The effectiveness of online calculus 2 learning during the Covid-19 pandemic

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Abstract. This study aims to analyze the effectiveness of online learning in calculus 2 during the Covid-19 pandemic. The study was conducted in a civil engineering study program at a private tertiary institution on Sumbawa Island. This research is a quasi-experimental research design model non-equivalent control group design. The number of subjects in this study was 71 people. Data analysis used a paired sample t-test analysis with the help of SPSS software. Based on the results of data analysis, online learning is not effective in calculus 2 subjects in the pandemic covid-19 period, there is a significant relationship between conventional learning and online learning and there is a significant difference between conventional learning and online learning. The average value of student learning outcomes is decreased when the online learning system is applied. From these results it can be concluded the online learning system in the 2nd calculus course during the Covid-19 pandemic has not been effective.

1. Introduction

The beginning of the Covid-19 pandemic that appeared at the end of 2019 certainly affected all aspects of life in the world. Indonesia is no exception affected by the pandemic. One of the things that is affected is education. Since March 2020 most tertiary institutions have implemented rules of online learning without face to face in order to minimize the spread of the Covid-19 virus. Unusual learning systems for some students certainly affect the effectiveness of the teaching and learning process.

The online learning process (ol-learning) is not uncommon for some tertiary institutions. Since all this time the learning process is more conventionally dominant (c-learning). In the conventional learning model (c-learning), students and lecturers meet face to face, in contrast to ol-learning, they don't need to meet face to face [1]. there is the hope that online learning will be able to provide a world class education to anyone, anywhere, and anytime as long as they have access to the internet [2]. The learning process that suddenly changes from c-learning to ol-learning certainly has a significant influence on lecturers and students. Lecturers are required to be able to use various applications that help the ol-learning teaching and learning process. Students are required to be more independent and disciplined in learning. Many things that affect this online learning process aside from the application are internet networks that must be stable so that the teaching and learning process runs smoothly as well as offline learning. Online learning in its implementation requires the support of mobile devices such as smartphones, tablets and laptops that can be used to access information anywhere and anytime [3].

Calculus 2 is a compulsory subject in the civil engineering study program which is a continuation of calculus 1. This course is a basic course that is a requirement for students to be able to take a course in engineering mathematics in the next semester. This course contains dual integral material, differential equations, vectors, matrices and other material. This course is a continuation of the Calculus 1 course
that was taken in the previous semester. Understanding the concepts in Calculus 2 greatly influences the learning process in engineering mathematics courses. Therefore, the depth of concept and understanding is highly demanded by students. During the co-19 pandemic, the learning process of calculus 2 naturally changes. Half the semester is done offline and the next half semester is done online.

This study aims to determine the effectiveness of applying online learning systems in calculus 2 courses during the Covid-19 pandemic. It is hoped that this research can provide an idea for further improvement of the online learning system considering the development of online learning support technology.

2. Method
This type of research is experimental research. This type of experimental research used is a quasi experiment design model nonequivalent control group design. Quasi-experiment is one experiment which is the smallest unit placement experiment into the experimental group and control is not carried out with random (nonrandom assignment)[4]. This research was conducted in the civil engineering study program of a private university on the island of Sumbawa. The number of subjects of this study were all students who took courses in calculus 2 in the even semester of the academic year 2019/2020 totaling 71 people. Data collected by test method. Student learning outcomes in the 2nd calculus course were analyzed using paired sample t-test. Before the data analysis is done by paired sample t-t, normality and homogeneity test is done. All data analysis processes use SPSS software. The online media used in this study were through whatsapp groups, online discussions through SIAKAD, zoom, email and google classroom

3. Result and Discussion
3.1. Normality test
The main requirement for parametric data analysis is the normality test. Normality test is used to find out whether data from a population is normally distributed or not. Data normality test results are as in Table 1.

| Table 1. Data normality test results |
|-------------------------------------|
|                                | Shapiro-Wilk |
|                                | Statistic | df | Sig.  |
| Conventional Learning           | 0.969     | 71 | 0.076 |
| Online Learning                 | 0.982     | 71 | 0.419 |

Based on the SPSS output data Sig. Conventional learning and online learning in table 1 shows the values of 0.076 and 0.419. The basis for the decision to infer normal distributed data is the value of sig. if Sig. greater than 0.05, the data is said to be normal, and vice versa. Sig. Value in this study, greater than 0.05, which means the research data is normally distributed.

