



THE EFFECTIVENESS OF BLENDED LEARNING USING A LEARNING SYSTEM IN NETWORK (SPADA) IN UNDERSTANDING OF MATHEMATICAL CONCEPT

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Abstrak

Dalam penelitian ini, pembelajaran dilakukan untuk melihat efektivitas penerapan Blended Learning (BL) menggunakan SPADA Teknokrat pada mata kuliah Kalkulus / Matematika terhadap pemahaman konsep siswa. Penelitian ini menggunakan teknik *quasi-eksperimental* dengan populasi semua mahasiswa Teknokrat Universitas Indonesia. Teknik pengambilan sampel menggunakan *random sampling* dan untuk menguji efektivitasnya digunakan statistik uji-T dengan $\alpha = 5\%$. Diperoleh hasil belajar siswa pada kelas eksperimen dengan rata-rata 78,48 lebih tinggi dari kelas kontrol dan standar deviasi 9,96. Berdasarkan hasil uji T, dapat disimpulkan bahwa pembelajaran ini efektif diterapkan pada kelas matematika. Kesimpulan dari penelitian ini menunjukkan bahwa penerapan pembelajaran di BL efektif jika dilihat dari pemahaman konsep siswa. Ini karena pembelajaran BL mampu menggabungkan pembelajaran tatap muka dengan pembelajaran dalam jaringan yang sesuai dengan perkembangan zaman saat ini. Siswa lebih tertarik dan termotivasi untuk belajar dengan lebih sungguh-sungguh dan mencari sumber belajar yang semakin dekat dengan mereka melalui gawai atau komputer.

Kata kunci: *blended learning*; pemahaman konsep; SPADA

Abstract

In this study, learning is carried out by Blended Learning (BL) with the SPADA 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 $\alpha = 5\%$. Obtained student learning outcomes in the experiment class with an average of 78,48 higher than control class and standard deviation 9,96. Based on the results of the T-test, it can be concluded that this learning is effectively applied. The conclusion of this study shows that the application of learning in BL is effective when viewed from the understanding of student concepts. This is because BL learning can combine face-to-face learning with learning in a network that by the current development. Students are more interested and motivated to study hard and look for learning resources that are getting closer to them through devices or computers.

Keywords: *blended learning*; concepts understanding; SPADA

Citation: Ulfa, M., Puspaningtyas, DN. 2020. The Effectiveness of Blended Learning Using A Learning System in Network (SPADA) in Understanding of Mathematical Concept. *Matematika dan Pembelajaran*, 8(1), 47-60. DOI: <http://dx.doi.org/10.33477/mp.v8i1.1280>

INTRODUCTION

The development of education at the tertiary level takes place very quickly. 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. (Arisanti et al., 2017) revealed that efforts are needed to change learning which only makes students listen and memorize it, into a challenging learning process to develop their thinking skills. This is in line with the opinion Budiman (2017) which states that future education will be more determined by information networks that allow interaction and collaboration, not oriented to school buildings.

Yeop et al., (2016) revealed that today every aspect of our lives is very dependent on technology and its development affects us socially, economically, politically, even in our culture and education. (Masykur et al., 2017) added 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. Furthermore, (Purnomo et al., 2017) also revealed that online learning is learning that utilizes telecommunications and communication technology as a bridge of communication between educators and students. (Effendi, 2019) also states that the learning system in the network (SPADA) has helped educators in facing the challenges of technological development.

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. (Arifin & Herman, 2018) revealed that the e-learning system is a form of learning implementation utilizing the internet through the form of websites and weblogs with multimedia content which is the process of transformation and digitization of conventional learning.

In this study learning is carried out with Blended Learning (BL). (Dinning *et al.*, t.t.) state that 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. (Bhatti *et al.*, 2016) stated that in mathematics education, many mathematicians recognized the value and importance of the Blended Learning (BL) approach in teaching mathematics. (Lalima & Lata Dangwal, 2017) said that blended learning is an innovative concept that embraces the advantages of traditional teaching in the classroom and ICT-supported learning. Furthermore, (Arisanti *et al.*, 2017) states that the use of offline and online activities is expected to provide better results than traditional face-to-face activities. A similar sentiment was also conveyed (Wardani *et al.*, t.t.) which states that blended learning is a learning model that combines the advantages of face-to-face learning models with e-learning models. (Oweis, 2018) also revealed that BL is a modern education strategy that replaces e-learning gradually in most educational institutions.

