



## THE MATHEMATICAL CONNECTIONS OF THE STUDENTS OF VOCATIONAL HIGH SCHOOL HEALTH MAJOR IN SCIENTIFIC APPROACH BY USING PROBLEM BASED LEARNING MODEL

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### Abstract

This research aimed at analyzing the mathematical connections of the students in Vocational High School Health Major in Nursing and Pharmacy department in solving the questions of sequence and series which is presented using scientific approach in problem based learning model. This research was held in Visi Global Vocational High School Banyuwangi, East Java, Indonesia. Subject of the research is 24 students which contain of students in the nursing major and pharmacy major in the form of heterogeneous group which contains of 4 students in each group. Every students was given the introduction of the materials by worksheet which was arranged based on the materials and using term which is connected with health. The task of solving the problem in the test step was showed the result of the study in the form of essay with the material of sequence and series in tenth grade. The results are the rate of the students' activity is 95%, the rate of students' positive response on learning is 90,4% and the last is the result of the students' achievement test is observed from their analysis of mathematical connection level. The students' mathematic connection activity on the process of solving the questions showed that there is a dictinction between a student with another students. There are some finding about the method of solving the questions which is used by the students according to their learning experience.

### Introduction

One of the standarts which is stated by NCTM is that the ability in making mathematical connection. According to NCT, the connection standart has to include connection in order to make students able to: 1) identify and use connection/ relation among the math ideas, 2) understand how the ideas in math is connected and built with another to produce a whole which is integrated, 3) recognize and use math in context out of Math or another field. Mathematical connection is an important part which must get emphasizing in every educational level (NCTM: 1989). In Vocational High School, the ability of mathematical connection is need to build students' knowledge about the important role of math in their major.

In Vocational High School of Health level, to make students more comprehend in learning math, students have to be given an explanation about the position and role of math in Health major itself. Example, for students in Pharmacy major, by learning the sequence and series, they can make a count the amount of medicine production in a certain period of time. For students in Nursing major, they can know the amout of medicine dose which is given to the patient in a certain period. Teachers are expected to be more creative in developing math problem by connecting it with knowledge in others field and in the daily life. For those reason, it is need a strategy to dig the ideas of mathematical connection for the purpose students' ability of mathematical connection can be trained.



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The math learning sets in curriculum which is used in vocational high school uses scientific approach. This approach make students in vocational high school more active in constructing knowledge according to their learning experience in their major field and make research in finding the fact from a problem/ case. Besides, students are accustomed to be able to think logically, harmonious and systematic. In this approach, students are not being as an object of learning, but they are subject of learning then teacher is as the facilitator and motivator. Teacher doesn't need to explain a whole materials.

In helping students to train their mathematic connection, a teacher need to use learning models which inclined give problems with mathematic topic that is connected with another math topics, another subjects or with the daily life. This model of learning is a model which is in every learning atmosphere is headed to daily problems. This model of learning intends to give a space to think freely for students in looking for a concept and solving the problems that is connected to the materials given by the teacher. Based on the explanation above, this essay analyzes the mathematical connection of the students of SMK Kesehatan in solving math questions relate to sequence and series materials in the tenth grade with scientific approach using problem based learning model.

### Research method

This research is qualitative research. The objective of the research is to analyze students' mathematical connection level of SMK Kesehatan in solving th problem of the questions about sequence and series materials in the tenth grade. Subject of the research is 24 students of SMK Kesehatan which consist of 12 students of Nursing major and 12 students of Pharmacy major. There were 3 datas in this research, they are: students activities data, data of the students responses' rate to the learning and data of the students' result of achievement test.

The learning model which is used is problem based learning. Students activities on the learning process is scored using the instrument of students' activities observation sheet which was validated by the Math expert. Problems given to the students are presented in the form of worksheets. They are arranged based on scientific approach. Then, in the end of the learning, students were given test. The test is arranged by connecting math with the health science. The problems are the real problems in the daily life. The results of the students' works are analyzed from the level of mathematical connections. Students' worksheet and the questions in the achievement test are also validated by the math expert.

