

Analysis of Mathematical Ability of Matrix Multiplication of Class XI Students

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Abstract. *This study aims to analyze the mathematical abilities of class XI students in matrix multiplication. The research method used is survey research using a special test designed to measure students' matrix multiplication abilities. Data was collected from class XI students through tests covering various aspects of matrix multiplication. Analysis was carried out to evaluate the level of students' mathematical abilities in the context of matrix multiplication and the factors that influence it. The results of the research will provide insight into students' level of understanding of the concept of matrix multiplication and can be used as a basis for developing more effective learning strategies.*

Keywords: *mathematical ability, matrix multiplication, class XI students, tests, analysis*

INTRODUCTION

Mathematics as something discipline science (Yunita , Juwita , & Kartika, 2021; Asdar , Arwadi , & Rismayanti , 2021) has objective learning listed in Minister of Education and Culture Regulation No. 59 of 2014 concerning The 2013 SMA/MA curriculum is are : (1) Understanding draft mathematics , that is explain connection between concept , as well apply draft And algorithm For finish problem in a way flexible , accurate , efficient , and accurate ; (2) Using pattern as conjecture For finish problem And capable base on phenomenon or existing data For generalized ; (3) Using reasoning qualitative For do operation mathematics , incl understand problem , establishing a mathematical model , refining the model, and explain the solution obtained , as well ability solve problem in life daily ; (4) Mutual exchange thought And reasoning , as well capable compile evidence mathematics ; (5) Own attitude value utility mathematics in life ; (6) Have attitude And appropriate behavior with mark mathematics And learning ; (7) Using knowledge mathematics For activity motor ; and (8) use tool show simple nor results technology For do activity mathematics .

One of draft math is a must understood with Good is multiplication matrix . Multiplication matrix is operation base in algebra matrix that has application wide in various field like knowledge computers , physics , and economy .

Learning mathematics at the level 11th grade has objective For give deep understanding about multiplication matrix to the students . However , in practice , understanding draft This often becomes challenge for student . A number of factor affecting understanding student to multiplication matrix including deficiencies teaching is effective , approaches are not right , as well inaccuracy in learn material .

By Because that , analysis understanding draft multiplication matrix in learning mathematics 11th grade became very important . With do analysis this , got it identified frequent problems faced student in understand draft the . Besides that , analysis this can also be done help teachers and teacher For designing strategy more learning effective And support student in understand draft multiplication matrix in a way comprehensive .

In writing this will done analysis to understanding draft multiplication matrix in learning mathematics class 11. Various aspect will studied , started from frequent difficulties faced students , influencing factors understanding students , up to strategy learning that can be done increase understanding draft multiplication matrix . Through analysis This is expected can give more insight in And constructive solution in increase understanding student to multiplication matrix .

METHOD

Study This use study descriptive-qualitative , according to Sukmadinata (Sudarman , 2016) research descriptive-qualitative is something form purposeful research For describe existing phenomena , well phenomenon natural nor artificial man . For know interest Study student to material matrix so can analyzed with a gradual process . Instruments used is 3 question description And questionnaire or questionnaire with total of 20 statements negative And positive is used For determine interest Study student . Population in study This is student class XI at Bina Bangsa Vocational School . Sample in study This is Class XI of Bina Bangsa Vocational School with a total of 20 students .

Step first thing to do in study This is preparation question test And questionnaire interest learned that has modified from existing questionnaire There is that is from Pujianti (Hendriana , 2017). Furthermore student fill in question And fill in questionnaire interest Study after learning mathematics . After the results data questionnaire collected , then processed with use Likert scale for get results percentage .

RESULTS AND DISCUSSION

The research carried out aims to find out students' mistakes in working on matrix material questions. In this study, students were asked questions about matrix material. When students receive the material, students are not allowed to open their notebooks when answering the questions. After that, students' answers will be analyzed to find out the extent of students' understanding of the matrix material and students' mistakes when solving questions. The results of the test are described in the following table:

Table 1
Diagnostic Test Results for Question Items

No	Students Who Answered Correctly	Percentage	Students Who Answer Wrong	Percentage
1.	19	95%	1	5%
2.	2	10%	18	90%
3.	15	75%	5	25%

Based on the table above, it can be concluded that the most number of students answering questions correctly was number 1 with 19 students answering correctly and 1 student answering incorrectly. The student who answered the most questions incorrectly was question number 2. Consisting of 2 students who only answered the question correctly and 18 students answered incorrectly. This is because students do not understand the concept of determinants. The following is an analysis of students' answers:

- Determine the results in the matrix below:

$$2 \begin{bmatrix} 1 & 3 \\ 4 & 3 \end{bmatrix}$$

Handwritten student work showing the calculation of a scalar multiplied by a matrix:

$$2 \begin{bmatrix} 1 & 3 \\ 4 & 3 \end{bmatrix} = \begin{bmatrix} 2 \cdot 1 & 2 \cdot 3 \\ 2 \cdot 4 & 2 \cdot 3 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 6 \\ 8 & 6 \end{bmatrix}$$

Figure 1

In question no.1, students are able to complete basic matrix multiplication. On average, students answered the questions correctly, namely 19 out of 20 students. because students already understand the initial concept of the matrix.

- Given two matrices, matrix A and matrix B as below:

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

If determinant matrix A is added with determinant matrix B is -4, then the value of x is

....

