepts.

The third, students who have low MCUA. Students who are in this category are able to define the concept of matrix correctly, have not been able to calibrate objects according to the concept of matrix, are able to give examples and non-examples, have not been able to present concepts in various forms of mathematical representation, and have not been able to use, utilize and choose procedures. This is in accordance with Kartika (2018) that the low ability to understand concepts is due to students not being able to explain the concepts they get and present concepts in the form of mathematical representations. Students in this category are only able to master 2 indicators out of 5 indicators of concept comprehension ability used in this study. Students' answers to questions that measure other indicators still have many errors. They still spell out the answer according to their ideas even though the answer is wrong. This has the potential to undergo changes. There is room for students in this category to meet many indicators from a number of indicators used. This is supported by the results of

research by Fajar et al. (2018) that students whose concept comprehension ability is low can master 4 indicators of 6 indicators of mathematical concept comprehension ability used.

CONCLUSION

Based on the results of research and discussion, it can be concluded that the ability to understand the matrix concept of grade XI students of a vocational high school at Kefamenanu is in the medium category with a percentage of 56.6%. Based on achievements in this medium category, 96% of students can restate a concept, 46% of students are able to classify objects according to their concepts, 57% of students are able to give examples and non-examples of concepts, 61% of students are able to present concepts in various forms of mathematical representation, and 23% of students are able to use, utilize and choose completion procedures.

Understanding concepts is a fundamental ability in mathematics. Therefore, recommend to mathematics teachers in schools to facilitate this ability in the learning process. Future researchers should focus on conducting research to improve these basic abilities before moving on to other mathematical abilities.

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