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The Effect of Blended Based On Problem-Based Learning and Logical Thinking Ability on Learning Outcomes Teaching Evaluation

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Abstract: *The purpose of the study was to find out whether the learning outcomes taught by blended problem-based learning (PBL) were higher than the learning outcomes taught by problem-solving (PS), to find out whether the learning outcomes of those who had high logical thinking skills were higher than those who had higher logical thinking abilities. low logical thinking skills, and knowing whether there is an interaction between the application of blended learning and the ability to think logically in influencing learning outcomes. The population of this study was all students who took teaching evaluation courses. The sampling technique is done by cluster random sampling. The research method uses a quasi-experimental method with a 2 x 2 factorial research design. The data analysis technique uses two-way ANOVA at a significance level of = 0.05. The results of this study indicate that the average learning outcomes taught by blended learning based on problem-based learning are higher than those with problem-solving-based blended learning, the average learning outcomes with high logical thinking skills are higher than those with low logical thinking skills. and there is no interaction between blended learning and logical thinking skills on teaching evaluation learning outcomes.*
Keywords: *blended, problem-based learning, problem-solving, evaluation of learning outcomes.*

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I. Introduction

The implementation of the learning process, especially in teaching evaluation courses, is still an obstacle. Undergraduate mechanical engineering education curriculum, learning outcomes of FT UNIMED in teaching evaluation assessment courses are: (1) Students can understand and proficiently use principles, procedures and techniques to evaluate learning processes and outcomes (elementary and secondary education levels), (2) Students can understand, master and analyze the procedure for evaluating the learning process and student learning outcomes, and (3) Students can evaluate the process and learning outcomes. With the evaluation of learning outcomes, students are required to have independent learning abilities. Learning improvement can be done using Blended This learning concept is learning designed by combining offline and online learning.

Blended Learning is a combination of face-to-face and e-learning models. With this learning model students benefit from receiving explanations from the teacher and can also take advantage of e-learning features that are applied anytime and anywhere so that it attracts students to participate in learning activities better [1]. By using Blended Learning, students can improve their learning because they are required to utilize learning resources through various e-learning applications that are by the current Covid-19 pandemic conditions. By following the rules of learning from home, it is very appropriate to use this Blended Learning model.

According to Garrison & Vaughan [2], blended learning is a learning model that combines face-to-face learning and online learning. The basic principle of the blended learning model is to optimize the integration of oral communication in face-to-face learning and written communication in online learning. In general, the application of this model can improve the quality of learning, so that it becomes a trend and has been widely used in the world's leading universities.

According to Yulaini [3], the advantages of the blended learning model are as follows: (1) being able to freely access and study the topics available in online learning, (2) having the opportunity to discuss with lecturers or with other students Communicating outside of time face-to-face, (3) can control student learning activities outside the face-to-face class, (4) can enrich learning material facilities via the internet; (5) can ask students to read or do homework before the learning process; (6) can handle tests and provide feedback more effectively; (7) can share files with other students.

Suryani [4] suggests that lecturers can perform four stages in implementing the blended learning model, namely: (1) Providing information and preparing learning materials that are integrated with learning methods. Internet before the implementation of face-to-face learning; (2) Instructing students to discuss e-

learning learning materials in face-to-face meetings and online course discussion forums; (3) Provide practical training on the clarification of the material studied in face-to-face meetings, which can then also be discussed in face-to-face meetings and online courses; (4) Evaluation, namely feedback on the learning process. Evaluation can be done in face-to-face meetings in the form of quizzes to discuss quizzes and can be done in online classroom discussions.

In this blended learning model, students have sufficient learning opportunities, learning resources are available on the website, and discussion spaces between lecturers and students or between students and other students are open, which is also important so that the learning process can become a lecturer. not limited by time and place.

Problem Based Learning (PBL) teaches students to think critically and logically in solving a problem based on the knowledge they already have. "PBL will encourage students to find alternative solutions to the problems that have been given, then they are asked to choose the best solution used to solve existing problems. PBL is an approach to learning by confronting learners with practical problems or learning that begins with giving problems and has context with the real world.