3.2. Homogeneity test of data
In addition to the normally distributed data, another requirement for analyzing data with paired sample t tests is the homogeneity of the data. Homogeneity test is used to determine whether the data obtained in this study has a homogeneous variant or not. The results of homogeneity test data using SPSS can be seen in Table 2.
Table 2. Test of homogeneity of variances

| Final_Score                     | Levene Statistic | df1 | df2 | Sig.  |
|---------------------------------|------------------|-----|-----|-------|
| Based on Mean                   | 0.757            | 1   | 140 | 0.386 |
| Based on Median                 | 0.375            | 1   | 140 | 0.541 |
| Based on Median and with adjusted df | 0.375            | 1   | 138.925 | 0.541 |
| Based on trimmed mean           | 0.685            | 1   | 140 | 0.409 |

Homogeneity data decision making using Sig. The data is said to be homogeneous if the Sig. more than 0.05. In table 2 the value of Sig. for research data that is 0.409 more than 0.05 which means the research data is homogeneous. The research data fulfilled two parametric statistical requirements so that the paired sample t-test was fulfilled.

3.3. Paired sample t-test

The results of the paired sample t-test consist of three main components, namely paired samples statistics, which are useful for knowing the effectiveness of online learning calculus 2, paired samples correlation to determine the relationship between conventional learning and online learning and paired samples test to determine the difference in effectiveness between conventional learning and online learning. These results are able to deduce what the purpose of this study.

One indicator of an effective learning method can be seen from the average value of students experiencing significant changes. And vice versa learning methods can be said to be ineffective if there is a decrease in learning outcomes between one method with another method. Based on the results of paired samples t-test using SPSS the results of the effectiveness of the application of online learning are shown in Table 3.

Table 3. Paired samples statistics

|               | Mean  | N    | Std. Deviation | Std. Error Mean |
|---------------|-------|------|----------------|-----------------|
| Pair 1        |       |      |                |                 |
| C_Learning    | 63.4648 | 71   | 12.99652       | 1.54240         |
| Ol_Learning   | 57.5634 | 71   | 12.15111       | 1.44207         |

Based on Table 3 the average value of learning outcomes when using conventional methods 63.4648 is seen. The average value of learning outcomes dropped when applied online learning to 57.5634. This decline in value can be concluded that online learning during the co-19 pandemic has not been effective.

Another thing that becomes the calculation output using SPSS is the relationship between conventional learning and online learning. These results are shown in Table 4.

Table 4. Paired samples correlations

|               | N  | Correlation | Sig.  |
|---------------|----|-------------|-------|
| Pair 1        |    |             |       |
| C_Learning &  | 71 | 0.631       | 0.000 |
| Ol_Learning   |    |             |       |

Table 4 show that the basis for making decisions to determine the relationship between conventional learning and online learning is the Sig. Sig value 0.000 or less than 0.05 indicates there is a significant relationship between conventional learning and online learning. The
correlation value between conventional learning and online learning is 0.631. This value is included in the strong category.

Another output from SPSS is paired samples test. This output is used to conclude the comparison between conventional learning and online learning. Decision making based on sig (2-tailed) values. These values are as shown in Table 5.

