The application of SPADA to students understanding of mathematical concepts

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Abstract. In this study, learning is carried out by SPADA (Network learning Systems) in calculus/mathematics courses in terms understanding of student concepts. This study aims to see the effectiveness of the application of learning with BL in terms of understanding students concepts. The study used a quasi-experimental technique with a population of all Indonesian Teknokrat University students. The sampling technique uses random sampling and to test its effectiveness a T-test statistic is used with α = 5%. Acquired score understanding of student concept in the experimental class is 78.48 higher than the control class namely 63.93. Based on T-test results, it can be concluded that this learning is effective applied to the mathematics class. The conclusion of this study suggests that the implementation of SPADA is effective when viewed from the understanding of student concepts. This is because SPADA combines face-to-face learning with a network of learning that matches the development of the current era in which every aspect of our lives relies heavily on technology and its development affects us socially, economically, politically, even in our culture and education. In addition, SPADA is an alternative learning to improve level thinking skills. Students are more interested and motivated to learn more earnestly and find learning resources that are getting closer to them through gadgets or computers.

1. Introduction
The development of education today lasts very quickly, including at the college level. Along with the times and increasingly sophisticated technology, the world of education must also adjust its learning system. Facing the sophisticated era 4.0 as it is today, inevitably the learning system must be adapted to learning based on smartphones, computers, and other technological devices. Efforts are needed to change learning which only makes students listen and memorize it, into a challenging learning process to develop their thinking skills [1]. Future education will be more determined by information networks that allow interaction and collaboration, not oriented to school buildings [2].

Changes to the technology’s features has opened doors to educators to find the best method through technology in order to produce learning environments that can meet the various learning styles and needs of the learners; and hence, lead to meaningful learning [3]. The need to design and develop an attractive learning media by utilizing technology that has been provided in the current era to improve the quality of education [4]. E-Learning has encouraged democratization of teaching and learning processes by giving greater control in learning to students [5]. The development of technology has spawned an
innovative and creative learning model in the learning process. The Networked Learning System (SPADA) has assisted educators in the face of technological development challenges [6].

Mathematics learning in tertiary institutions was also affected by technological developments. Lecturers in the mathematics education department also must implement a lecture system that uses learning in the network. Along with the development of sustainable technology. The advancement of technology to the inland, despite its limitations, learning can now be done through an Internet-accessible computer. This is also known as Web base learning, Internet learning, or e-learning [7]. However, during this time the study of mathematics at the University of Teknokrat Indonesia still prioritize direct face to face meeting. During the learning process, lecturers also still apply conventional learning where lecturers explain the material, give examples and practice questions. This suggests that the learning process is only routine so that students tend not to be eager to learn and acquire less good grades.

In this study the study was carried out using SPADA Teknokrat with blended learning. Blended learning is described as an approach to learning and teaching that combines and harmonizes learning conducted in face-to-face sessions with online learning [8]. In mathematics education, many mathematicians recognized the value and importance of the BL approach in teaching mathematics [9]. It’s because, blended learning is an innovative concept that embraces the advantages of traditional teaching in the classroom and ICT-supported learning [10]. The use of offline and online activities is expected to provide better results than traditional face-to-face activities [11]. BL is a learning model that combines the advantages of face-to-face learning models with e-learning models [11]. BL is a modern education strategy that replaces e-learning gradually in most educational institutions [12]. If we can combine the advantages of teaching in the classroom and e-learning, the effects of learning will increase and expand in mixed learning models [13]. BL enhances student experience and offers greater efficiency in communication [14]. BL is integrated into students’ access, success, and perception of their learning environment [15]. BL is an alternative learning to improve higher-order thinking skills [16].

Besides having to develop mathematics learning according to the times, lecturers majoring in mathematics education also need to focus on learning the ultimate goal of learning, namely on understanding students’ mathematical concepts. Understanding concepts is an ability about understanding mathematical ideas that are thorough and functional [17]. Learning mathematics students must first understand mathematical concepts to solve problems and be able to apply these learning in the real world [7]. Understanding concepts is a very important ability to be developed [18]. A good understanding of concepts will be obtained by students if the learning process runs smoothly and pleasantly. Lecturers understanding of good concepts will support the learning process that can realize educational goals [19]. Based on the explanation, the research related to the application of learning with BL using a learning system in the network (SPADA) in terms of understanding students' mathematical concepts is very important to do.

2. Methods
This research is a quantitative study with the experimental quasi method. The purpose of this study is to investigate the possibility of causal relationship by wearing learning with SPADA to the experiment group, which then compares the results with the control group that is not subject to treatment condition. The population of this research is all students at the Universitas Teknokrat Indonesia 2019/2020 school year. Samples were taken by random sampling technique to class by selecting 2 classes. One class as an experimental class and another class selected as a control class. 19A was selected as an experimental class with 33 students and 19B as a control class with 30 students. In the experimental class, treatment is given by applying the BL learning and then reviewing it based on understanding students' mathematical concepts. Whereas the control class uses a face-to-face learning system in full.

The data in this study are quantitative data obtained from student test results. The data is a data understanding of students' mathematical concepts obtained from the concept understanding test in the experimental class and the control class. This research was carried out in the calculus/mathematics class that is the material limit and derivatives. This is because both of these materials include material that
must be understood in learning mathematics/calculus. The instrument used in the form of tests of understanding mathematical concepts that are made based on the criteria of understanding concepts and based on the lattice of questions made before making the test. The test given is in the form of essay questions to accurately measure students' mathematical understanding of concepts. The test questions are 7 questions, adjusted for the number of indicators understanding the concept.

