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The Effectiveness on The Use of Constructivism-Based Vector Analysis Module For 4th Semester Students in Department of Mathematics Education UNRIKA in Academic Year of 2016/2017

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Abstract. Based on the observations on the students in department of Mathematics Education UNRIKA, especially in Vector Analysis course, it is found that the students find it difficult to understand the material. This study aimed at knowing the effectiveness on the use of constructivism-based vector analysis module. The research design was using one shoot case study. The research population was 41 students with saturated sampling technique. The research instrument was using essay test consisting of five questions that hadtested its validity and reliablity. The hypothesis testing was using one sample T-test assisted with SPSS Statistics 20.0 in the significant level of 5%. Based on the analysis results, it was obtained sig (0.007) < α (0.05), so it can be concluded that the use of constructive-based vector analysis module to wards the learning outcomes for 4th semester students in department of Mathematics Education UNRIKA in academic year of 2016/2017 can be categorized as moderate.

***Keywords*: constructivism , effectiveness, module, vector analysis**

1. INTRODUCTION

Based on the United Nation Development Program (UNDP) report in 2005, the quality of Human Resources (HR) in Indonesia is ranked 109th from 117 countries [1]. It is very urgent to improve the teacher quality to support HR development by enhancing the education sectors. To realize this, mathematics that has been the most common prerequisites in education need to be enhanced. The pre-service teacher of mathematics should gain knowledge on vector analysis material including constant vectors, vector functions, differential vectors and vector integral. Vector analysis is one of the compulsory subjects for 4th semester students in department of Mathematics Education UNRIKA. The benefit of this course is to prepare the teaching about the vector concept in the secondary and senior high levelor vocational high school.

The basic vector basics have been taught in high school, especially for the students of science. It is presented in two subjects such as physics and mathematics, two subjects that are considered as the most difficult course for the students [2][3]. Vector is a subject that required high accuracy. It means this subject should be presented as best as as possible with a fun method. In university level, vectors learns in the course of vector analysis.

The vector analysis courses have some prerequisites, i.e. Calculus I, Calculus II and Advanced Calculus [4]. As Mathematic decipline, vector analysis is a branch of science that studies the real analysis of vectors in two or more dimensions. Vector analysis encompasses vector and scalar operations, vector fields and scalar fields, differentiation &

vector integration, and theorems which is related to vector. It also involves differential and integral concepts [5][6].

Based on observations, most of the fourth semester students who join vector analysis courses have difficulty in understanding the material. The available teaching materials is only from the books in the library with a very limited number. The available books also use the language which is difficult to understand by students. In addition, based on the data of students'learning resultof vector analysis courses, it showed that 87.8% of the students obtain the score below 56, as shown in Figure 1.

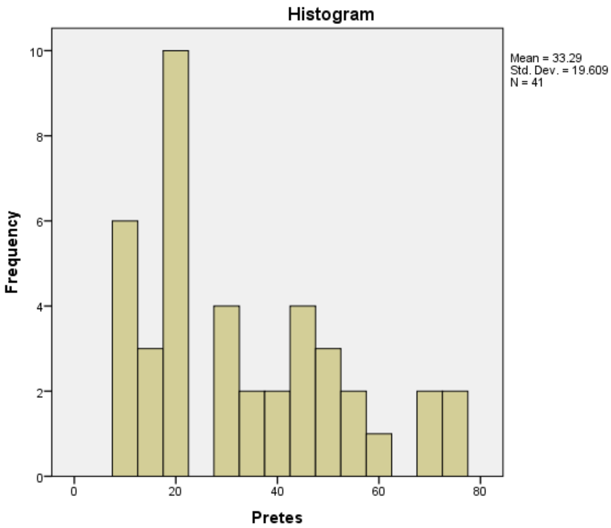

Figure 1. The students' score on vector analysis course

In mathematics learning, a strong foundation of mathematical description is needed to develop even to teach mathematics because it is a science of patterns and rules [7]. One strategy to improve the students' understanding is by providinga problem as stimulus. Thus, the development of learning resources is crucial, one of which is in the form of a mathematics module. Module is a form of teaching material in the form of printed materials. It is usually applied in universities level with a distance learning concept. According to Suprawoto [8], the module is a tool or means of learning that contains material, methods, limitations, instructions for learning activities, exercises and evaluation that are designed systematically and interestingly to achieve the expected competencies. It is also support the autonomous learning.

