

Analysis of Student Learning Barriers in Solving Context Problems Related to the Matrix

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ABSTRACT

Matrix is one of the mathematical content that has an important position both in its application in everyday life and as basic to learn advanced mathematics. The purpose of this research are analyzed (the obstacle in learning matrix for high school students) by providing a contextual questions. This research method is descriptive qualitative. The research location is in SMAN 6 Kota Tangerang Selatan. The research was conducted on September in the academic year 2019/2020. The subjects were the 36 students of SMAN 6 Kota Tangerang Selatan grade XI MIPA-1. The data were obtained by the results of the test, post-test interview, and documentation. In conclusion: (1) students experiencing epistemology obstacles and (2) the error made by students in general because of unfamiliarity with the contextual questions (in the form of essays).

Keywords: Learning obstacles, matrix, contextual

INTRODUCTION

Mathematics is used, whether directly or indirectly in everyday life. This can be seen by the applications of mathematics in our daily life, for example in calculating the profit and loss, the cost of production, checking the speed of a vehicle, establishing the calendar, determining the height of a cliff and the depth of the trough, a population census, and many more. As Ruseffendi said that mathematics is an important basic knowledge to study, because the mindset of mathematics can help students to think in logic, analytic, systematic, critical, and creative, not to mention train students to cooperate with others [1].

One of the material in mathematics at the high school is a matrix. The role of the matrix in the curriculum is very important for students to understand advanced mathematics, including the systems of linear equations, vector and geometry transformation. Moreover, the matrix is very useful for studying other sciences, such as Physics and Economics, and is also frequently applied in everyday life, such as flight schedules, producing yield tables, and tables score at sporting events. In contrast with the urgency, the matrix has been very challenging and difficult for students at high school level, students have not been able to apply the concept of matrix to solve real problems, provide real-world examples, and rarely know the benefits matrix in everyday life. As stated by Horton and colleagues [2] that students learn the procedures on how to solve the matrix problems but do not know why they are learning it.

Students can represent math if they understand the mathematical concepts and interpret it in both verbal and nonverbal ways into more concrete situations. The concept will be embedded if it can be imagined by the student and or is obvious in everyday life[3], [4] and found by the students themselves [13]. In other words, context-based learning becomes essential to build students' conceptual knowledge in matrix.

The principles of realistic mathematics education according to Freudenthal includes three things, they are namely guided reinvention and didactical phenomenology (students find their own strategy in learning to solve a problem based on the cognitive level), progressive mathematization (formulation into the mathematics language in the form of abstract concepts through mathematical model), self-develop models (models that are used, in this case they are made by teachers or students). The first order of the mathematical models is situational model (the real objects or can be imagined by the students), the

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second is a model-of (pictures or modelling without object). Then, a model-for (mathematical symbols, such as plus, minus, multiplication and division). The last one is a formal model.

In learning, students often have problems or learning obstacles. According to Brousseau [8], there are three factors that may cause learning obstacles, which are experienced by students during the learning process, they are ontogeny obstacles, didactic obstacles, and epistemology obstacles. Ontogeny obstacles are limitations in learning concept when students experience developmental process. Didactic obstacles are misconceptions which inappropriate with the readiness of the students. While the epistemological obstacle is the limited application that is done by the students.

In the research conducted by Suastika, et al. [9], found that 21.25% of the students do not understand the concept of matrix. Incomprehension associated with matrix algebra student associated with squaring matrix and settlement system of linear equations by reduction lines. Furthermore, a research by [10], Reported that students' conceptual understanding is low. Students with high basic ability is only able to classify objects in the operating matrix by nature and able to provide examples and is not an example of the concept. Students with a basic ability is being able to give an example and not an example of the concept, and that with a low basic capabilities are not able to express the concept, is not able to classify objects in the operating matrix according to certain qualities, and not able to give an example and not an example.

Additionally, Setyanto conduct research module development approach matrix material Realistic Mathematic Education (RME) for class X SMK Muhammadiyah 1 Sukaharjo, found that based on the quality assessment module by subject matter experts and practitioners declared valid with an average score of 4.14 with a percentage of 83 % were categorized as good. While based on the student questionnaire responses, modules developed to be feasible with an average score of 4.11 with a percentage of 82% are included in both categories [10].

