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Hybrid Lectures with Problem-Based Learning to Improve Learning Outcomes

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Abstract: Universities are faced with the great challenge of managing input from passive students into outputs ready to solve problems in the industry. One of the things universities can do to answer these challenges is to design and implement learning strategies that can turn surface learning into deep learning, from passive learning to active learning. One of the learning strategies that can be used to prepare students to become professional graduates is problem-based learning. This study aims to analyze, evaluate, and optimize the implementation of problem-based learning in practicum lectures, with case studies in the Practicum of Procurement System, Logistics of Oil and Gas Study Program, Polytechnic of Energy and Mineral Akamigas. The research design used experimental research in hybrid lectures and two analyses. The first analysis is to test the initial ability differences between the experimental group and the control group. The second analysis is to test the proposed hypothesis. In addition, psychomotor influences were also analyzed using Peer Assessment. The results showed that the problem-based learning model could improve students' learning outcomes. The classes given problem-based learning have higher cognitive, affective, and psychomotor aspects of students compared to conventional ones.

Keywords: Problem-Based Learning, Learning Outcome, Lectures.

Introduction

The national exam is a tool to find out the picture of student learning achievement nationally. The community obtains accurate information about the achievements achieved by students nationwide. They can use that information to make comparisons of learning achievements between schools, districts, and provinces. However, this has the disadvantage that it can only be used to measure the success of students from the intellectual (cognitive) side and cannot be used fully to measure the affective and psychomotor realms because the final evaluation only targets cognitive aspects. Students' motor, social, spiritual, and moral abilities often become neglected. Learning in schools prioritizes the ability of students to remember information, store information, and reproduce information so that students can do exam questions well. According to O'Kelly (2005), this type of learning is called surface learning. Surface learning makes students passive in learning. Passive students tend to be less motivated to achieve goals. The goal students want to achieve does not come from themselves but from the school and other pressures arising due to national exams.

Schunk (1985), in his study, managed to prove that students are capable of achieving high performance if they have goals set by themselves. Such students will perform better than those whose goals are set by other parties and with absolutely no goals. In addition, passive students will only take advantage of the time to memorize the material. The phenomenon shows that many students take tutoring to find solutions quickly and quickly to answer questions. Students who pass the national examination and enter college are still accustomed to passive learning that relies solely on information from teachers.

The Covid-19 pandemic that has hit Indonesia has also affected the learning system in schools.

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During the pandemic, students are required to do online learning. As a result, students are often unaccustomed to making study plans for themselves, cannot guide and monitor themselves to learn, and cannot evaluate whether the implementation of the learning process is following the planning. The level of student independence in finding various information relevant to the material studied is also still low. Likewise, the level of time utilization is still not optimal, and students are often unable to complete assignments from lecturers on time. It causes students to tend to experience difficulties when faced with real phenomena. It is contrary to the industry's wishes, which wants college graduates to have the ability to solve problems.

Currently, universities are faced with the big challenge of managing input from passive students into outputs that are ready to solve problems in the industry. One of the things universities can do to answer these challenges is to design and implement learning strategies that can turn surface learning into deep learning, from passive learning to active learning. One of the learning strategies that can be used to prepare students to become graduates who are ready to solve problems in the industry is problem-based learning. According to Barrow (1980), problem-based learning is where learning outcomes are obtained from a series of processes of understanding and solving problems. Learning with problem-based learning strategies will produce students who can think critically in analyzing and solving complex problems as problems arise in the real world, work together in groups, and communicate effectively both orally and in writing (Dutch et al., 2001).

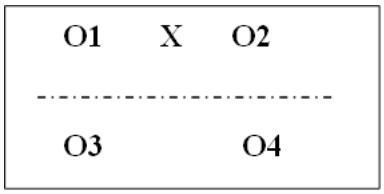
Previous research has analyzed problem-based learning, including Tri Pudji Astuti in the Proceedings of Jakarta State University entitled Model Problem Based Learning dengan Mind Mapping dalam Pembelajaran IPA Abad 21 and Tika Zahara in the Thesis of Syarif Hidayatullah State Islam University Jakarta entitled Pengembangan Modul Praktikum Berbasis Problem Based Learning untuk Kimia Kelas X Semester Genap. The analysis in the two studies above limits problem-based learning to students' cognitive aspects through the test assessment results but has not analyzed the affective and psychomotor aspects. Compared to previous studies, problem-based learning in this study was analyzed holistically, not only cognitive aspects but also considering affective and psychomotor aspects as important units in student learning outcomes. In addition, the analysis in this study uses hybrid learning experiments, which is different than relevant studies. Hybrid learning is a learning method that combines online learning with face-to-face learning. So in its implementation, there are times when students and lecturers meet face-to-face in class.