In this study the effectiveness of the aspects of learning outcomes can be seen from the mastery of mathematical concepts of students. Students' concept of mastery is measured based on indicators of student conceptual understanding. There are several indicators regarding mastery of understanding mathematical concepts, namely: (1) Defining concepts verbally and in writing; (2) identify and make examples and not examples; (3) using models, diagrams and symbols to represent a concept; (4) changing one form of representation to another; (5) recognize various meanings and interpretations of concepts; (6) identify the characteristics of a concept and recognize the conditions that determine a concept; (7) comparing and differentiating concepts [20]. To determine the achievement of the objectives of mathematics learning seen from the strengthening of the concept with minimum completeness criteria that is 70% of students complete learning and get a minimum grade of C.

The data obtained from the test results are used as a basis for testing research hypotheses that have previously been tested for normality and homogeneity. In this study, data analysis was performed using a paired sample t-test using a two-tailed test (sig. 2-tailed). This test is used in the analysis of test result data using SPSS.

3. Result and Discussion

Based on the results of a mathematical concept understanding test, the student's scores are shown in the following table.

<table>
<thead>
<tr>
<th>HM</th>
<th>Experimental class</th>
<th>Control class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Students %</td>
<td>Students %</td>
</tr>
<tr>
<td>A</td>
<td>19 57.6</td>
<td>4 13.3</td>
</tr>
<tr>
<td>B</td>
<td>9 27.3</td>
<td>7 23.3</td>
</tr>
<tr>
<td>C</td>
<td>4 12.1</td>
<td>8 26.7</td>
</tr>
<tr>
<td>D</td>
<td>1  3.0</td>
<td>10 33.4</td>
</tr>
<tr>
<td>E</td>
<td>0  0</td>
<td>1  3.3</td>
</tr>
</tbody>
</table>

Average : 78.48
Standard Deviation : 9.96

Average : 63.93
Standard Deviation : 10.98

Based on the table 1, we can see that the average score understanding of student concepts in the experiment class is 78.48 higher than the average score comprehension concept in the control class. Beside it, in the experimental class many students who passed and received an A-C score were 32 people with a percentage of 97%, and the remaining 3% scored among the D-E so they were declared not passed. In the control class, 19 students passed and received an A-C score with a percentage of 63.3%, and the remaining 11 people or 36.7% received scores among the D-E so they were declared not graduated. The average value of students in the experimental class is higher than average value of students in the control class. Beside it, the magnitude of the percentage of graduates in the experimental class was also higher than the control class. This shows that students' understanding in the experimental class is better than the control class. Students in the experimental class also answered more questions correctly due to a good understanding of concepts. The magnitude of the standard deviation in the experimental class is smaller than the control class. This shows that the difference in values in the experimental class is smaller than the control class. So based on the graduation level, it can be said that in the experimental class more students passed than the control class.
Based on tables 1, it can be seen that the percentage of indicators understanding achievement of the best concepts achieved by the experimental class compared to the control class. This is because in this class students are more interested in learning. Students are also more independent, more motivated, and easy to learn because they can learn with a device/computer that is closely related to their daily activities that are current and following the times. After the normality test using SPSS, the following results were obtained.

Based on Liliefors and Shapiro-Wilk methods sig.> 0.05 were obtained in both the experimental and control groups. So that it can be said that both groups come from populations that are normally distributed. The significant value in the Levene method is 0.480 where> 0.05, which means there is a similarity of variance between groups or that means the sample comes from a homogeneous population. The results of students’ mathematical concept understanding tests in the form of student achievement scores in both classes were then tested by paired sample t-test using a two-tailed test (sig. 2-tailed) with SPSS and obtained the following results.

<table>
<thead>
<tr>
<th>Levene’s Test</th>
<th>t-test for Equality of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal Variances</td>
<td>t</td>
</tr>
<tr>
<td>Assumed</td>
<td>.505</td>
</tr>
<tr>
<td>Equal Variances not assumed</td>
<td>5.485</td>
</tr>
</tbody>
</table>

Based on table 2, it appears that the value of Sig. (2-tailed) is 0.00 which indicates that the value is <0.05. Because the value is <0.05, there is a statistically significant difference between the experimental class and the control class or it is significant at the 0.05 probability. The magnitude of the difference in mean or mean of the two groups is shown in the mean difference column, which is equal to 14.552. Because it is positive, it means that the experimental group has a higher mean than the control group.

The results of the study showed a significant difference, where the experimental class subjected had higher mathematical concept mastery values compared to the control class that was only subjected to face-to-face learning. This is because students who study in a SPADA are more motivated in independent learning, are more critical and responsible, more enthusiastic in learning because they can access courses more easily through devices or computers. Besides, SPADA is contemporary learning that is in line with the times. This learning is also carried out with a system that is more interesting and enjoyable so that it can improve students' understanding of concepts.

The results of this study are in line with the following research results learning with the blended learning method is effective and can develop communicative, creative, curious, and hard work characters [21]. There are significant differences in the two groups where the experimental group performs better than the control group [12]. Blended learning strategies are found to be significantly effective in improving student achievement [22].

4. Conclusion
Based on the results of data analysis, hypothesis testing and the effectiveness discussion of the application of SPADA Teknokrat to understand the mathematical concept, the conclusion is as follows: (1) the average understanding of the concept of students learning with spada higher than the average understanding of the concept of students who are not subject to learning with SPADA; (2) number of students who earned A-C (graduated mathematics course) in a class that is subject to learning with
SPADA more than the number of students who graduate in a class that is not subject to learning with SPADA.

5. References
[19] Perdani H Nand Azka R Teknologi Dan Pembelajaran Matematika Generasi Milenial 8

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