Research on realistic mathematics education has been done. But the focus to analyze learning obstacles high school students to the material matrix by providing a contextual matter is still rare. Based on the introduction that has been explained by the researcher, the problem in this research is how the results of analysis of high school students' learning obstacles on matrix by giving the contextual questions? This study was aimed to analyze the learning obstacles of high school students in learning matrix by providing a contextual question.

RESEARCH METHOD

The research took place in SMAN 6 Kota Tangerang Selatan, during its first semester of the academic year 2019-2020. This study was conducted on September 2019. This research is classified as a qualitative descriptive study which describe the analysis of learning obstacles of high school students in learning matrix by providing the contextual question. Data were obtained by the results of the test, post-test interview, and documentation.

The subjects were the 36 students of SMAN 6 Kota Tangerang Selatan grade XI MIPA-1. Thirty three out of the 36 students took the tests. The research instruments include test and non-test. The test instrument includes the question of matrix and non-test instrument is an interview guidance. The test given was previously tested the validity of its contents. The results of the content validity will be used as a reference in improving the research instruments that are considered less appropriate or less proper by experts. The method of calculating the Content validity used in this study using CVR (Content Validity Ratio). The formula used is as follows [11].

$$CVR = \frac{\left(n_e - \frac{N}{2}\right)}{\frac{N}{2}}$$

Information:

CVR = Content Validity Ratio

n_e = the number of assessors who declared about essential items

N = the number of assessors

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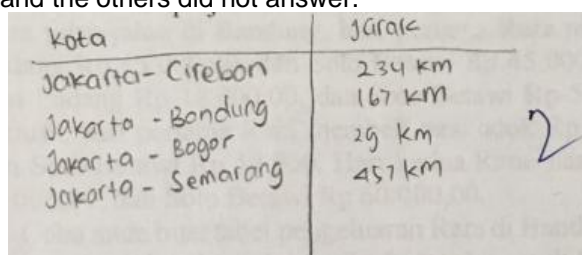
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This content validity of using CVR has been done on each item. If the value of the CVR was statistically insignificant as determined by the CVR minimum table presented by Lawshe [11] then the item is declared invalid. Based on the calculation, the result, the questions are valid.

Data collection methods used in this study include: 1) test that is used to determine the errors of the students in solving a matrix; 2) interviews were used to obtain data about the cause of error.

RESULTS AND DISCUSSION

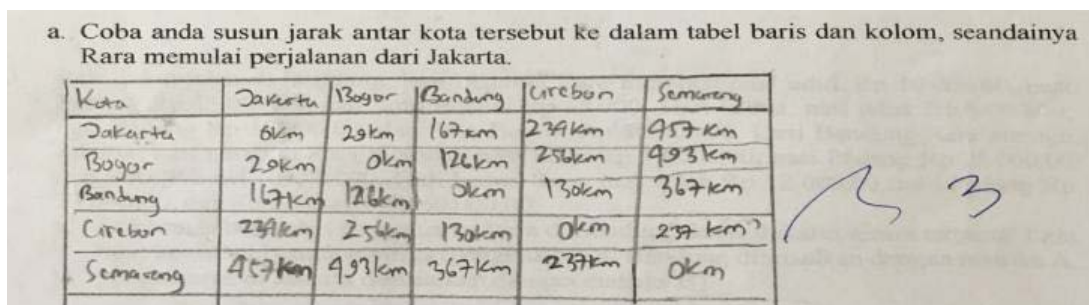
Researcher conducted tests on 33 students grade XI MIPA-1 and interviewed based on the results of tests of 9 students. The Results of tests and interviews showed that students' learning obstacles on epistemology obstacles. The Problem that is given consisted 5 questions. The first question was asking students to compile the data of the contextual problem into the form of tables, and then from the table into the matrix. In the first case, only one out of 33 students who answered correctly, the three students gave the wrong answers, and the others did not answer.



kota	Jarak
Jakarta - Cirebon	234 km
Jakarta - Bandung	167 km
Jakarta - Bogor	29 km
Jakarta - Semarang	457 km

Figure 1: The Example of the Wrong Answers made by Student in Creating Table No. 1

a. Coba anda susun jarak antar kota tersebut ke dalam tabel baris dan kolom, seandainya Rara memulai perjalanan dari Jakarta.