Problem-based learning especially needs to be implemented in vocational-based colleges where learning outcomes are directed specifically at the profile of certain graduates. In this regard, as a vocational college, the Polytechnic of Energy and Mineral Akamigas must be able to produce competent graduates in the oil and gas field. The object of this study is the Practicum of Procurement System course that is taken by fourth-semester students. Learning outcomes are designed based on the Regulation of the Minister of Research, Technology, and Higher Education Number 44 of 2015 concerning National Standards for Higher Education at SKKNI Level 6. The problem-based learning model is expected to support the profile of course graduates, namely the Procurement Supervisor, as an officer responsible for planning the procurement of oil and gas materials, arranging partners, and carrying out cooperation. A competent and professional Procurement Supervisor can create a value chain for the oil and gas industry in running their core business.

Materials and Methods

This type of research, scientifically, is included in the scope of experimental research. Experimental research is used to find the influence of certain treatments on others under controlled conditions (Sugiyono, 2011). The form of experimental design used is Quasi-Experimental. This design form was chosen because this study used a control group. Still, the control group could not fully function to control outside variables that affected the

implementation of the experiment (Sugiyono, 2011). The Quasi-Experimental form used in this study is the Non-Equivalent Control Group Design, where the research will be applied to experimental and control groups as a predetermined comparison class. The design of this study gave treatment to the experimental group and the control group using pretests at the beginning of treatment. Then posttests were given after treatment in both classes (Burke & Larry. 2014: 358). The experimental class uses the Problem Based Learning model, while the control class uses the lecturing model. Then Pretest is given to find out the initial situation before implementing the learning process and giving posttest after giving treatment.



Picture 1. Experiment Non-Equivalent Control Group Design (Source: Burke & Larry. 2014)

Formula description:

X : Treatment (Problem-Based Learning model)

O1 : Initial measurement of treatment group learning outcomes

O2 : Final measurement of treatment group learning outcomes

O3 : Initial measurement of control group learning outcomes

O4 : Final measurement of control group learning outcomes

This research was conducted to determine whether problem-based learning can improve student learning outcomes. O1 and O3 are the student learning outcomes level before problem-based learning treatment. O2 is the level of learning outcomes of students after being treated with problem-based learning. O4 is a learning outcome that is not treated with problem-based learning.

In this study, two analyses will be carried out. The first analysis was to test the difference in initial ability between the experimental group and the control group (O1: O3) using an independent t-test. The expected result is that there is no difference between the initial ability of the control group and the experimental group, namely between O1 and O3 (Sugiyono, 2011). The second analysis is to test the hypothesis proposed. The proposed hypothesis is that implementing problem-based learning will increase learning outcomes in this case. The statistical technique used to test both hypotheses is the t-test for two related samples. What was tested was the difference between O2 and O4 (Sugiyono, 2011).

Measurements were made against the LOG 2A class as the Control Class and the LOG 2B Experimental Class on 56 respondents in the Practicum of Procurement System Course. The Control Class and the Experimental Class are categorized based on a non-lame average based on the results of the Midterm Exam.

Results and Discussion

Result

This research was conducted at the Polytechnic of Energy and Mineral Akamigas. The subject of this study is a student of the Oil and Gas Logistics Study Program in LOG 2A and LOG 2B classes. LOG 2B is an experimental class that is given Problem Based Learning learning by providing case studies and peer assessment to see student participation in solving cases in groups. In comparison, LOG 2A is a control class that is not getting a case study. Both classes take 16 hours of face-to-face and 16 hours of online learning.

