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Student's mathematical skills in solving vector connection analysis

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Abstract: This research aims to learn and analyze the capability of the student's mathematical material connection with vector analysis. The Data collected are the result of test instruments and interview result with several students. The method of this research uses descriptive qualitative method. The subject of this research is Siliwangi Teachers' Training Students who have taken material vector analysis. Based on the Data from the analysis of the test results of the mathematical connection of the problem indicator, the first indicator percentage is Obtained items, namely finding the relationship between the various concepts of representation and procedures, then understanding the relationship between mathematical topics, the presentation is 41.25%. The second indicator of understanding the equivalent representations of the same concept, the presentation is 67.5%. The third presentation indicator, using mathematics in other fields of study or in daily life is 65%. As for the fourth indicator, use an evaluation of the relationship between mathematical topics and the mathematical topic outside is 47.5%. The results of the interviews show that students sometimes forget to use formula prerequisite concepts as material.

1. Introduction

Vector analysis is one of the teaching materials related to other subjects as for example with calculus. In addition, this subject relates to other fields and fundamentals of physics. Students learn concepts, linking concepts, and apply basic concepts of vectors with other concepts. In studying the concept and applying it needed a connection that every concept can be connected to each other. Vector analysis on student learning to associate the concept of one another, both among and between the mathematical topics beyond the topic of mathematics. For example in the study of vector analysis, in addition to related to the field of physics, students will recall its ability prerequisites regarding calculus, matrices, linear algebra related teaching materials therein. Starting capabilities student must possess is the ability to connect mathematical concepts that ultimately this mathematical connection capability can be a prerequisite knowledge to master other skills. Very important mathematical connection capabilities possessed by students. By having the ability mathematical connection, students can develop the ability to think mathematically higher. Sumarmo [1] explain some mathematical connection indicator that can be used are as follows:

1. Looking for a relationship of various representations of concepts and procedures
2. Understanding the relationship between mathematical topics
3. Applying mathematics in another field or in everyday life
4. Understanding the equivalent representation of a concept

5. Looking for a relationship of the procedure with another procedure and representation
6. Applying mathematical relationships between topics and between mathematical topics with other topics

The importance of the mathematical connection capabilities mentioned in the National Council of Teachers of Mathematics (NCTM) [2] which sets the standard five processes, namely: problem solving, reasoning and proof, communication, connections and representation. In order to achieve the ability to connect a student should be able to complete the concept by linking concepts with one another and connect mathematical concepts to everyday life. The indicator connection mathematically summarized and used in the present study were 1) to find a relationship between the various representations of concepts and procedures, and understand the relationships between mathematical topics, 2) understand the representation equivalent to the same concept, look for connections one procedure to another procedure in the representation equivalent, 3) use mathematics in other subject areas or everyday life, 4) use and assess the relevance between topics mathematics and mathematical topic by topic relevance beyond mathematics.

2. Experimental Method

This research is a descriptive qualitative study aimed to analyze and describe the student in completing four errors about mathematical connections. Data analysis is a student obtained written answers from the written test a sample of 20 Student. In implementation, researchers directly involved in collecting, processing, analyzing, and draw a conclusion from the data obtained. The test instrument was developed by the researchers in accordance with the teaching materials are delivered. The guidelines for scoring the tests in narrative form used in this study were Quasar General Rubric expressed Lane [3] presented in Table 1.

Table 1. Scoring Guidelines on Ability Test of Mathematical Connections

Criteria for answers and reasons	Score
There is no answer at all / do not understand the problem	0
Understand most mathematical concepts and processes matter, using the tools and strategies improper completion and do a lot of mistakes in the calculation.	1
Almost understand mathematical concepts and processes matter, identify the important elements, but a lot of ideas - ideas that wrong, did some miscalculations.	2
A good understanding of mathematical concepts and processes matter, using terms and notation that is almost true, do the algorithm is complete and in general the calculation is correct, but there are still errors	3
Demonstrate understanding of mathematical concepts and processes matter, using the right terminology and notation, implement the algorithm correctly and comprehensively.	4

To measure the difficulty of students based on the ability to solve the problem of student understanding of vector analysis can be seen in Table 2 [4].