Teaching Evaluation

Learning assessment is the professional ability of educators. This ability is by the teacher's ability assessment tool which is one of the indicators for evaluating learning. Believe that in essence evaluation is a systematic and continuous process, which determines the quality (value and meaning) of a thing based on certain considerations and standards so that an out of assessment can be carried out. Decided.

Based on this understanding, several things about evaluation are: (1). Evaluation is a process, not a result (product). The results obtained from evaluation activities are a description of the quality of something, both related to value and meaning. At the same time, the activity that reaches the level and meaning is evaluation. The quality description is the logical outcome of the evaluation process. Of course, the process is carried out systematically, continuously, and continuously in the sense that it is planned by procedures and rules. (2). The purpose of the evaluation is to determine the quality of an object, especially in terms of value and meaning. (3). In the evaluation process, an assessment must be carried out. This consideration is the basic concept of evaluation. Through these considerations, the value and benefits of the thing being evaluated can be determined. Regardless of the factors, the activity is not a category of evaluation activity. (4) The consideration of value and meaning must be based on certain criteria. Without clear standards, judgments of value and meaning cannot be classified as evaluations. This standard is important for evaluators when considering the following factors: (a) the evaluation results can be proven scientifically reasonable (b) the evaluator is more confident (c) avoids the element of subjectivity (d) allows the evaluation results to be the same even though these assessments were made at the same time. and different people, and (e) make it easier for raters to interpret the results of the assessment.

Evaluation of learning outcomes in learning includes material on (1) Basic Concepts of Evaluation of Learning Outcomes; (2) Basic Principles, Areas, and Evaluation Steps; (3). Test and Non-Test Techniques as a Learning Outcome Evaluation Tool; (4). Characteristics, Principles, Forms, and Types of Learning Outcomes Tests; (5). Testing the Validity and Reliability of Learning Outcomes Tests; (6). Analysis of Learning Outcomes Test Items; (7). Final Grades, Ranking, and Making Learning Achievement Profiles.

Blended Learning Based Problem Based Learning (PBL)

Blended learning means that students learn at least partly in a supervised place, and some learn through the internet to control some elements of students in time, place, and time. Online learning in blended learning still requires control from the educator, so that the independent learning process carried out by students remains focused on achieving learning objectives. This means that educators need to design online learning materials in a way that allows learning to focus on achieving learning objectives.

Kaur [5] describes several advantages of blended learning: (1) Providing a learning environment that requires students to stay active through reading, speaking, listening, and thinking activities; (2) Integrating online and face-to-face variations A face-to-face learning delivery system to provide better learning opportunities for all students with different learning styles; (3) Integrating face-to-face learning and online learning to increase teacher interest, sense of responsibility, and actual assessment ability; (4). Allows to deliver content in a structured manner according to the learning needs of each student, thereby increasing individualization, individualization, and relevance of learning; (5) Combining the best modes of online and face-to-face learning so that teachers and students can gain greater flexibility and accessibility through online learning without sacrificing face-to-face social interaction.

The term "blended learning" grammatically consists of two words, namely "mixed" and "learning". The word hybrid means "mingling to improve quality and make life better" [6]. This means using information and

communication technology infrastructure to combine learning that is traditionally done in the classroom with learning that is done independently and collaboratively online.

Lectures conducted through blended learning are considered to be the right choice to facilitate student movement, because they can provide a comfortable education regardless of country, region, and level of backwardness. In addition, the application of blended learning has been proven to support lifelong education, create a friendly learning environment, save resources and eliminate gaps in the learning process. In general, blended learning is a learning process that integrates traditional (face-to-face) learning processes with online digital learning [7]. Blended learning applications can be packaged through a learning management system (LMS) that combines online, face-to-face learning, and real-world learning experiences [8]. Some examples of LMS types are moodled, Edmodo, and Schoology.