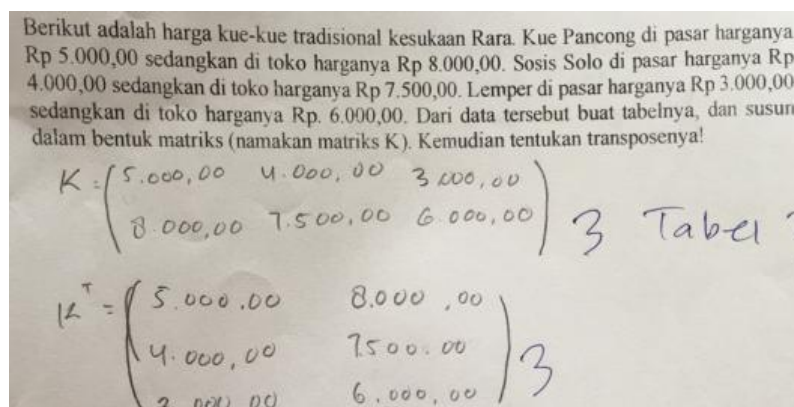


Kota	Jakarta	Bogor	Bandung	Cirebon	Semarang
Jakarta	0km	29km	167km	234km	457km
Bogor	29km	0km	126km	254km	493km
Bandung	167km	126km	0km	130km	367km
Cirebon	234km	254km	130km	0km	277km
Semarang	457km	493km	367km	277km	0km

Figure 2: The Student's correct answer for question No. 1

Question number two about the matrix transpose, with contextual issues of the cakes price at the market price and in the store. In this question, most of the students were able to create the table, but have not been able to compile them into a matrix. Only three Students who were able to arrange into a matrix (which included the top group). While others have problems as much as 90.91%.

Berikut adalah harga kue-kue tradisional kesukaan Rara. Kue Pancong di pasar harganya Rp 5.000,00 sedangkan di toko harganya Rp 8.000,00. Sosis Solo di pasar harganya Rp 4.000,00 sedangkan di toko harganya Rp 7.500,00. Lemper di pasar harganya Rp 3.000,00 sedangkan di toko harganya Rp. 6.000,00. Dari data tersebut buat tabelnya, dan susun dalam bentuk matriks (namakan matriks K). Kemudian tentukan transposenya!



$$K = \begin{pmatrix} 5.000,00 & 4.000,00 & 3.000,00 \\ 8.000,00 & 7.500,00 & 6.000,00 \end{pmatrix}$$

$$K^T = \begin{pmatrix} 5.000,00 & 8.000,00 \\ 4.000,00 & 7.500,00 \\ 3.000,00 & 6.000,00 \end{pmatrix}$$

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Makanan	Pasar	Toko	
Mie panceng	5000	8000	$\rightarrow k = [5000, 8000]$
Sosis Solo	4000	7500	$\rightarrow k = [4000, 7500]$
Lemper	3000	6000	$\rightarrow k = [3000, 6000]$

3

Figure 3: Some Student's answers for Question No. 2

All students have problems in the matrix addition- Students could not give the right answer for question number three, they said the question was confusing. There are students who are able to perform matrix addition, but since the tables and matrices that were arranged was still incorrect, then the result is incorrect. Students are already accustomed to the question that directly ask the addition or subtraction, without the need to understand the contextual issues.

Students who experience obstacles in a matrix scalar multiplication were 87.88%. In question number four, there are three students who have been able to answer using the matrix concept- Students who responded using the matrix concept from the first question was able to compile the data into the matrix.

4. Terdapat data hasil penjualan Bakso dan Soto Mie Bogor di tiga kantin berbeda yang dirangkum pada Tabel berikut.

	Banyaknya terjual (bungkus)	
	Bakso	Soto Mie Bogor
Kantin A	100	90
Kantin B	75	80
Kantin C	150	120

Jelaskan cara anda untuk menentukan banyaknya Bakso dan Soto Mie Bogor yang terjual, jika permintaan meningkat menjadi dua kali lipat?