Table 2. Criteria for Student Understanding of Vector Analysis

NO	Criteria	Information
1	0% - 33%	Lack of understanding
2	34% - 67%	Simply understanding
3	68% - 100%	Good understanding

Meanwhile, to measure the completeness criteria and the success of student work on the problems of vector analysis in Table 3**.**

Table 3. Criteria for Student Understanding of Vector Analysis

NO	Criteria	Information
1	90% - 100%	Very good
2	80% - 90%	Well
3	70% - 80%	Pretty good
4	60% - 70%	Less
5	0% - 60%	Very less

3. Result and Discussion

After being given a test, obtained a score of answers to students in doing mathematical connection item 4.

Table 4. Score Answers Test Instruments

Student code	Each score Grain Problem				Total score
	X1	X2	X3	X4	
M1	4	3	4	2	13
M2	2	2	3	2	9
M3	2	2	2	1	7
M4	1	3	1	2	7
M5	2	3	2	2	9
M6	1	2	2	3	8
M7	2	2	2	2	8
M8	1	3	3	1	8
M9	1	3	3	1	8
M10	1	3	3	3	10
M11	1	2	3	1	7
M12	2	2	3	3	10
M13	1	2	3	2	8
M14	1	4	2	2	9
M15	2	4	2	2	10
M16	2	2	3	3	10
M17	2	4	3	3	12
M18	4	3	3	1	11
M19	1	3	3	1	8
M20	2	2	2	1	7
total	35	54	52	38	179

Table 4 shows the results of calculations and the number of scores obtained from 20 samples of students. The maximum score for each indicator a matter of 80 (meaning the highest grade 4) with each number, students can be said to understand very well as long as the number of students above 9.6 as much as 60% of the total. Dati Table 1, that the number of students who score above 60 as much as 7 students or 35% of the 20 students. To view a student completeness average value of vector analysis, carried out with the normality test is Chi-squared test with Chi-square count while the Chi-squared 8.00 3.84 table with a significant 5%, because the Chi-squared test bigger than Chi-square table it can be concluded that the average value data of normal distribution of student grades, followed by the Z test, acquired Z count and Z -2.28 -1.65 table with a significant level of 5%, and for the Z count is smaller than Z table concluded that the average value of vector analysis test under 9.6, this means that the student has not been well understood material vector analysis. To see the criteria based on the frequency interval.

Criteria for students who have as many as seven students above 9.6 means 35% or categorized enough understanding. However, 65% of students still below 9.6. For each item on vector analysis criteria masiswa understanding can be seen in Table 3, where the ability of students' understanding of the value above 2.5 or completeness value if the value of the average grade above 2.5.

Table 5. Criteria for Student Understanding Each item Problem

NO	grain Problem	many Students		Criteria	test Z		Information
		total	Presentation		Z count	Z Table	
1	Problem 1	2	10%	Lack of understanding	-4.56	-1.65	unfinished
2	Problem 2	11	55%	Simply understanding	-0.46		complete
3	Problem 3	12	60%	Simply understanding	0		complete
4	Problem 4	6	30%	Lack of understanding	-3.19		unfinished

From Table 5, the difficulties students solve problems of vector analysis contained in about 1 and about 4. Indicators of about 1 is looking for relations between various representations of concepts and procedures, as well as understand the relationship between different mathematical topics only 2 students or 10% were able to master gain value of 4 and 90% of students under the thoroughness and about 4 isuse and assess the relevance of mathematics and the interrelationship between topics mathematical topics with topics beyond the math, numbering 6 or 30% of students who received grades 3 and 70% of students below completeness, it can be seen from Table 5 students difficulty in numbers 1 and 4.