According to Boud, Felleti and Fogarty The modules should be designed to provide problems to direct the concept discovery foundedbased on the students' views, images and initiatives of students [9]. In the modules preparation, there are six components that must be known related with these elements [10], such as: 1) learning instructions; 2) competencies to be achieved; 3) supporting information, 4) exercises; 5) instructions; 6) evaluation. Having these 6 elements, the use of modules can improve students' abilities, especially the visual abilities of thinking [11].

The learning process should be able to improve the students' knowledge, especially in building and finding new things as well as to realize student-centered learning in order togive more impressive learning experience and to facilitate long-term memory in achieving the learning goals [9], [12], [13]. This idea is in accordance with the concept of constructivism learning. It emphasizes on the students' involvement in a problem to make them aware of their own knowledge discoveryas the results of thinking from the problems solving process [14]

Philosophisly, constructivism is a view on how a knowledge is owned by someone. According to Nussbaum [15] considers constructivism as a major concept that wants to change the paradigm of "logical positivist" or "objectivist". It perceives knowledge as absolute being"relativistic view" where knowledge is constructed individually. According to Zahorik [15], there are five elements of learning based on the philosophy of constructivism, such as:

a. Activating Knowledge,this stage is to reactivate the knowledge that is already owned by students
b. AcquiringKnowledge, it is the phase of acquiring new information/knowledge. This process can take place by learning the whole thing first, then paying attention to the details.
c. Understanding Knowledge, this process is carried out through three steps, namely (1) preparing a temporary concept (hypothesis), (2) sharing with others to get a response (validation) and based on the response (3) the concept was revised and developed.
d. Applaying Knowledge, this stage is to practice the knowledge and learning experiences that have been obtained in the previous stages.
e. Reflecting Knowledge, this final stage is to reflect on the knowledge development strategy.

This module is arranged to make sure the conveyed material in teaching and learning activities always directed to the goals that have been clearly and specifically formulated [16]. Module teaching is an individual teaching effort that allows students to master a unit of learning material before moving to the next unit. In other words, teaching a module is a teaching that is partly or wholly based on modules.

Module teaching provides students withopportunities to learn by their own, since they use different techniques to solve certain problems based on their respective background knowledge and behavioue [16]. Teaching with this module, lecturers can act as organizers to make students more active in order to achieve the formulated teaching objectives. In addition, lecturers must be able to maintain and arouse students' learning motivation.

Based on the previous research, constructivism-based vector analysis module has been produced in which the module validation has been carried out by media experts and material expert. The validation result showed that the modules are appropriate for the students to facilitate the material learning. Therefore, further research is conducted to know the effectiveness of the use of constructivism-based vector analysis modules on the learning outcomes amon the students of mathematics education study program. Based on the presented problems above, the researcher is interested in conducting a research entitled "The Effectiveness On The Use Of Constructivism-Based Vector Analysis Module For 4th

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Semester Students In Department Of Mathematics Education UNRIKA In Academic Year Of 2016/2017".

2. RESEARCH METHOD

The research was conducted at UNRIKA in the academic year of 2016/2017. The research method was uisng experimental method by using one-shoot case study design. The paradigm in this research can be described as follows:

Table 1. One shoot case study desain

X	O

Explanation:
X: The given treatment
O: Observation

The research sample was treated with constructivism-based vector analysis module. It was about 41 people as the research population by using saturated samples technique. They were mathematics education students of attended Vector Analysis Courses. The data collection technique was the measurement techniques with 5 test essay items. The test items were tested for its validity and reliability of 0.771 to the students beyond the research sample. Before to the data were analyzed, the normality test was performed with Kolmogrov-Smirnov. The hypothesis testing was donethroughOne Sample t_{test} with the assistance of SPSS version 20.0 and in case of the effectiveness catagorization Gain (G) formula was employed as follows:

$$gainindeks = \frac{mean\ score\ of\ post\ test\ - mean\ score\ of\ observation}{maximum\ score - mean\ score\ of\ observation}$$

The gain index is interpreted using the criteria in the following table:

Table 2. Gain Index Criteria [17]

Gain Index (g)	Criteria
$\boldsymbol{g > 0,7}$	High
$\boldsymbol{0,3 < g \le 0,7}$	Medium
$\boldsymbol{g \le 0,3}$	Low

3. FINDINGS AND DISCUSSION

The implementation of constructivism-based vector analysis module was conducted in four meetingsin March-April 2018. The data obtained from this study were scores of the students' learning outcomes that was tested after being treated with the module. The following is the descriptive data of thestudent learning outcomes.