In the achievement test, the emphasize of mathematic connection is on the problems presented correlate with health field with sequence and series materials. The example of the questions on nursing major is below:

“A diabetic patients is given insulin hormone to help carbohydrate metabolism and decrease deterioration. The dose which is given to the patient is about 0,001% from her/ his weight. It is known that the weight of the patient is 50 kg. To help the optimal recovery, the insulin hormone dosage is given everyday with the fixed reduction about 50mg per day. The patient can be stated completely recovered if she/ he had about 0mg in giving that hormone. If the patient was cured at 26<sup>th</sup> of March 2017, on what date the patient can be stated completely recovered and how many insulin hormone which is given to the patient up to completely recovered? Present the level of insulin dosage in the form of graph!”

### Results and discussion

According to research method which was done, the datas got are the result of the students' worksheet in solving the problems from the math questions correlate to health field. The questions are as stated on the previous section (research method). Below are the answers of the students.

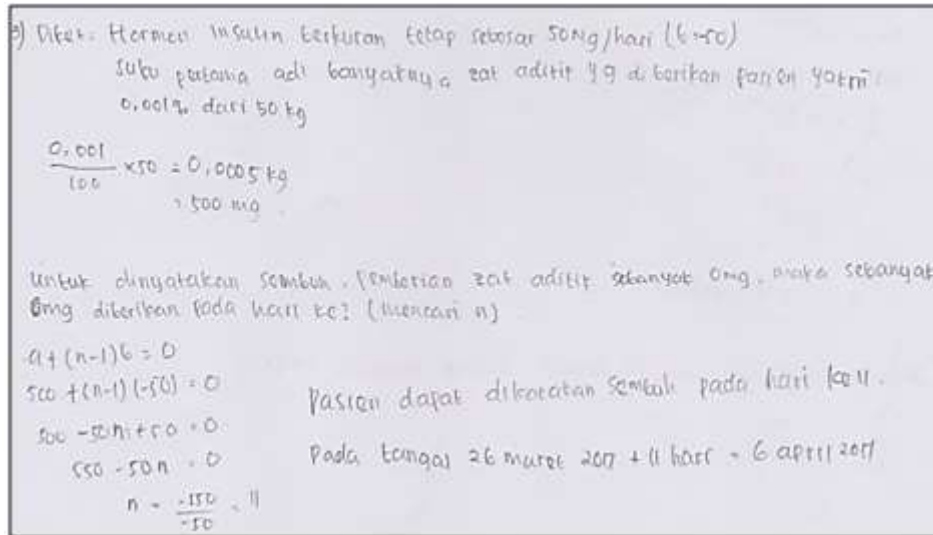


Figure 1: The answering of students

The process of solving question number 3, students are expected to understand some important things which are stated on the question. The question contains problems on nursing major. It is the process of giving infusion by mixing the pattern of numbers on the date requested as the solution. In this activity, it can be seen students are completely understand the problems. Students answer the question structured well by the process of finding the formula which discussed in the students' worksheet on the previous meeting. Students are able to represent their work in the form of graph.