PBL is learning that trains and develops the ability to solve authentic problem-oriented problems from students' actual lives, to stimulate high-level abilities. The PBL learning model is a learning model that trains students' skills to solve problems and gain new knowledge, in addition to the PBL learning model trains students to think at higher levels.

Problem Solving is learning to solve problems, at this level students solve problems, respond to stimuli that describe the problem situation that occurs, using various rules that they have mastered. The PS learning model is learning by providing opportunities for students to solve problems according to real situations in everyday life. It is concluded that the PS learning model is a problem-solving learning process with the abilities possessed by students so that they can train higher-order thinking skills. In addition, students also get direct experience from the existing learning process.

Both PBL and PS learning models are the same as problem-based learning or problem-solving. The PBL and PS learning steps are the same, namely giving problems from the teacher. While the difference between the two lies in the problem that is solved or solved. In PS the problem given is usually not a real problem like in PBL, and the way of solving it is also different. In PS the problem can be solved only by discussion, but in PBL it takes a research on the problem so that the solution given has gone through a long process.

In this study, the authors conducted experiments on the PBL and PS Learning Models to improve logical thinking skills. This is reviewed because of the author's doubts in applying the two models to improve students' logical thinking on teaching evaluation materials, which most students still get below-average scores.

Blended Learning Based on Problem Solving (PS)

Problem Solving is learning to solve problems, at this level students solve problems, respond to stimuli that describe the problem situation that occurs, using various rules that they have mastered. The PS learning model is learning by providing opportunities for students to solve problems according to real situations in everyday life. It is concluded that the PS learning model is a problem-solving learning process with the abilities possessed by students so that they can train higher-order thinking skills. In addition, students also get direct experience from the existing learning process.

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Logical Thinking Ability

The ability to think logically contains the meaning of right or right based on the rules of thinking and general rules or standards to be able to think right. This means that the logical word contains certain rules that must be met to produce the correct result. People who think logically will obey the rules of logic.

Logic requires rules or benchmarks that must be considered to be able to think correctly, carefully, and regularly so that truth is obtained. Memorizing refers only to the attainment of mere memory abilities. Meanwhile, logical thinking refers more to understanding (being able to understand), application skills, analytical skills, synthesis abilities, and even evaluation abilities to form skills.

Paying attention to the meaning of logical thinking, for someone to arrive at logical thinking, one must understand the logical proposition which is a verbal map consisting of three parts that show progressive ideas, namely: (a) the basis of thought or reality on which to stand, (b) argumentation or how to put the basis of thought together. , and (c) conclusions or results achieved by applying arguments to the rationale. In mathematics, the process of obtaining the truth rationally or the process of concluding can be done using inductive and deductive thinking.

The research problems are as follows: (1) Are student learning outcomes taught with Blended PBL higher than those taught with Blended PS?; (2) Are the learning outcomes of students with high logical thinking skills higher than those of students with low logical thinking abilities?, and (3) Is there an interaction between blended learning and students' logical thinking skills in influencing teaching evaluation learning outcomes?

II. Material And Methods

This research was carried out on students of mechanical engineering education, Faculty of Engineering, the State University of Medan who took the Teaching Evaluation course for the academic year 2021/2022, totaling 24 students consisting of classes A and B. The sampling technique was carried out using cluster random sampling technique, then through class A drawing. (experiment A) as a class treated with Blended PBL learning and class B (experiment B) as a class treated with Blended PS learning. Before the experiment, the two-sample classes were first given a test to determine the students' logical thinking ability. The ability to think logically is categorized into high logical thinking ability and low logical thinking ability.

This study uses a quasi-experimental design by conducting experiments in the existing classroom as it is, without changing the classroom situation and learning schedule. The treatment was carried out in teaching evaluation learning using Blended PBL as Experiment A class and compared to Blended PS learning in experimental class B. In each class, some students had high logical thinking skills and low logical thinking skills, based on the results of the analysis of thinking ability scores. logical standards that have been standardized and compiled using standardized indicators. The research design used is a 2 x 2 factorial design, as shown in table 1.