2. Diketahui dua buah matriks, matriks A dan matriks B seperti dibawah ini:

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

Jika determinan matriks A ditambah dengan matriks B adalah -4, maka nilai x adalah

$$\det(A) = \begin{vmatrix} 1 & 2 & x & 1 & 2 \\ 3 & 2 & 1 & 3 & 2 \\ 1 & 2 & 3 & 1 & 2 \end{vmatrix}$$

$$\det(A) = (1 \cdot 2 \cdot 3) + (2 \cdot 1 \cdot 1) + (x \cdot 3 \cdot 2) - (1 \cdot 2 \cdot x) + (2 \cdot 1 \cdot 1) + (3 \cdot 3 \cdot 2)$$

$$\det(A) = 6 + 2 + 6x - 2x + 2 + 18$$

$$\det(A) = 4x + 28$$

$$\det(B) = \begin{vmatrix} 3 & 4 & 2 & 3 & 4 \\ 1 & 2 & 4 & 1 & 2 \\ 1 & 1 & 1 & 1 & 1 \end{vmatrix}$$

$$\det(B) = (3 \cdot 2 \cdot 1) + (4 \cdot 4 \cdot 1) + (2 \cdot 1 \cdot 1) - (1 \cdot 2 \cdot 2) + (1 \cdot 4 \cdot 3) + (1 \cdot 1 \cdot 4)$$

$$\det(B) = 6 + 16 + 2 - 4 + 12 + 4$$

$$\det(B) = 36$$

$$\det(A) + \det(B) = -4$$

$$4x + 28 + 36 = -4$$

$$4x + 64 = -4$$

$$4x = -68$$

$$x = -17$$

Figure 2

In question number 2, the average student fills in the question with the wrong answer, because many students make mistakes regarding addition and subtraction of matrix determinants.

3. If the points P, Q, R are in a line and P(-1,1) and R (3,5) and PQ = QR then point Q is...

3. Jika titik-titik P, Q, R segaris dan P(-1,1) dan R (3,5) dan PQ = QR maka titik Q adalah...

Jawab:

$$PQ = QR \text{ maka } Q - P = R - Q$$

$$2Q = R + P$$

$$Q = \frac{1}{2}(R + P)$$

$$Q = \frac{1}{2}(3,5) + (-1,1)$$

$$= \frac{1}{2}(2,6)$$

$$= (1,3)$$

Figure 3

In question number 3, students were able to solve the problem correctly until it was completed precisely and thoroughly.

Next, the researcher distributed questionnaires to students, the questionnaire results data were calculated using a Likert scale. In the instrument in the form of a questionnaire there are 20 statements and 5 indicators.

Table 2

Percentage of Vocational School Matrix Multiplication Difficulty Indicators

No	Indicator	Percentage
1	Lack of understanding of the concept	65%
2	Symbol usage error	74.23%
3	Miscalculation	54.49%
4	Class conditions are not conducive	32%
5	Feel bored in learning	30%

If we look more deeply, the lack of understanding of the concept is the largest factor in students' difficulties in solving this problem related to matrix material, 74.23%. In understanding the basic concepts of the matrix, some students already understand the material. Then, when adding matrices of order $m \times 2$ with operations on positive integers, students do not experience difficulties, but when adding $m \times 2$ matrices with operations on negative numbers and fractions, students will experience difficulties. The inability to use positive (+) and negative (-) signs in natural number operations is another factor in increasing students' difficulties in answering questions, so that it can be concluded that aspects of conceptual understanding of matrix material in the problem solving process found that students still do not understand the basics of fractions. students are not careful in calculations and students do not understand negative number operations.

Then, in the matrix multiplication operation, most students do not understand the concept of multiplying matrices of both $m \times 2$ and $m \times 3$ orders and the conditions for a matrix to be able to perform multiplication operations. Many students still incorrectly pair elements between matrices, most of them carry out matrix multiplication operations like adding matrices which pairs each position of the same matrix element. These mistakes are students not mastering the prerequisite material. This was obtained from the results of interviews and test results that the researchers carried out. Incomplete basic understanding if left alone will give rise to a negative stigma towards mathematics such as "mathematics is difficult" and boredom in learning mathematics (Abrar, 2018).

Reason difficulty students faced student in finish questions operation algebra on matrix is student not enough understand And understand about addition , subtraction And multiplication on fraction And not enough thorough in calculation . With So , it's best student must more Lots given practice And task question fractional , frequent ask to the teacher, so that the teacher can explained return principal topics that are not understood often discuss with Friend or make group Study Good carried out during class hours or outside class hours so that student can finish questions the with Correct And Good . Then the teacher can explained return principal topics that are not understood often discuss with Friend or make group Study .

Furthermore For overcome boredom student moment following the activity process Study teach is change paradigm student to mathematics That difficult (Gazali , 2016) with the way teachers should more proactive And make atmosphere more fun for students can follow lesson mathematics specifically on matrix , teachers must capable change method or method teaching to students No feel bored in Study . Every given problem by student should tightly connection with student so that they interested For solve it , so student Study No Because demands value , however based on needs and curiosity student .

CONCLUSION

Based on the results of data analysis and discussion, looking at the percentages, it can be concluded that the mastery of matrix material and aspects of understanding concepts in class XI students at SMK Bina Bangsa is not good. The cause of students' difficulties in mastering matrix concepts is that students are not prepared with prerequisite material such as fractional number operations and negative number operations. Lack of practice questions is also a factor in students not understanding matrix determinant material. These difficulties will later have an impact on advanced sub-materials. Before starting the matrix material, teachers are expected to prepare students for learning first. Provide structured exercises and provide responses to student exercises so that students know what is right and what is wrong. The teacher must also pay attention to the choice of learning method so that students feel comfortable in learning.

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