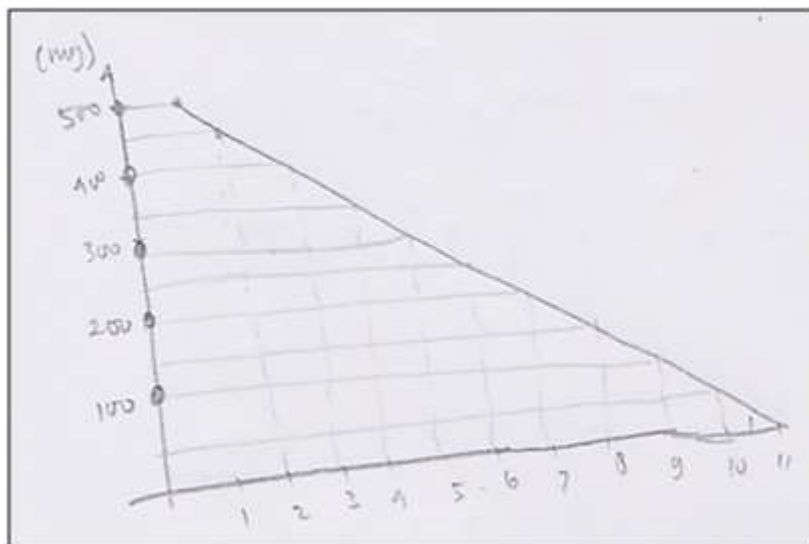


Figure 2: The answering of students



5) Dik: racun larut 50%/jam  
 $r = 50\% = \frac{1}{2}$   
 Setelah 12 jam kandungan racun sebesar 0,25 mg  
 $U_{13} = 0,25 \text{ mg}$   
 $U_n = ar^{n-1}$   
 $0,25 = a \left(\frac{1}{2}\right)^{12-1}$   
 $\frac{1}{4} = a \left(\frac{1}{2}\right)^{12}$   
 $2^{-2} = a \cdot 2^{-12}$   
 $a = \frac{2^{-2}}{2^{-12}}$   
 $a = 2^{10} = 1024$   
 racun yang masuk ke darah tersebut adalah 1024 mg

Figure 3: The answer of the question in Pharmacy major

Students solve the problem by implementing the formula of geometric sequence. But there is a unique finding on the process of that work. The teacher asks students to make a graph from the sequence number of the levels cyanide. Then students try to represent the work in the form of graph and when looking at the form of the graph and comparing to the sample question on the worksheet. From the result, it means that students are able to correlate their mathematic ideas with the previous materials about function. The picture below is the representation of the problems in the question.

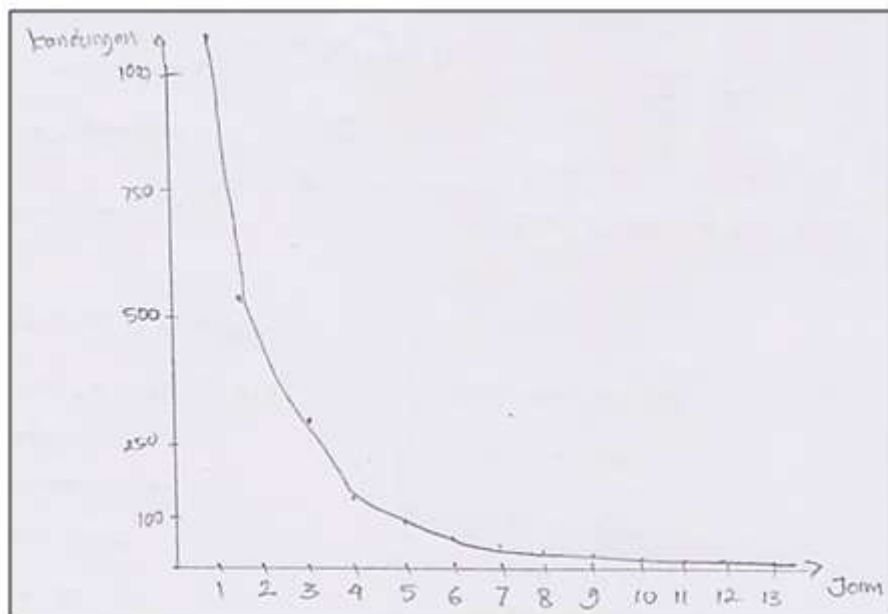


Figure 4: The representation of the problems in the question



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Beside the students answer, on the learning process is explained that problem based learning with scientific approach has important role in mathematical connections. The table below are the data of students' activity on learning process.