Lin *et al.*, (2016) state that ideally, 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. (Tawil, 2018) revealed that blending learning enhances student experience and offers greater efficiency in communication. (Dziuban *et al.*, 2018) stated that BL is integrated into students' access, success, and perception of their learning environment. (Eliyasni *et al.*, 2019) assert that blended learning is an alternative learning to improve higher-order thinking skills.

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. (Fahrudin *et al.*, 2018) states that understanding concepts is an ability about understanding mathematical ideas that are thorough and functional. Furthermore, (Arifin & Herman, 2018) revealed that in learning mathematics students must first understand mathematical concepts to solve problems and be able to apply these learning in the real world. (Kowiyah *et al.*, 2019) also revealed that understanding concepts is a very important ability to be developed. A good understanding of concepts will be obtained by students if the learning process runs smoothly and pleasantly. (Perdani & Azka, t.t.) stated that lecturers understanding of good concepts will support the learning process that can realize educational goals. 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.

METHOD

This research is a quasi-experimental study. The purpose of this study is to investigate the possibility of a causal relationship by wearing BL learning with SPADA Teknokrat to the experimental group, which then compares the results with a control group that is not subject to treatment conditions.

The population of this research is all students who receive/take mathematics/calculus courses at the Indonesian Teknokrat University 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. Kindergarten class 19A was selected as an experimental class with 33 students and Kindergarten 19B as a control class with 30 students. This is done after paying attention to the relative characteristics possessed. The characteristics are that students get material based on the same curriculum, students are taught by the same teacher, class divisions use a random system, use the same package/reference book, and get math lessons with the same number of hours. 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 steps in this research are as follows:

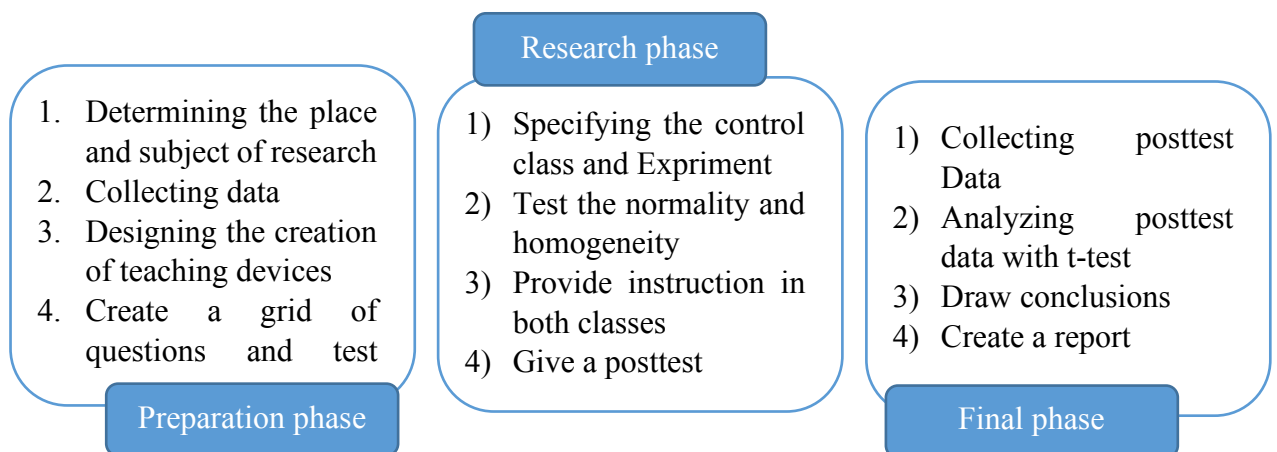


Figure 1. Steps in this Research

Based on the research steps in Figure 1, the researcher applies BL learning with SPADA Teknokrat in the experimental class, where learning will be subject to online and offline learning systems and applies full face-to-face learning to the control class then compares the results of understanding the mathematical concepts based on the understanding test the concept in the form of essay questions that are made according to indicators understanding concepts.

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. The preparation of the test kit is carried out in the following steps. The preparation of the test kit is carried out in the following steps:

1. Restrict the material being tested.
2. Determine the type of questions.
3. Determine the number of items
4. Determine the time to work on the problem.
5. Make a matter grid.
6. Write down instructions for working on questions, answer keys, and determining the score.
7. Write items.
8. Trial instruments.
9. Analyze validity, reliability, difference power, and difficulty level.

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 5 questions, adjusted for the number of indicators understanding the concept.

The effectiveness of learning states the level of success of researchers in achieving their learning objectives, 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. NCTM in (Sudirman, 2016) states that 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. In this study, to determine the achievement of the objectives of mathematics learning seen from the strengthening of the concept of students with minimum completeness criteria that is 70% of students complete learning and get a minimum grade of C. The criteria for understanding the mathematical concepts used in this study are only 5 indicators. This is because not all the criteria for understanding concepts are following the material chosen, namely material limits and derivatives.

