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Implementation of Online Learning with a Problem-based Learning Approach to Improve Student Problem Solving Ability

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ABSTRACT

The purpose of this study was to test whether online learning with a problem-based learning approach can improve students' problem-solving skills. This is because, with the outbreak of the pandemic corona virus disease 2019, which resulted in the learning process being carried out online, to prevent the spread of the corona virus in society. As a result, many students experience difficulties in the online learning process. This research is quasi-experimental research with Nonequivalent Control Group Design. This research was conducted on students of the Mechanical Engineering Study Program who are programming the Motor Fuel Course for even semester 2021. The treatment in this study was the application of online learning with a problem-based learning approach (30 students) and normal online learning (30 students). From the results of the t test analysis, it was found that tcount = 4.179 with p (Sig = 0.00) <0.05. This means that there is a significant difference in problem-solving abilities between groups of students learning online using a problem-based learning approach (mean 80.23) and groups of students learning online normally (mean 74.36). Thus, it can be concluded that the application of online learning with a problem-based learning approach can improve students' problem-solving abilities.

Keywords: *Online learning, Problem-based learning approach, Problem solving ability.*

1. INTRODUCTION

In the industrial era 4.0, it demands reliable quality human resources in order to survive and develop in a life full of competition and competition. In the conditions of the educational process which was full of challenges and competition in the industrial era 4.0, the world was hit by the massive Corona Virus Diseases 2019 (Covid 19) pandemic. The same condition also occurred in Indonesia, where the Covid 19 outbreak until the beginning of October had spread almost evenly throughout Indonesia [1]. In order to control and prevent the spread of the Covid 19 pandemic, the Government is implementing the Large-Scale Social Restrictions (PSBB) policy, namely by violating community interactions known as physical distancing and social distancing. This condition also applies to the education sector, where the Government decided to move the teaching and learning process on campus to homes by implementing online learning. The online learning system is a face-to-face learning system directly or indirectly via online that uses the internet network. In online learning the teacher must ensure that teaching and learning activities continue, even though students are at home [2]. There are various online learning facilities that are used, including e-learning LMS (Learning Management System) models, Zoom, Google Class Room, email, WhatsApp applications and others.

But in reality, the implementation of the online learning process which was carried out suddenly as a result of the Covid 19 pandemic made the mental attitude and culture of learning unprepared for teachers and students alike. For example, many teachers only send subject matter, assignments, or learning videos in e-learning applications without providing adequate explanations, so that students experience difficulties in the learning process. This is in line with the results of Fitriyani et al [3], which stated that in the midst of the Covid-19 pandemic that hit Indonesia and the world, it caused students to have low learning motivation, but had no other choice but to optimize online learning. Therefore, in order to help students overcome learning difficulties in online learning, an appropriate learning

approach is needed to overcome these problems. One approach to improve students' problem-solving abilities in online learning is a problem-based learning approach. In online learning with a problem-based learning approach, real world problems are used, in order to train students to think critically and creatively in finding solutions to problem solving, in order to obtain in-depth skills and knowledge [4]. Therefore, this approach helps students to develop critical and creative thinking skills in solving problems independently and in groups. Where students are careful to be able to overcome learning problems both individually and in groups, and this ability is very necessary in winning competition in the highly competitive Industry 4.0 era.

2. MATERIAL

2.1. Online Learning with a Problem-Based Learning Approach

Online learning with a problem-based learning approach is a learning process that uses real world problems as the initial topic of learning. This condition requires students to think critically and creatively to learn to find solutions to problem solving by using all existing abilities, resulting in a meaningful learning process. Therefore, online learning with a problem-based learning approach will help students develop critical and creative thinking skills in solving problems as adults and independently. Problem-based learning demands the ability to explore and investigate independently, in pairs or small groups which is the essence of this approach [5]. Thus the problem-based learning approach will encourage students to be more analytical and creative in making decisions to solve problems.

Therefore, online learning with a problem-based learning approach can guide students in finding solutions to problem solving, namely encouraging students to get to know how to learn and work together in groups to find solutions to real-world problems. The problem-based learning approach is an approach to curriculum development and learning that is needed to develop process skills and problem solving, and to help students acquire the knowledge and skills needed in life, both independently and cooperatively [6] [7]. In order to carry out online learning with a problem-based learning approach, it is necessary to follow the syntax, namely:

Table 1. The syntax of problem-based learning strategies.

Stage	Teacher Behavior	Student Behavior
Identify the problem	The teacher explains the goals and logistics of learning, participates in identifying problems, motivates students, is involved in problem solving activities.	Students listen to the teacher's explanation about the goals and logistics for working in groups to find solutions to problem solving
Organizing students to learn	The teacher helps students define and organize learning tasks that are used as problem topics.	Students define and organize group tasks
Looking for problem solving solutions	The teacher encourages students to gather information, carry out experiments to get explanations/ problem-solving solutions.	Students work in groups to search for data and information in order to find authentic problem solving solutions
Presenting the results of problem solving solutions	The teacher assists students in preparing appropriate work, such as reports, videos, models and helps students share assignments with their friends.	Students design activity reports in the form of problem solving solutions and decision making, then presentations
Evaluate the results of problem solving	The teacher helps students to reflect or evaluate the process of investigation and problem solving	Students reflect and evaluate the activities that have been carried out

[adapted from Arends [5].