Table3. Descriptive data on the learning result of vector analysis

	N	Range	Min	Max	Sum	Mean	Std. Dev
Post-test	41	70	30	100	2632	64.20	18.427
Valid N (listwise)	41						

Based on table 3 above, it was found that the mean score of the student learning outcomes were 64.20 with the standard deviation of 18.427. It was then tested for its normality by using the Kolmogrov-Smirnov test, the results of which are as follows:

Table 4. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Postes	.078	41	.200*	.976	41	.528

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on Table 4, it can be seen that the student learning outcomes after using vector analysis modules were normally distributed where the sign value (0.200)> α (0.05). Then,one sample T-test was used to answer the hypothesis, as follow.

H_0: The use of constructivism-based vector analysis module is not effective towards the learning outcomes for 4th semester students in department of mathematics education unrika in academic year of 2016/2017.

H_a : The use of constructivism-based vector analysis module is effective towards the learning outcomes for 4th semester students in department of mathematics education unrika in academic year of 2016/2017.

Based on the results of hypotheses testing, the result is presented in Table 5 below.

Table5. One-Sample Test

	Test Value = 56					
	T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Postes	2.848	40	.007	8.195	2.38	14.01

Based on the testing result with one sample test, it was obtainedthe score of$sig\ (0.007) < \alpha\ (0.05)$, it means H_a is accepted, in which the use of constructivism-based vector analysis module is effective towards the learning outcomes for 4th semester students in department of mathematics education unrika in academic year of 2016/2017. Then, the following gain index was used to know the effectiveness catagory of the use of constructivism-based vector analysis module.

$$gain\ indeks\ = \frac{mean\ score\ of\ post\ test\ - mean\ score\ of\ observation}{maximum\ score - mean\ score\ of\ observation}$$

$$= \frac{64.19 - 33.29}{100 - 33.29} = 0.46, \qquad moderate\ catagory$$

The use of constructivitsm-based vector analysis modules makes students motivated because the appearance of the vector analysis module is very interesting. It is also presented problems that require students to answer questions and solve the problems

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with their logical testing among the facts of their observations. It stimulates the students to construct their own knowledge based on the provided information in the module. The appearance of constructivism-based vector analysis modules is presented in Figure 2.

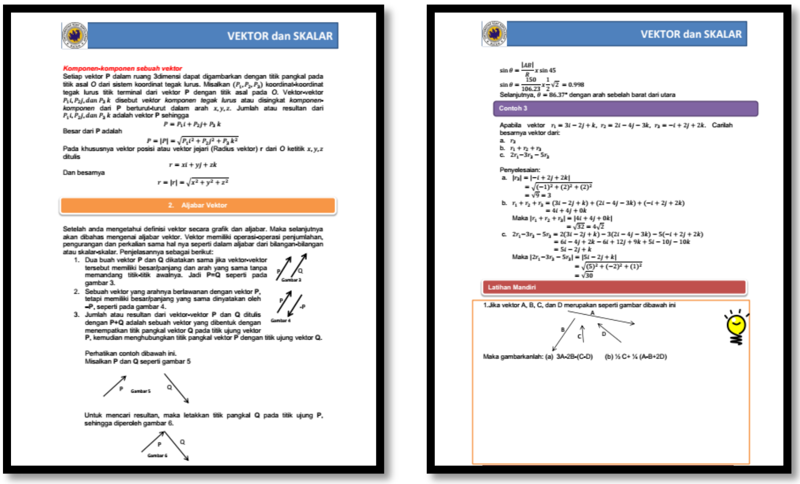

Figure 2. The content of constructivism-based vector analysis modules

During the learning process, the students were very serious and enthusiastic to solve the existing problems, theytried to arrange the existed concepts and the principles into some important order.Thelearning activities is presented in the following figure 3.

Figure 3. learning activities with constructivism-based vector analysis modules

This result is consistent with the research by Sumitro 2016 who facilitatedthe learning using constructivism-based biology modules on human digestive system material. The obtained score of the learning outcomes showed the mean of 82.5 that can be categorized as “very high”since the students have their own learning experience. It is also supported with constructivism ascpects, such as Activating Knowledge, Acquiring Knowledge, Understanding Knowledge, Applaying Knowledge, and Reflecting Knowledge.

4. CONCLUSION

Based on the resreach result and discussion, it can be concluded that theuse of constructivism-based vector analysis module is effective towards the learning outcomes for 4th semester students in department of mathematics education unrika in academic year of 2016/2017 that can be catagorized as “medium”.

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