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.

RESULTS AND DISCUSSION

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

Table 1. Concept Understanding Test Results

HM	Experimental class		Control class	
	Students	%	Students	%
A	19	57,6	4	13,3
B	9	27,3	7	23,3
C	4	12,1	8	26,7
D	1	3,0	10	33,4
E	0	0	1	3,3
Average : 78,48		Average : 63,93		
Standard Deviation : 9,96		Standard Deviation : 10,98		

Based on the table above, it can be seen that 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 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 of concepts 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.

After analyzing the score of the concept understanding ability for each indicator, it is known that the achievement indicator of the mathematical concept comprehension ability in the experimental class is 77.7% better than the

achievement of the concept understanding indicator in the control class that is 72.9%. The results of achieving the indicators are presented in Tables 2 and 3.

Table 2. Achievement Indicators for Understanding the Concept of Experimental Classes

No	Indicator	Achieved Score	Total Scor	Average (%)
1.	Restate a concept	58	66	87,88
2.	Classifying objects according to certain properties according to the concept	48	66	72,73
3.	States concepts in various forms of mathematical representation	52	66	78,79
4.	Use, utilize, and select certain procedures or operations	56	66	84,85
5.	Apply the concept	50	66	75,76
AVERAGE				80

Table 2 shows that the average achievement indicator of mathematical concept understanding in the experimental class is 80%. The best indicator achieved by students is to restate a concept that is 87.88%. While the lowest indicator achieved by students is to state concepts in various forms of mathematical representation that is 72.73%.

Table 3. Achievement Indicators for Understanding the Concept of Control Classes

No	Indicator	Achieved Score	Total Score	Average (%)
1.	Restate a concept	50	66	75,76
2.	Classifying objects according to certain properties according to the concept	44	66	66,67
3.	States concepts in various forms of mathematical representation	40	66	60,61
4.	Use, utilize, and select certain procedures or operations	52	66	78,79

No	Indicator	Achieved Score	Total Scor	Average (%)
5.	Apply the concept	46	66	69,70
AVERAGE				70,3

Table 3 shows that the average achievement indicator of mathematical conceptual understanding in the experimental class was 70.3%. The best indicator achieved by students is to use, utilize, and choose certain procedures or operations that are 78.79%. While the lowest indicator achieved by students is to state concepts in various forms of mathematical representation that is 60.61%.

Based on tables 2 and 3 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.

Table 4. Tests of Normality

kelompok	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
nilai 1	,137	33	,117	,961	33	,284
2	,158	30	,053	,953	30	,199

a. Lilliefors Significance Correction

Based on table 4, it can be seen that 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. Similar results are also shown in the homogeneity test results as shown in the following table.

Table 5. Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
nilai	Based on Mean	,506	1	61	,480
	Based on Median	,594	1	61	,444
	Based on Median and with adjusted df	,594	1	60,998	,444
	Based on trimmed mean	,558	1	61	,458

Table 5 shows the homogeneity test results with the Levene's test method. 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 6. Paired Samples T-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
nilai	Equal variances assumed	,506	,480	5,511	61	,000	14,552	2,640	9,272	19,831
	Equal variances not assumed			5,485	58,761	,000	14,552	2,653	9,243	19,860

Based on table 6, 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 to BL with SPADA 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 BL 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, BL learning 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 results of the study (Isti'anah, 2017) which states that at the end of the semester, most students find that online activities help them understand and practice the material they are learning. Furthermore, (Fisher & Kusumah, 2018) which states that learning with the blended learning method is effective and can develop communicative, creative, curious, and hard work characters. A similar opinion is also expressed (Oweis, 2018) which states that there are significant differences in the two groups where the experimental group performs better than the control group. This opinion is also reinforced (Harahap *et al.*, 2019) which states that more blended learning strategies are found to be significantly effective in improving student achievement. Similar research is also shown by (Fitri *et al.*, 2019) which states that the results of student studies taught with blended learning are better than those taught through conventional learning.

CONCLUSION

Based on the results of data analysis, hypothesis testing, and discussion of the effectiveness of the application of BL learning using SPADA Technocrats to understanding students' mathematical concepts the following conclusions are obtained: 1) The application of BL can increase the percentage of student graduation. 2) The application of BL learning can improve the achievement of indicators of understanding students' mathematical concepts. 3) The application of BL learning has a positive effect on the understanding of students' mathematical concepts that appear from the average final test score.

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