2.2 Learning Outcomes Problem Solving

The learning outcomes of problem solving abilities are aspects that are oriented towards students' abilities to think and reason and include the ability to remember to solve problems/create things. This condition requires students to combine the concepts that have been studied before. The cognitive learning outcomes according to Bloom which was revised by Anderson and Krathwohl [8] provide six categories to measure these learning outcomes, namely: remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), creating (C6).

A student is said to think to remember (C1) if he can mention the definition of a particular concept. If the same concept is asked to students, then he can explain it in his own words, it means he already understands (C2), including these dimensions, interpreting and explaining. If students can apply the concepts they understand, it means that they are already thinking about applications (C3), including these dimensions executing and implementing. In the analysis dimension (C4), students are asked to analyze a complex relationship or situation on basic concepts, parse or solve something in its interconnected parts (differentiating, organizing, attributing). Then, if students are able to provide views and give true or false judgments, make decisions regarding implications, changes, predictions, using

consistent standards or norms, it means that students already have evaluation skills (C5). The ability to create (C6) is putting elements together to form something coherent and functional (eg create, plan, and produce). Based on various opinions about learning outcomes, what is meant by learning outcomes in problem solving abilities here is the ability to think and reason and includes the ability to remember to solve problems in order to find solutions.

3. METHOD

3.1 Research design

This research is a quasi-experimental study with the Nonequivalent Control Group Design [9]. This research was conducted on students of the Mechanical Engineering Study Program who are programming the Combustion Engine Course for even semester 2021. The treatment in this study was the application of online learning with a problem-based learning approach (30 students) and normal online learning (30 students). To determine the experimental class (Problem Based Learning) and the control class (normal approach) is done by drawing lots. The treatment in the experimental group and the control group was guided by learning tools, namely: 1) syllabus, 2) lesson plans, 3) worksheets, and 4) student assessment sheets. Then it was continued with a Seminar on the test results of the application of online learning in the Combustion Engine Course which refers to a problem-based learning approach and reporting research results.

3.2 Research Instruments

The research instrument was arranged based on the main points in the Combustion Engine Course Syllabus. To test the validity and reliability of the test instrument, it was tested first on students who had passed the Combustion Engine Course. To measure the validity of the items and the reliability of the test instrument was carried out with the help of SPSS for Windows 16.0. After the new valid and reliable research instruments were used to measure the learning outcomes of Combustion Engine Course.

3.3 Analysis of Research Data

Test requirements analysis using: 1). test for normality with the Lilliefors Significance test, 2). homogeneity test with Levene's test. After the data is declared normal and homogeneous, it is continued with descriptive analysis and t-test analysis. Descriptive analysis to describe the value, mean, and standard deviation. The t-test analysis was used to see differences in learning outcomes between groups that were treated with online learning with a problem-based learning approach and groups with a normal approach. Data analysis in this study was processed with the help of the SPSS for Windows version 16.0 computer program.

4. RESULTS AND DISCUSSION

4.1. Results

4.1.1. Description of Learning Outcomes Pretest Data

Before the experimental treatment began, the two groups of experimental class research subjects were given a pretest.

Table 2. Descriptive Analysis of Pretest Result Data

Online Learning	N	Mean	Std. Deviation	Std. Error Mean
PBL Approach	30	41.1000	4.88029	.89102
Normal Approach	30	42.8333	4.95555	.90476

To find out whether the two groups were significantly different or not, a t-test analysis of two independent samples was performed. The test results for the pretest data were t = -1.36 with a sig (2-tailed) value of 0.178 > 0.05, so it can be concluded that there was no significant difference between the learning outcomes (pretest) of the experimental group and the control group (equivalent).

4.1.2. Post-test Learning Outcome Data

Based on the measurement results during the study in the experimental class with the online learning PBL approach, it was found that the mean learning outcomes were 80.233 with an SD of 5.7934. Then from the measurement results during the study in the control class with normal online learning, it was found that the mean learning outcomes were 74.366 with an SD of 5.0547.

4.1.3. Analysis Requirements Test Results

The results of the analysis requirements test using the Kolmogrov-Smirnov test for data on experimental class learning outcomes were obtained (sig) 0.200> 0.05 and for the control class (sig) 0.095> 0.05, so that the research data (posttest) were normally distributed. For the homogeneity test, it was obtained (GIS) 369> 0.05, so that the research data (posttest) was homogeneous. Because the data is normally distributed and homogeneous, it can be continued with the t-test analysis.