Table 1. Factorial Design

Logical Thinking Ability (B)	Blended Learning (A)	
	Blended PBL (A^1)	Blended PS (A^2)
Height (B^1)	$A^1 B^1$	$A^2 B^1$
Low (B^2)	$A^1 B^2$	$A^2 B^2$

Information:
A = Blended Learning
B = Logical Thinking Ability
A^1 = Blended PBL
A^2 = Blended PS
B^1 = High logical thinking ability
B^2 = Low Logical Thinking Ability
$A^1 B^1$ = Learning outcomes of teaching evaluations taught using Blended PBL with high Logical Thinking Ability
$A^1 B^2$ = Learning outcomes of teaching evaluations taught using Blended PBL with low Logical Thinking Ability.
$A^2 B^1$ = Learning outcomes of teaching evaluations taught using Blended PS with high Logical Thinking Ability
$A^2 B^2$ = Learning outcomes of teaching evaluations taught using Blended PS with low Logical Thinking Ability

The data analysis technique in this study used descriptive analysis and inferential analysis. The descriptive analysis technique is intended to describe the research data including the mean, median, standard deviation, and trend of the data.

The data that has been obtained is then presented in the form of a frequency distribution table and histogram. Inferential analysis technique was used to test the research hypothesis by using two-way analysis of variance (ANOVA). To use two-way ANOVA it is necessary to fulfill several conditions, namely: (1) the data used must be normally distributed, to test the normality of the data, the Liliefors test is used, and (2) the data must have a homogeneous population variance, to test the homogeneity of the variance, the F (Fisher) test is used. And The formulation of the statistical hypothesis in this study is as follows:

a. First hypothesis:
Ho : $\mu_{A1} \leq \mu_{A2}$
H1 : $\mu_{A1} > \mu_{A2}$

b. Second hypothesis:
Ho : $\mu_{B1} \leq \mu_{B2}$
H1 : $\mu_{B1} > \mu_{B2}$

c. Third hypothesis:

Ho : A x B = 0

H1 : A x B ≠ 0

Information:

A = Blended Learning

B = Logical Thinking Ability

A^1 = Blended PBL

A^2 = Blended PS

B^1 = High logical thinking ability

B^2 = Low Logical Thinking Ability

μ_{A1} = Average learning outcomes of teaching evaluations that get learning with Blended PBL

μ_{A2} = Average learning outcomes of teaching evaluations that get learning with Blended PS

μ_{B1} = Average learning outcomes of teaching evaluations that have high Logical Thinking Ability

μ_{B1} = Average learning outcomes of teaching evaluations that have low Logical Thinking Ability.

A x B = Interaction between blended learning and Logical Thinking Ability.

III. Result

Hypothesis testing is carried out to prove the truth of the established hypothesis so that data is obtained whether the hypothesis designed in a study is rejected or accepted. To test the hypothesis by using the two-way factorial analysis of variance (ANOVA) 2x2 and then continued with further testing using the Scheffe test and Tukey test, the average price for each group is needed as a source of research data, the following is a summary of learning outcomes data. teaching evaluation as a source of data processing for hypothesis testing. The summary of the data can be seen in Table 1 using descriptive analysis.

Table 2. Data Summary of Descriptive Analysis Calculation Results

Blended Learning	Logical Thinking Ability	Mean	Std. Deviation	N
Blended PBL	High logical thinking ability	84.67	1.78	12
	Low Logical Thinking Ability	80.34	1.08	12
	Total	82.51	2.64	24
Blended PS	High logical thinking ability	74.59	2.07	12
	Low Logical Thinking Ability	70.17	1.59	12
	Total	72.38	2.89	24
Total	High logical thinking ability	79.63	5.49	24
	Low Logical Thinking Ability	75.26	5.36	24
	Total	77.44	5.80	48

Based on learning outcomes data on Blended PBL and Blended PS learning and logical thinking skills, it shows that the average value of learning outcomes for teaching evaluation using Blended PBL with high logical thinking skills is 84.67 while low logical abilities are 80.34. While the average value of learning outcomes in Blended PS learning on high logical thinking skills is 74.59, which is higher than those with low logical thinking abilities, which is 72.38.