### Table 5. Paired samples test

|     | Mean  | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | t    | df  | Sig.   |
|-----|-------|----------------|-----------------|----------------------------------------|------|-----|--------|
| Pair 1 C_Learning - Ol_Learning | 5.90141 | 10.83006       | 1.285           | 3.33                                   | 8.46 | 4.591| 0.000  |

Sig value (2-tailed) in Table 5 shows the value 0.000. This value is compared with 0.05, if it is smaller than 0.05, it can be concluded that there are significant differences in learning outcomes between conventional learning and online learning. Vice versa.

Average student learning outcomes are decreased when the online learning system is influenced by many factors. One problem is the location of lecturers and students who are not in the same location. This of course makes the focus of the students can be divided differently from conventional learning systems that are face to face. In line with research conducted by Firman and Rahman [5] which concluded that one of the difficulties of the location of lecturers and students who were separated when carrying out learning made the lecturer unable to directly monitor student activities during the lecture process. There is no guarantee that students really pay attention to the explanation given by the lecturer. Szpunar, Moulton, & Schacter [6] stated that students fantasize more frequently in online lectures compared to face-to-face lectures. Therefore, Khan [7] suggested that online lectures should be carried out in a short time because of difficulties in maintaining concentration if online lectures are held for more than one hour

Another factor influencing the ineffectiveness of the online learning process in this study is supporting facilities. Supporting facilities in this case the internet connection. Most students in this study use cellular data to connect to the internet. The data package used during the online learning process is certainly not small. Plus the location of students who are indeed difficult to reach by internet connections.

Another difficulty that makes the online learning process ineffective is the difficulty of understanding the material provided online. The material that is mostly distributed in the form of reading tends to be poorly understood by students. Students still need verbal explanations by the lecturer for some material that is considered complex and not enough to be solved by instant messaging applications or discussion columns that exist in online class applications. Garrison & Cleveland-Innes [8] conduct research by engineering the involvement of lecturers in lectures online. In classes where the involvement of lecturers is very small, it does not indicate deep and meaningful learning. Interaction with lecturers becomes very important in online learning because it is able to reduce psychological distance which in turn will lead to better learning [9].

Online learning requires students to be more independent and disciplined in understanding each given material. As a result of direct guidance that is less than lecturers cause students to be more creative in looking for supporting references such as books, journals and other scientific articles. In line with research conducted by Kuo et al. [10] which states that online learning is more student centered so that it can bring up the responsibility and autonomy of students in learning. Online learning requires students to prepare their own learning, organize and evaluate and simultaneously maintain their learning motivation [11].
Another problem that is the cause of the ineffectiveness of online learning in this case is the method of delivery from educators who are limited to providing material followed by assignments to be done. Utilization of applications that help the teaching and learning process has not been maximally carried out. The ability to understand and use facilities to support online learning activities should be increased in order to achieve maximum learning outcomes. Submission of material in the form of reading is certainly not easily understood thoroughly by students[12]. Teaching material used in conventional learning should be virtualized so that the learning process is interesting and effective [13].

The online learning system which has been implemented for two months is quite effective to be used to maintain social distancing to prevent the spread of Covid-19. In accordance with research conducted by Sadikin and Hamidah which concluded that online learning is able to mentor social distancing behavior [14]. In online learning in the eyes of Julian calculus 2, the media that are often used are WhatsApp group, zoom and siakad. Siakad media is an online learning media that has long been used and facilitated by the campus but the use and utilization is still very lacking. Students tend to be more active and dominant using whatsapp groups. The use and use of information technology during online learning in the co-19 period is very important for the learning process[15].

4. Conclusion
Based on the research process that has been carried out it can be concluded that the online learning process in the 2nd calculus course during the Covid-19 pandemic has not been effective. Some factors that are the cause of the ineffectiveness of online learning in this research are internet connection and the lack of understanding of students in this online learning process. The independence and discipline of students need to be improved in improving the effectiveness of online learning. In addition, facilities and infrastructure as well as learning media must be more interesting and effective. Another thing to consider in online learning is the learning method applied by the lecturer. Some of these things can be considered considering online learning will be a must in the era of technological advancements.

5. References
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