In this study, pretests and posttests were carried out in experimental classes and control classes. Pretest values are performed to determine the state before being given initial treatment in experimental and control classes. The posttest score is used to determine the results of the student's learning on experiments after getting treatment. Descriptive analysis in this study used SPSS v16.0. The results of the descriptive analysis of the pretest and posttest values for the experimental and control class can be seen in Table 2.

Table 1. Descriptive Statistics of Learning Outcome Variables

	N	Minimal	Maximal	Average	Standard Deviation
Experimental - Pretest	30	75.00	85.00	81.1000	2.88097
Experimental - Posttest	30	82.00	95.00	87.7667	3.45097
Control - Pretest	26	73.00	85.00	79.4231	3.63509
Control - Posttest	26	80.00	88.00	84.1154	2.74703

Table 1 shows that the average scores in both the experimental and control classes increased after treatment. The experimental class increased by 6.6667, while the control class increased by 4.6923. But when compared between the experimental and control classes, the average score of the experimental class was higher after being given Problem Based Learning than the control class that was not given the treatment with a difference of 3.6513. Although we already know the best values, paired t-tests, and independent t-tests are necessary to know those pretest and posttest values go up significantly. The differences between the experimental and control classes are also significant.

Normality Test

The normality test or Kolmogorov-Smirnov test is a test that compares the distribution of data owned with the same normal, mean, and standard deviation data distribution. Table 2 shows Kolmogorov Smirnov's test results for Learning Outcome variables measured by tests both before and after the application of problem-based learning for the experimental group and tests for the control group.

Table 2. Kolmogorov Smirnov Test Results

	Kolmogorov-Smirnov Z	Significance (2-tailed)
Experimental Class - Pretest	1,194	0,116
Experimental Class - Posttest	1,033	0,236
Control Class - Pretest	0,999	0,271
Control Class - Posttest	1,036	0,233

Based on the normality calculation data presented in the table above, it was found that the pretest and posttest values in the experimental class and control class were declared normally distributed if the significance was greater than 0.05. Based on the data processing in the experimental class, there was an influence of 0.116 for the pretest value and 0.236 for the posttest value. It shows that the data is normally distributed because it is greater than 0.05, which is 0.116 > 0.05 and 0.236 > 0.05.

Meanwhile, from data processing in the control class, there is an influence of 0.271 for the pretest value and 0.233 for the posttest value. It shows that the data is normally distributed because it is greater than 0.05, namely 0.271 > 0.05 and 0.233 > 0.05. Thus, it can be concluded that the results of the normality calculation presented in the table above all significance values for the Learning Outcome data of both the experimental and control classes show a number greater than $\alpha = 0.05$. This hypothesis can be generalized to the population.

Variance Homogeneity Test

A homogeneity test is a test to determine that two or more sample data come from populations with the same (homogeneous) variance. This study used the Levene Test, and the data carried out by the test was said to be homogeneous based on its significance value. A significance value (p) of ≥ 0.05 indicates the data group comes from a population that has the same (homogeneous) variance. A significance value (p) of < 0.05 indicates each data group came from a population with a different (inhomogeneous) variance. Based on the results of the homogeneity calculation presented in table 3, it can be concluded that the variance before and after being given treatment for each class comes from the same variance because all values are above 0.05.

Table 3. Levene Test Results

Variable	Test	Significance
Learning Outcome	Pretest Experimental – Control Class	0,052
	Posttest Experimental – Control Class	0,324

Hypothesis Test: The Effectiveness of Problem-Based Learning in Improving Learning Outcomes

Due to the two data tested normally and homogeneously, the next step is to conduct a t-test. Two Independent Samples (Independent Sample t Test) were used to compare the difference between the Mean of the two independent samples assuming data were distributed normally. The first test was carried out to determine the difference in learning outcomes before treatment in both the experimental class and the control class (the difference between O1 and O3), while the second test was to determine the difference in learning outcomes after treatment in the experimental class and control class (the difference between O2 and O4). This test was performed with a t-test for an

independent sample, where the full results are shown in Table 4.