Test the requirements of experimental research with the Normality Test and Homogeneity Test for blended learning and logical thinking skills on learning outcomes.

Table 3. Normality test of blended learning and logical thinking skills on learning outcomes

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized Residual for learning outcomes	0.09	48	0.20*	0.99	48	0.86

Requirements if the significance value > 0.05, then the residual value is normally distributed. And if the significance value is < 0.05, then the residual value is not normally distributed. The results of the normality test on the learning outcomes of Shapiro-Wilk show that for the experimental class the significance value is 0.86 > 0.05, it can be concluded that the residual value is normally distributed.

Table 4. Test the homogeneity of blended learning and logical thinking skills on learning outcomes

		Levene Statistic	df1	df2	Sig.
Learning outcomes	Based on Mean	1.11	3	44	0.36
	Based on Median	1.07	3	44	0.37
	Based on Median and with adjusted df	1.07	3	39.31	0.37
	Based on trimmed mean	1.12	3	44	0.35

If the significance value is > 0.05, then the data distribution is homogeneous. And if the significance value is < 0.05, then the data distribution is not homogeneous. The results of the homogeneity test on the average learning outcomes as a condition in the experiment showed that the significance value was 0.35 > 0.05. Then the distribution of learning outcomes data is homogeneous. So that the assumption of homogeneity in the two-way ANOVA test is fulfilled.

Table 5. Factorial ANOVA Calculation Summary

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	289295.08[a]	4	72323.77	26101.81	0.00
Blended	1230.19	1	1230.19	443.98	0.00
Logical Thinking Ability	229.69	1	229.69	82.89	0.00
Blended * Logical Thinking Ability	0.02	1	0.02	0.01	0.93
Error	121.92	44	2.77		
Total	289417.00	48			

Based on the results of the ANOVA calculation, it shows that: (1) the sig value is obtained. of 0.00 < 0.05, so it can be concluded that "there is a difference" in the learning outcomes of student teaching evaluation based on blended learning; (2) obtained the value of sig. of 0.00 < 0.05, so it can be concluded that "there is a difference" in learning outcomes of student teaching evaluation based on logical thinking ability; and (3) obtained the value of sig. of 0.93 > 0.05, so it can be concluded that there is "no difference" in blended learning with students' logical thinking abilities in determining student teaching evaluation learning outcomes, so no further test is carried out.

IV. Discussion

Based on the results of calculations in the research obtained, that the learning outcomes of teaching evaluation on students who are taught with Blended PBL learning are higher than those taught with Blended PS. This is possible because learning using Blended PBL provides students with various authentic and meaningful problem situations, which can serve as a springboard for investigation and investigation. This learning model will involve students actively seeking solutions to solve problems through certain stages so that they can learn knowledge related to these problems as well as have critical thinking skills to solve problems in blended learning. The first hypothesis which states that the average learning outcome of teaching evaluation teaching taught by blended PBL is higher than the average learning outcome of teaching evaluation taught by blended PC is accepted. It can be understood that learning with the Blended PBL model provides an overall improvement in the aspects of students' knowledge and psychomotor by strengthening problem-solving, developing higher-order thinking skills so that students can improve their learning outcomes. The same thing is also from research which states that the effectiveness of the Blended Learning Model in terms of student responses during the learning process shows that the percentage of student responses is very high. So that the application of the Blended Learning model is effective to be applied during the Covid-19 pandemic. The implementation of the Blended Learning learning model is effective in increasing learning independence in economics lessons. The implementation of the Blended Learning learning model is effective in improving student learning outcomes [4].

The same opinion is that the application of blended in the learning process can improve students' academic abilities. Also, the application of the blended learning model using Schoology can improve students' academic abilities. In the sense that in the experimental class that applies blended learning, the academic ability of students is higher than the academic ability of the control class that does not apply blended learning [9]. According to research by Koyimah, Suryani, and Nuryatin [10], it shows that the application of Blended Learning in a problem-based learning model is stated to be more effective than the lecture method, and can be used as an alternative for educators to improve students' creative thinking skills.