Table 6. Difficulties Students at number 1 and 4

No.	indicator Problem	difficulty	Many	Percentage
1	Problem 1: looking for relations between various representations of concepts and procedures, and understand the relationships between mathematical topics	Do not understand the formula of trigonometric identities.	14	70%
		Arithmetic operation errors	10	50%
		Can not justify by linking steps are less precise.	15	75%
2	Problem 4: use and assess the relevance of mathematics and the interrelationship antartopik mathematical topics with topics beyond the math	Failed to interpret the problem of the integral.	13	65%
		Incomplete complete results.	14	70%
		Errors in calculations using numbers	7	35%
		Errors in the calculation concept	9	45%

Table 6 explains that difficulty factor for the number 1 is 1) the students do the problems but by linking every step there is no connection or improper use of the rules of formula truth, 2) students can not understand the formula of trigonometric identities because the formula is an afterthought or simply memorized course, this is in line with Rajaguguk [5], Many students learn trigonometry not understand but just memorized it, 3) Often students make mistakes rules of arithmetic operation formula with regard to workmanship problems many students are not able to use arithmetic operations properly [6], While the difficulty factor number 4: 1) Students already do the problems but did not complete or get the answer, because students find it difficult [7]; 2) Students can not spell well for not understanding math symbols such as the integral cycle that occurs miskonsep [8]; 3) Students wrong to give the concept of calculation in the answer, 4) Students make a mistake when calculating the numbers.

Table 7. Difficulty student at the No. 2 and 3

NO	indicator Problem	difficulty	Many	Percentage
1	Problem 2: understand the same concepts equivalent representation, seeking a connection one procedure to another procedure in an equivalent representation	Difficulty making construction vector images.	6	30%
		Not to understand the properties of vector operations.	8	40%
2	Problem 3: use mathematics in other subject areas or everyday life	Difficulty way derive a formula derived by mathematical symbols.	5	25%
		Difficulty interpret the derivative symbol.	7	50%

Table 7 describes the difficulty for the number 2 and 3 while the question has the ability understanding of vector sufficient and the average value of the class has been completed, but that needs to be a factor of weakness in Problem 2: 1) Student difficult to construct an image, for lack of understanding how relation of mathematical shapes to form an image, 2) Students do not understand the properties of vector operations, too many rules formula. While the weakness factor of about three, namely difficulty to interpret the derivative symbol, a symbol of the confusion many students derivatives [9]; 2) student hardship by lowering such symbols such complex exponential mathematics and trigonometry, the students did not master basic calculus [10].

In Table 2 indicator first question lowest numbers and indicators about the number 3 most populous. Percentage indicator amounted to 43.25% the first question, Question 2 percentage indicator of 67.5%, the percentage of Question 3 by 65%, while the percentage of indicators about 47.5%. While the overall percentage score of 55.93%, which in general is still very lacking dkategorikan. 3 eggs indicator of matter, the highest student scores 4 and the smallest gain score 1 corresponds rubric score is determined, except for item 4 score the highest number is 3. That is the whole question answered all, there are students who are capable of completing a full answer and right, those that only write part they understand it.

Indicator number 1 looking for relations between various representations of concepts and procedures, and understand the relationships between mathematical topics. Problem: prove that the + =!$|A \times B|^2 |A \,.\, B|^2 |A|^2 |B|^2$

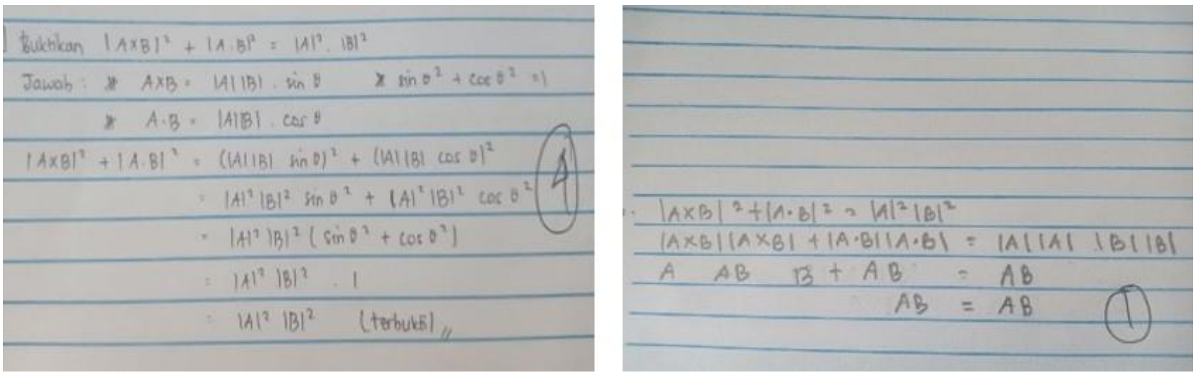

Figure 1. Answer Problem No. 1

From Figure 1, it appears the answers of students who received a high score him understand the forms of representation of the dot and cross product, in order to connect concepts and problem-solving procedures. While students who receive low scores, the students just completed the course and penyelesaiannyapun algebraically imprecise.