Table 4. Independent Sample t Test Results Learning Outcome Variables

	t	df	Sig. (2-tailed)	Mean Difference	Standard Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
O1 and O3	1.925	54	0,060	1,67692	0,87134	-0.7000	3,42385
O2 and O4	4.333	54	0,000	3.651286	0,84261	1,96194	5,34062

The test criteria used are:
If the value of Sig. (2-tailed) < 0.05, then H0 is rejected, or Ha is accepted.
If the value of Sig. (2-tailed) > 0.05, then H0 is accepted, or Ha is rejected.

For the t-test on the difference test O1 and O3, when viewed from the Equal Variances Assumed, in the sig column. (2- tailed) shows a figure of 0.060 > 0.05, so it can be concluded that the average Learning Outcome before being treated in the experimental and control classes did not differ significantly. In the table, there is also a test difference between O2 and O4, namely significant differences after implementing Problem Based Learning in the experimental class and the non-implementation of Problem Based Learning in the control class. Results on Equal Variances Assumed, on the sig column. (2- tailed) shows a figure of 0.000 < 0.05, then as the basis for deciding the independent sample t-test that H0 is rejected and Ha is accepted. Thus, it can be concluded that the average learning outcome between experimental class students who apply problem-based learning and control class students who do not apply problem-based learning is significantly different (real).

Although the implementation of problem-based learning has a positive effect on learning outcomes, the t-test for paired samples still needs to be done to determine whether there is an average difference between O1 and O2, which described the difference between the Pretest and the Posttest value in the experimental class. The output of paired t-test can be seen in table 5 below.

Table 5. Test Results t Samples Paired Learning Outcome Variables

	t	df	Sig. (2-tailed)	Mean Difference	Standard Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
O1 dan O2	-10,847	29	0,000	-6,6667	0,61464	-7,92374	-5,40959

Before discussing the interpretation of the numbers contained in the output table above, the formulation of the research hypothesis in decision-making is as follows:

- H0 = No average difference between Pretest and Posttest learning outcomes in experimental classes, which means that there is no influence on the use of Problem Based Learning to improve Learning Outcomes
- Ha = There is an average difference between Pretest and Posttest learning outcomes in experimental classes, which means that there is an influence on the use of Problem Based Learning to improve Learning Outcomes

The test criteria used are:

- If the value of Sig. (2-tailed) < 0.05, then H0 is rejected, or Ha is accepted.
- If the value of Sig. (2-tailed) > 0.05, then H0 is accepted, or Ha is rejected.

Based on the output table, Sig's value is known. (2-tailed) is 0.000 less than α = 0.05, then H0 is rejected and Ha is accepted. So it can be concluded that implementing problem-based learning in the Procurement System Practicum lecture can effectively improve students' learning outcomes.

Peer Assessment

In Peer Assessment, students assess their group of friends based on the level of attendance in group discussions, the level of readiness to participate in class discussions, the ability to listen to the opinions of other members, the ability to communicate with other members, the ability to share the information obtained with other members, the ability to support and develop the overall performance of the group. Based on this, an assessment is carried out using the indicators in Table 6 below:

Tabel 6. Peer Assessment Indicators

Point	Criteria
1	Very Low
2	Low
3	Moderate
4	High
5	Very High

Based on the indicators, the average Peer Assessment data for control and experimental classes is obtained in the table below:

Table 7. Average Peer Assessment Results

Indicators	Control Class	Experimental Class
The attendance rate in group discussions	2,98	4,58
Level of readiness to participate in class discussions	2,82	4,46
Ability to listen to the opinions of other members	2,86	4,28
Ability to communicate with other members	2,75	4,25
Ability to share information obtained with other members	2,83	4,23
Ability to support and develop overall group performance	2,82	4,33
Average	2,84	4,35

The average Peer Assessment results show that the experimental class is higher than the control class. It means that in classes with the application of problem-based learning, student performance is more visible and active than the control class in solving the problems of the given group.