Hikmawati and Ningsih's research [11] shows that the Effectivity of Blended-PBL in the improvement of critical thinking skills and IL has manifested in students learning habits, particularly in the exploration to gain information of what students know, how they gain the information they need, and how they plan to manage the strategy to implement the process of seeking information independently. Time and space flexibility are the determinants between Blended-PBL and face-to-face PBL which results in different improvements for every critical thinking indicators and developing students IL. And some things are the same with blended-based learning which is stated by Triyanto's Research, Prabowo [15] that the Lesson Study-based Blended-PBL learning model is effective in improving students' cognitive learning outcomes. This effectiveness is strongly supported by the Lesson Study process, the reflection of which is obtained that the synchronization between online and face-to-face learning in the classroom must receive special attention. The application of the Problem Based Instruction learning model based on Blended Learning can improve students' critical thinking skills and Students' responses to the application of the Problem Based Instruction learning model based on Blended Learning maintained the category of very happy with the ongoing learning [13].

The application of blended learning in PBL turned out to be more effective in increasing student learning activities in the learning process. Problem-based learning strategy, because learning begins with real problems and to provide more learning opportunities, discuss comprehensive concepts, improve learning transfer and experience in leading self-study, blended learning is needed so that it will be able to improve critical thinking processes and lead to a learning environment that is conducive to learning. optimally [16].

The Problem Based Learning (PBL) learning model that is carried out can be shown as follows: (1) The application of Problem Based Learning (PBL) can be used as a learning model that is applied in every science learning in online learning conditions so that students more easily understand the material and increase student motivation in the learning process. (2) Furthermore, it is expected to use effective and interesting learning media in the learning process so that it can increase student motivation and learning outcomes during the Covid-19 Pandemic [17].

The second hypothesis which states the average learning outcomes of teaching evaluation learning outcomes that apply high logical thinking skills is higher than the average teaching evaluation learning outcomes that apply low logical thinking skills is accepted. This shows that students with high logical thinking skills can clearly understand the material being taught in teaching evaluation courses with an average good academic score. With various tasks and problems given by the lecturer, for the development of logical thinking and creativity, as well as logical abilities in thinking and acting, students are very high compared to students who have low logical thinking abilities.

The same thing in Masfinatin's research [20] that the logical thinking ability of climber students in solving geometric problems, in understanding the problem can do coherent thinking in the good category, in formulating a problem-solving plan able to do a coherent thinking and argumentation ability in the good category, in implementing the plan. Problem-solving subjects can argue and conclude the good category, and in re-examining the results of the solution able to conclude well. And supported in the statement that logical thinking ability is the ability to use statements in the form of ideas, and described systematically. Individuals who think logically will express their ideas and ideas in structured words so that the reasons put forward become correct arguments [21]. The same thing in Murni's research [22] shows that the results of the correlation test with a value of r = 0.609 and a significance value of 6.372 indicate that there is a high relationship between logical thinking ability and student learning outcomes in genetics courses. The results of the analysis also show that the ability to think logically contributes 42.35% to student learning outcomes.

V. Conclusion

Based on the results of the analysis and discussion, it can be concluded that:

1. There is a difference in the effect of the application of blended based on problem-based learning with the application of blended based on problem-solving on the learning outcomes of student teaching evaluation. It also shows that the average learning outcomes of teaching evaluation with blended learning based on problem-based learning are higher than problem solving-based blended learning.
2. There is a difference in the effect of high logical thinking skills with low logical thinking skills on student teaching evaluation learning outcomes. It also shows that the average learning outcomes of teaching evaluations with high logical thinking skills are higher than those with low logical thinking abilities.
3. There is no interaction between blended learning based on problem-based learning and problem-solving based blended with the ability to think logically on the learning outcomes of student teaching evaluation.

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