The Effect of Blended Learning on Student Learning Outcomes in Calculus Vector Course

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Abstract. Rapid development of technology has become an inseparable part of life. This poses a challenge for the world of education to be able to take advantage of technological developments in achieving educational goals. However, switching from a direct learning model to technology-based learning requires a lot of effort and money. However, this can be started with the Blended Learning Model. This study aims to analyse whether student learning outcomes are better with the application of Blended Learning using e-learning and to describe how student learning activities with the Blended Learning model. This type of research is a combination of quasi-experiment and descriptive research. The research data are the value of the midterm exam and the final semester test scores after the implementation of the learning Blended Learning model which will be analysed. Therefore, it can be compared students’ learning outcomes using the Blended Learning model with student learning outcomes with the conventional learning model. Based on the results of data analysis, it can be concluded that the N-gain test results obtained from the control class are better than the experimental class, which means that the use of the Blended Learning model is less effective in improving student learning outcomes in vector calculus subjects.

1. Introduction
The rapid development of technology has become an inseparable part of life. This poses a challenge for the world of education to be able to take advantage of this technological developments in achieving educational goals. [1], [2] recommend utilizing technology in learning, especially mathematics learning. However, switching from a direct learning model to technology-based learning requires a lot of effort and money. However, this can be started with the Blended Learning Model. [3], [4], [5] stated that Blended Learning is a mix method of face-to-face learning with online learning experiences. Many research results state that this model has a positive attitude in learning, especially mathematics learning [6], [7], [8], [9]. Likewise in vector calculus learning [10], [11], [12], [13].

Vector calculus is one of the compulsory subjects that all mathematics majors must take. However, there are many studies that state that students experience difficulties in this subject [12], [14]. The situation also happened to students majoring in Mathematics and Natural Sciences, of Universitas Negeri Padang. Based on the data, 35 percent of students who took this vector calculus courses, are fail and only a small proportion of them passed with satisfactory grades. The results of interviews with several students, it was revealed that students generally failed
their final semester exams. This is because the topics that are tested on the final exam are very difficult. These difficult topics include the green theorem, the Gauss divergence theorem and the Stokes theorem. Students generally rely on notes when repeating lessons at home. However, students have difficulty understanding lecture notes because there are parts of the lecturers' explanations that are not recorded comprehensively. This of course will not happen if the lecturer explanation about the lecture material has been included in a learning video that is integrated with e-learning. The video can be accessed by students anytime and anywhere so that they can pay attention to every detail of the material explanation from the lecturer and review it as needed.

Based on this, researchers are interested in applying the Blended Learning model at Universitas Negeri Padang (UNP) where students at UNP are already literate with the technology and the facilities are already available at UNP. This research produced a vector calculus learning video with the topic of the green theorem, the Gauss divergence theorem and the Stokes theorem as part of the implementation of the blended learning model that will be applied. The video is expected to improve student learning outcomes in vector calculus courses. Based on the descriptions that have been presented, a research was conducted on the Effect of Blended Learning Application on Student Learning Outcomes in Vector Calculus Subjects.

2. Research Methods

The type of research used is a combination of quasy experiment research and descriptive research. Quasy experimental research is used to analyze whether student learning outcomes are better with the application of blended learning. Meanwhile, descriptive research is used to describe how student learning activities are carried out using the blended learning model. The quasy experimental research design used was the Static Group Design. This design uses two sample classes, namely the experimental class and the control class.

This research was conducted in several stages. The first is the preparation stage, namely looking for literature on vector calculus on the topic of the green theorem, the Gauss divergence theorem and the Stokes theorem to detail the material to be made into the learning video. Furthermore, based on the details of the material that has been made, a vector calculus learning video is made on the topic of the green theorem, the Gauss divergence theorem and the Stokes theorem.

Furthermore, the research implementation stage was carried out by uploading a video about vector calculus on the topic of the green theorem, the Gauss divergence theorem and the Stokes theorem to the UNP elearning after the learning videos were assessed by experts to be accessible by students in online learning. In the following week students were asked to submit questions about recovery material that had been delivered in the video and given additional questions to be worked on by students in groups with the guidance of the lecturer.

The data collection stage was carried out with the results of the final test of students in the control class and experiments to be able to make comparisons, for the experimental class students who had received treatment were then interviewed about their opinions regarding the treatment given and then the data obtained from the test results and subsequent interviews were analyzed so that they can summarizes the conclusions of the research that has been carried out.

3. Research Results and Discussion

This research produced three videos about green theorem, gauss theorem and stokes theorem. All of these videos are in Indonesian Language. Students on experiment class are able to watch those three
videos so that they can learn anytime and anywhere about these three fundamental theorems. The data were analyzed using N-Gain. Its results of the analysis shown in Figure 1.

![Table]

| Descriptives | Statistic | Std. Error |
|--------------|-----------|------------|
| NGain_Person | -167.6500 | 26.38167   |
| 95% Confidence Interval for Mean | Lower Bound -221.0200, Upper Bound -114.2860 |
| 5% Trimmed Mean | -145.5556 |
| Median | -132.6867 |
| Variance | 27639.892 |
| Std. Deviation | 166.85231 |
| Minimum | -959.00 |
| Maximum | 0.00 |
| Range | 959.00 |
| Interquartile Range | 94.50 |
| Skewness | -3.194, 0.374 |
| Kurtosis | 12.74, 2.73 |

| Descriptives | Statistic | Std. Error |
|--------------|-----------|------------|
| NGain_Control | -50.0016 | 8.44645 |
| 95% Confidence Interval for Mean | Lower Bound -67.9862, Upper Bound -33.4711 |
| 5% Trimmed Mean | -48.5026 |
| Median | -44.4444 |
| Variance | 2823.699 |
| Std. Deviation | 53.42002 |
| Minimum | -200.00 |
| Maximum | 23.08 |
| Range | 223.08 |
| Interquartile Range | 55.88 |
| Skewness | -1.290, 0.374 |
| Kurtosis | 1.70, 2.73 |

**Figure 1.** analysis of the N-gain test for the control and experimental classes.

The N-gain test shows that the average N-gain score for the experimental class (applying the blended learning model) is -167.65% are categorized as ineffective. The minimum N-gain score is -960% and a maximum of 0% in the experimental class, while the average N-gain score for the control class is -50%, including in the ineffective category with a minimum N-gain value -200% and a maximum of 23.08. This calculation shows that the implemented blended learning model has negative impact with the learning process.

This finding contradict with [10], [11], [12], [13], [15] in which all of those research found that the blended learning give positive impact on students learning. The interviewed data found why this situation seems to contradict. Our students are happy to download the videos (green, gauss and stokes theorem) that we gave to them, but they just watch it on a while without repeating the videos and eagerness to understand the material on the video. Most of them do not want to ask the lecturer about the material on the videos on whatsapp group even the lecture always ask whether they have question or not.

### 4. Conclusion

The process and results of the research concluded that the use of the Blended Learning model is less effective in improving student learning outcomes in vector calculus courses in our experiment. This is due to several things including: the topic of final semester exam is more difficult than the topic for midterm exam, students are not accustomed to the learning model Blended Learning and the lack of communication between students and lecturers via whatapps group application.
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