4.1.4. Hypothesis Testing Results

Table 3. Analysis of the t test for Combustion Engine Course Learning Outcomes Data

LEARNING OUTCOMES	t-test for Equality of Means				
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	4.179	58	.000	5.86667	1.40374

From the results of the independent sample t test, the t count value is 4.179. Then the value of p (Sig 2 tailed) 0.00 < 0.05. Therefore, there is a significant difference between the learning outcomes of problem solving abilities between the experimental group and the control group. Thus the application of online learning with the PBL approach in learning Combustion Engine Course (on experimental class) is superior and able to improve problem solving abilities.

3.1 Discussion

During the Covid-19 pandemic, it became a multidimensional problem facing the world, its impact was also felt in the education sector which caused a decrease in the quality of student learning **[10],** this pandemic emergency period required the learning system to change to online learning so that the learning process continued **[11]**. This clearly changes the pattern of learning which requires teachers and educational developers to provide learning materials and teach students online or virtually. In an emergency situation with the outbreak of the Covid 19 pandemic, only technology is the bridge in the transfer of knowledge and technology from lecturers to students. At Nusa Cendana University, it is mandatory for every lecturer to conduct online learning via LMS, Zoom, Google Meet, Whatsap, email and others, so that the learning process continues to run well.

Therefore, it is clear that in online learning it is necessary to make various efforts so that learning independence occurs in the learning process. One of the efforts to increase student learning independence, the online learning process with a problem-based learning approach, is able to provide a learning environment and motivate students to develop all their learning abilities in finding solutions to existing problem solving.

Online learning is a distance education system with a set of learning strategies in which teaching activities are carried out separately from learning activities. This means that in online learning the use of communication technology as a learning tool is very important [12]. Therefore, the application of a problem-based learning approach in online learning will be able to improve the quality of online learning itself. This can be seen from the results of research on online learning classes with a problem-based learning approach the average value obtained is 80.23, while in normal online learning classes it is 74.36. This is because, with a problem-based learning approach it will encourage students to try to find learning resources in solving learning problems. In addition, a problem-based learning approach will train and condition students' mental attitudes to study independently or in groups. The results of Nurhayati's research [13] explain that there is a significant relationship between learning independence and learning outcomes, both in direct learning and in distance learning. With high curiosity it will encourage students to find what they want to know, so that it can affect their learning outcomes [14]. Online learning provides benefits in helping to provide access to learning for everyone, thereby removing physical barriers to learning within the classroom [15]. In fact, this is seen as something that is effective to implement, especially in higher education. However, according to Pilkington [16] it is undeniable that not all learning can be transferred into an online learning environment.

The online learning process with a problem-based learning approach is a learning innovation involving elements of information technology. With a problem-based learning approach, students are presented with real problems that are not complete, thus encouraging them to understand, investigate situations, develop questions, which allows solutions to emerge to solve the problems they face. Problem solving can be done individually or collaboratively, so that the principles and concepts of problem solving can be explored properly. Thus, students are conditioned not only to receive learning information from lecturers, but also to be able to explore and explore all available learning resources, both individually and in groups in order to find the best problem-solving solutions. Furthermore, online learning with a problem-based learning approach, trains and conditions problem-solving abilities, continues to increase, because students directly identify all data that is relevant to the existing situation, and try to provide the right solution with higher-order thinking skills. In addition, problem-based learning situations provide conditions that make students more motivated in learning, always enthusiastic and submit assignments on time. Thus, online learning that applies a problem-based learning approach needs proper attention because it has a positive influence on learning outcomes of problem-solving skills, even with the same learning materials and facilities.

Problem-based learning is a strategy in the contextual learning model which has seven main principles, namely: (1) constructivism, (2) inquiry, (3) questioning, (4) learning community, (5) modeling, (6) reflection, and (7) authentic assessment **[17].** These problem-based learning principles must be implemented in the online learning

process, thus enabling students to learn more independently, learn more meaningfully, and apply higher-order thinking and integration from various disciplines. This process encourages students to play an active role in discussing subject matter with their peers with their own strategies for solving problems, collaborating and formulating concepts. With online collaboration, students become familiar with the activities of peer tutors, which are carried out alternately to explain the material they have mastered to other friends. Another possibility is that in discussing problems, students who are critical and creative suggest solving problems related to the material being discussed. Thus it can be expected that the learning outcomes of problem solving skills can increase, so that they are able to overcome learning problems during the current Covid 19 pandemic.

5. CONCLUSION

From the results of the t-test analysis, it was found that tcount = 4.179 with p (Sig = 0.00) <0.05. This means that the learning outcomes of problem-solving abilities between groups of students learning online using a problem-based learning approach and groups of students learning online normally show that there is a significant difference (p <0.05).

The application of online learning with a problem-based learning approach to experimental class students (mean learning outcomes 80.23) is superior to normal online learning to control class students (mean learning outcomes 74.36).

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