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Indicators Question 2, understand the same concept equivalent representation, seeking a connection one procedure to another procedure in an equivalent representation ,. Problem: State in the form of a picture that the vector sum of commutative and associative ie, A + B = B + A and A + (B + C) = (A + B) + C!

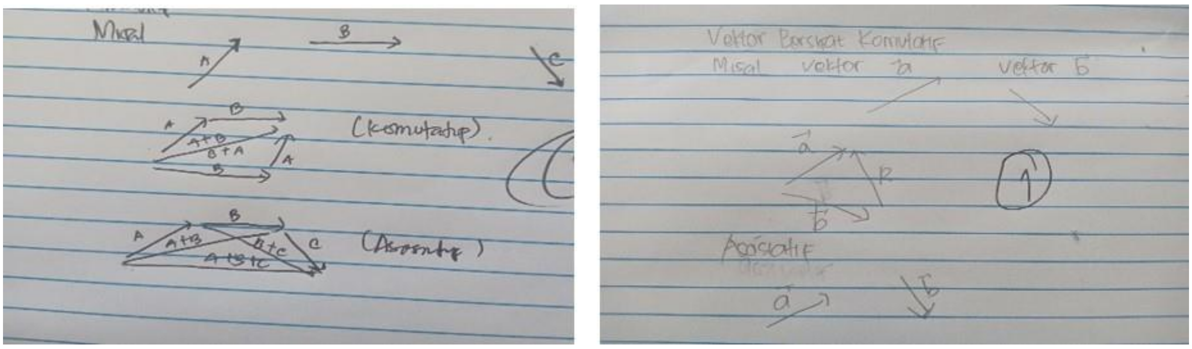

Figure 2. Answer Problem No. 2

From Figure 2 it can be seen that students with high scores (left) can draw a shape other representations of the algebra into the form of images, meaning that he understood that equivalent forms of representation on the matter requested. While students with low scores, he was only able to complete one picture with the lack of proper completion.

Indicators Question 3, use mathematics in other subject areas or everyday life. Problem: A particle moves along a curve equation parameters is x =, y = 2 cos 3t, z = 2 sin 3t, where t is time.e^{-t}