Discussion

The application of Problem-Based Learning model is applied using tests. For the test, Pretest and Posttest questions are prepared. In the learning process, the problem-based learning model is applied in the experimental class, while the control class is not applied because it only uses ordinary learning. The problem-based learning model is a learning model based on many problems that require investigation, namely investigations that require real solutions to real problems (Trianto, 2010: 90). According to Dewey in Sudjana (2001:19), in Trianto (2010:91) that problem-based learning is the interaction between stimulus and response, is a relationship between the two directions of learning and the environment. The environment provides input in the form of help and problems, while the nervous system of the brain functions to interpret the assistance effectively so that the problem at hand can be investigated, analyzed, and solved properly. Based on this opinion that the learning process runs effectively, namely the existence of a stimulus which means stimulation, in this case, information that attracts students, then there is a response, in this case, the student responds to what has been given and what the student has gotten. Then students can solve their problems well based on daily problems. And students carry out the learning process well with the interaction between lecturers, students, and the environment.

From the results of data testing the results showed that the implementation of problem-based learning in the Procurement System Practicum lecture was effective in improving the learning outcomes. The significance value of the O2 proves the statement and O4 difference test of 0.000 and the O1 and O2 difference test of 0.000, where the value of both is smaller than $\alpha = 0.05$. The average learning outcome score in experimental class students before and after the application of problem-based learning increased by 6.6667, where the increase was significant. This significant difference occurs because students are more interested and understand when problem-based learning is applied in the classroom. When applying problem-based learning, students can interact with friends and the environment. Lecturers solve problems that usually occur in the world of work, and the application of problem-based learning even improves the Learning Outcomes owned by students.

In addition to individual tests using pretest and posttest systems to see student performance, a Peer Assessment is conducted where students conduct assessments on other students in the same group. This Peer Assessment is carried out in experimental and control classes with the intention of seeing students' activeness in solving problems given using the application of problem-based learning. In addition to looking at activeness and performance, Peer Assessment also assesses students' psychomotor abilities. Student performance abilities can usually be seen during practicum activities by applying problem-based learning. Peer assessment is a process in which students are involved in the performance assessment of other students of the same level (Bostock, 2000: Zulharman, 2007). According to Tohey (Wilson, 2002), the benefits of peer assessment are encouraging students to be more critical in analyzing their performance, helping to clarify assessment criteria, training decision-making skills, measuring what should be measured, reducing the burden on assessing, making assessment part of the learning process and emphasizing on processes, not just results.

Black et al. (2004) stated that peer assessment is unique because students can accept friends' criticism of their work even though the teacher also gives the criticism. When students don't

understand what the teacher is explaining, they prefer to ask their friends instead of the teacher. Peer assessment is part of formative assessment, feedback, and self-assessment (Zainul, 2001). Peer assessment means making decisions based on individual responsibilities that benefit the group. On peer assessment, students are trained to communicate, write and report what they mean. The assessment is carried out after the practicum process is completed.

In the results of the Peer assessment of the control class, all assessment indicators given are below 3, which means that the performance of the control class students can be said to be low. It can happen because the group of students has difficulty completing the assignments given due to a lack of understanding of the material and difficulty solving the problem of tasks that are too broad. As for the experimental class applied problem-based learning, all assessment indicators are above four, which means that the student's performance, activeness, and psychomotor are high. It can happen due to the application of problem-based learning in the experimental group. In problem-based learning, students will independently try to find information about what they want to know and what they need to solve problems. Individual students will be responsible for finding relevant information and bringing the information obtained into the group to work with other members to find solutions to the problem. This requires students to be present in group discussions, listen to the opinions of others to solve given problems, communicate and discuss problem-solving ideas, share information about problems with other members, and develop the group's overall performance.

Conclusions

Based on the results of research, data analysis, and discussions that have been carried out, the following conclusions can be drawn:

1. The problem-based learning in hybrid lectures model can improve learning outcomes in the Practicum of Procurement System. The significance value of the O2 and O4 difference test is 0.000 and the O1 and O2 difference test is 0.000 where the value of both is less than α = 0.05. The average learning outcome score in experimental class students before and after the application of problem-based learning increased by 6.6667 where the increase was significant. Thus, there is an increase after being treated using Problem Based Learning.
2. The Peer Assessment test shows that the classes given Problem Based Learning, have higher performance, activeness, and psychomotor students compared to the control class. This is evidenced by the average Peer Assessment of the control class of 2.84 and the experimental class of 4.35.

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