$A = \begin{pmatrix} 100 & 75 & 150 \\ 90 & 80 & 120 \end{pmatrix}$
 $2A = 2 \begin{pmatrix} 100 & 75 & 150 \\ 90 & 80 & 120 \end{pmatrix}$
 $= \begin{pmatrix} 2 \times 100 & 2 \times 75 & 2 \times 150 \\ 2 \times 90 & 2 \times 80 & 2 \times 120 \end{pmatrix}$
 $= \begin{pmatrix} 200 & 150 & 300 \\ 180 & 160 & 240 \end{pmatrix}$

Posisi: –?–

2

Figure 4: Student's answer using Matrix Method for Question No. 4

There is also the correct answer although did not apply the matrix concept. They used logic in answering questions. In addition, there are also many who did not answer.

	banyaknya terjual (bungkus)	
	100x2:	90x2:
Kantin A	200	180
Kantin B	150	160
Kantin C	300	240

Banyaknya bungkus yang terjual dikali 2

3

Figure 5: Student's Answer using Matrix Method for Question No. 4

Students who experience obstacles in the matrix multiplication using matrix were 90.91%. Only one person who answered correctly, even it was improper in the writing. Two people answered correctly by logic. While others answered, but incorrect, and most of them did not answer.

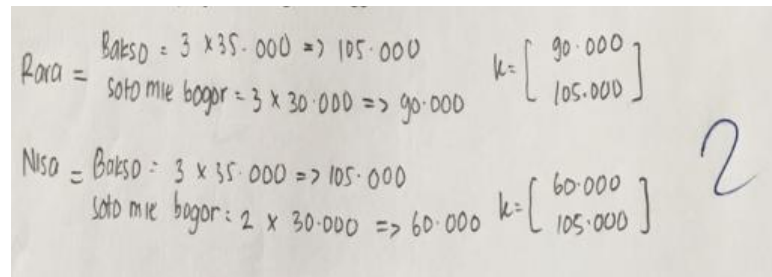


Figure 6: Correct Answer but Incorrect Writing for Question No. 5

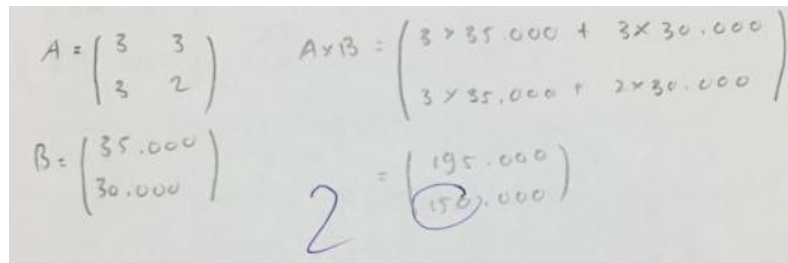


Figure 7: Incorrect answer but Student Already Used Matrix for Question No. 5

Based on the test results it can be concluded that most of the students have not had an understanding and knowledge of the concept of matrix yet. Students are already accustomed to questions which directly ask addition, subtraction, or multiplication without giving the contextual issues. While the questions given in this test requires conceptual knowledge, while students are familiar with procedural knowledge. Mathematical procedural knowledge refers to the ability of students to apply, compute, and use symbols and algorithms to solve the problem, efficiently, and accurately. While conceptual mathematical knowledge refers to the ability of students to make a connection or relationship between mathematical concepts and integration for contextual situation [12]. The findings of this study revealed that most of the students have not been able to do the third principles of realistic mathematics education according to Freudenthal [13], that is self-develop model. By applying of realistic mathematics education, it is expected to increase the students' conceptual knowledge, because research by Hidayat shows that with a realistic mathematics learning the students' understanding becomes better [14].

CONCLUSIONS

The students' errors in solving problems about the matrix through the contextual questions caused by the lack of understanding of the concept, pre concept and misconceptions. Students' learning obstacles are epistemology obstacles and the errors in general because of unfamiliarity with the contextual matter (in the form of essay). As for the errors committed by students include: 1) do not understand the problem in question; 2) do not understand how to change the contextual issues into the table and matrix; 3) do not understand the matrix operations (addition, scalar multiplication with the matrix, and the multiplication of two matrices); and 4) carelessness in the problem solving process.

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