1. Determine the velocity and acceleration at any time
2. Look of the velocity and acceleration at t = 0

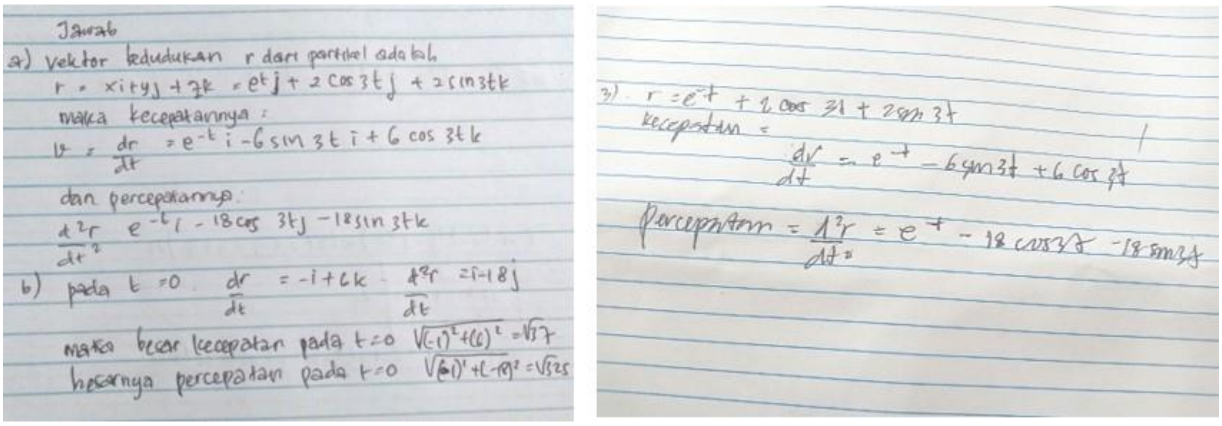

Figure 3. Answer Question Number 3

From Figure 3, it can be seen that the students who answered correctly he was able to complete the contextual matter that is about connections associated with everyday life. Students understand the process of settlement of the question until the right answer. While students who answered quite right just to understand the process but not right in the finish. From interviews with students who have difficulty solving problems, he mngerti settlement but forgot the prerequisite material which is derived materials that have been studied in other teaching materials.

Indicators Question 4, using and assessing the linkages antartopik mathematics and mathematical topic by topic relevance beyond mathematics. Question:

If known = 2, F = xyi - ZJ + k and C is the curve x =, y = 2t, z = from t = 0 to t = 1, count!$\emptyset \boldsymbol{x y^2 x^2 t^2 t^3} \int_c \boldsymbol{F} \times \boldsymbol{dr}$

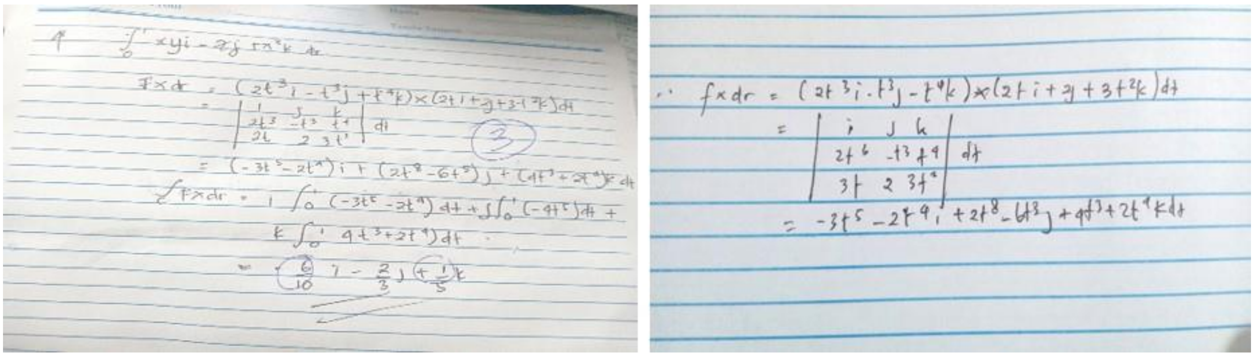

Figure 4. Answer Problem No. 4

From Figure 4, students with a high score answer the question correctly, only the less scrupulous in the final stage in the calculation. After the interviews, the students understand the concept of what is and is with regard. Spoken concepts related teaching materials on other subjects. While the students who scored low, he just finish the answer in the early stages, he said it was difficult to answer questions until the end.

4. Conclusion

Based on the explanation above, the conclusion that the ability to connect students in solving mathematical vector analysis is still under either category. It is viewed as a whole 55, 93%. In addition, it can be seen from the mathematical connection percentage four indicators. Firstly, finding relationships between the various representations of concepts and procedures, and understand the relationships between mathematical topics, the percentage is 43.25%. Secondly, understanding the equivalent representations of the same concept, look for connections one procedure to another procedure in an equivalent representation, the percentage is 67.5%. Thirdly, use mathematics in other areas of study or presentation of everyday life 65%. Lastly, use and assess the relevance antartopik mathematics and mathematical topic relevance to the topic of mathematics beyond the percentage 47.25%.

From the interviews conducted, the student difficulties in solving problems due to forget a formula or pre-requirements material is not so strong. Students who score high, they are able to understand the way used in problem solving with its prerequisite material. While most students who score low, they are only solving part or recollection only. For the prerequisite knowledge is very important for students to understand, because the mathematics are interrelated with the other fields as well as with everyday life [11, 12].

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