*Table 1. The data of students' activity on learning process*

Steps	Students' Activities	Score per meeting			Rate	Rate (%)
		1	2	3		
First	Gathering based on the group	4	4	3	3,7	91,7
	Paying attention, understanding, and taking a close look at the learning objective	4	4	4	4,0	100
	Making an agreement of the definition prerequisite materials and paying attention the motivation about the important of the materials from the teacher	4	4	3	3,7	91,7
Core	Paying attention to the problems in the worksheet	4	4	4	4,0	100
	Discussing the problem solving with the group	4	4	4	4,0	100
	Working with the group to solve the problem according to the instructions from the worksheet	3	4	4	3,7	91,7
	Investigating the truth of the eneral formula of sequence and series	3	4	4	3,7	91,7
	Representing the result of discussion by writin it on the white board and explaining the arguments	4	3	4	3,7	91,7
Last	Making conclusion together with the teacher	4	4	4	4,0	100
	Paying attention to the teacher's explanations about the next meeting	4	3	4	3,7	91,7
Rate		3,8	3,8	3,8	3,8	95
Rate (%)		95	95	95	95	95

From the table, it can be seen the rate of each indicators of students' activity. The indicator of the students' activity with the minimum score (75%) is on the process making conclusion with the teacher. Overall, according to the tble 4.9, it can be seen the score rate from observing the students' activity is 3,8 and the presentage of the score rate from observing students' activity is 95 %. In conclusion, according to the students' attendance criteria, the score rate fulfills the active criteria. The following data is the students' responses data to the learning.

*Table 2. The students' responses data to the learning*

No	Description	Amount of Answer		The Presentage Answer (%)	
		Yes	No	Yes	No
1.	Are you interesting during learning math using scientific approach and Problem Based Learning to increase the mathematical connection?	22	2	91,7	8,3
2.	Are you interesting with				
	a. the way of learning by group discussion?	23	1	95,8	4,2
	b. how the way of teacher explaining?	22	2	91,7	8,3
	c. the learning atmosphere in the classroom?	22	2	91,7	8,3
3.	Are you interesting with the activity in the larning process?				
	a. studying using worksheet	23	1	95,8	4,2
	b. stating idea/ argument to friends	20	4	83,3	16,7
	c. responding friends ideas/ arguments	18	6	75,0	25,0
4.	Do you have more chances for:				
	a. Discussing with friends in solving the problems?	22	2	91,7	8,3
	b. Stating idea/ argument?	23	1	95,8	4,2
5.	Do you understand the lanuae used in:				
	a. Worksheet?	20	4	83,3	16,7
	b. Achievement test / Formative test?	21	3	87,5	12,5
6.	Do you agree if the Math learning with scietific approach and Problem Based Learning to increase mathematical connection is used to teach another materials?	23	1	95,8	4,2
Rate		21,7	2,33	90,4	9,6

From the analysis of each questions in the students' response in table questioner, it can be seen that the minimum positive answer (75%) is in the question number 3c about responding friends' idea/ arguments. It is because students is accustomed with learning individually so they are not used to giving arguments to their friends. The second minimum score of positive response (83,73) is on the question number 3b and 5a. The question number 3b is asked about stating ideas/ arguments to friends and then in 5a is about the use of language in the worksheet. it is due to students are used to choose friends by themselves if there were any group working, so it is normal if students are difficult to interact with friends in the learning process with the group that has been divided by the teacher. The language used iin the woreksheet still makes students find difficulty in understanding it, because in the previous, students used conventional worksheet which means there are no health terms found in the worksheet developed by the reseacher. Overall, the percentage of the rate in each questions is 90,4% answer "yes" and 9,6% answer "no". It indicates most of the students like the learning model used.

## Conclusion

According to the result and discussions about the mathematical connection of students in Vocational High School, it can be known that Math is very important in supporting learning process in vocational. In this research, it is just the minor example of math learning which is correlated with daily life and healt major. Scientific approach on the cuurriculum of Vocational High School and the teaching and learning process by using problem based learning are very helpful in giving a meaningful Math learning for students. So, students of Vocational High School feel that Math is an important subject to learn because it closely relate to the Nursing and Pharmacy Major

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