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The Effect of Problem-Based Learning Using Simulators on CPS Skills And Learning Outcomes of Lighting Systems

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ABSTRACT

Collaborative Problem Solving (CPS) skills are a skill that must be possessed in the 21st century, besides that learning outcomes must also be better in order to become Vocational High School graduates who are ready to become a professional workforce. One of the learning methods that can be applied is Problem-Based Learning (PBL) using simulators. The purpose of this study was to determine the PBL method using simulators to have a better influence than the lecture method on CPS skills and learning outcomes of student lighting systems. The type of research used is a quasi-experiment with non-equivalent group design. The population in this study was class XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro, the sample selection in this study used Cluser Random Sampling, from 4 classes selected XI TKR A Experiment, XI TKR B Control. The instruments of this study are the width of the CPS skill questionnaire and pretest & posttest student learning outcomes. Data analysis technique using t-test preceded by prerequisite tests, namely normality test and homogeneity test. The research results show that the CPS skills and learning outcomes of lighting system students are better using the PBL method than the lecture method. The implication of this research is that teachers can use this method as an alternative learning strategy to improve students' CPS skills as creative problem solvers.

Introduction

Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential (Nurhadi & Zahro, 2019). Therefore, education is a basic thing for every community to have. But at this time Indonesia has an education problem because education in Indonesia is ranked 67th out of 203 countries (worldtop20.org, 2022), so education must be considered by observers of this education, the government's efforts are made

through Vocational High School. Vocational education is a type of education that prepares students so that they can master specific skills so that they can become professionals in the world of work. In general, Vocational High School aims to equip students with specific skills according to their interests. But in 2022, Badan Pusat Statistik (BPS) announcing the open unemployment rate that Vocational High School graduates are the largest contributor to unemployment in Indonesia as of August 2022 of 8.42 million people (bps.go.id, 2022). That data assumes that the goals of Vocational High School in Indonesia have not been achieved.

At this time, the demands of Vocational High School graduates must have high Collaborative Problem Solving (CPS) skills because CPS skills are skills that individuals must have in the 21st century (Andrews-Todd & Kerr, 2019). However, the OECD stated that the 2015 PISA survey focused on science with mathematics, reading, and CPS skills proving that Indonesia's CPS skills index is still very low compared to other countries, these problems are also found in vocational high schools (Sumiyaty et al., 2023). CPS skills are very important for every vocational school student, this is based on the ability to solve problems in a structured manner (problem solving) which is an important competency for people in an industry from operators to management level (Sieckmann et al., 2020). Then CPS becomes a very important skill in almost all areas of 21st Century life (Rojas et al., 2021). The application of CPS is able to help students develop their work skills both individually and in teams (Ariyanto et al., 2019).

According to the research results, the CPS of vocational high school students is still low, therefore early training is needed so that problem-solving skills of vocational high school students can develop properly (Rachmad Syarifuddin Hidayatullah et al., 2020). Future vocational high school graduates must be equipped with 21st Century skills that can be utilized optimally to meet the demands of the industrial world, in this case CPS skills are no exception (Azura et al., 2021). CPS skills are very much needed by vocational high school students so that when they graduate they are able to become highly competitive graduates in the world of work.

Based on the results of observations made during the lighting system learning process of the TKR class XI at Vocational High School Muhammadiyah 1 Bambanglipuro, it can be seen that the learning process is not optimal, this is shown by the lack of creation of CPS skills. CPS skills of students in learning the lighting system class XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro are still low due to learning that still uses the lecture method because the lecture method has weaknesses, namely the material that students can master as a result of the lecture will be limited to what the teacher masters, can result in verbalism, students tend to be inactive and of

course these weaknesses can affect the non-realization between collaboration and problem solving that is not visible due to the absence of collaboration between teachers and students (Mutende et al., 2021). To overcome the lack of CPS skills, a better learning method is needed, namely the Problem-Based Learning (PBL) method, according to (Mashuri, 2022) the results show that the use or implementation of STEM-integrated PBL significantly impacts learners' learning achievement in the social domain CPS skills influenced by the fact that learners in general have demonstrated a fairly good skill level, i.e. at the intermediate level, since the initial meeting.

In addition to CPS skills that are still low, it turns out that learning outcomes are also still low. Learning outcomes can be interpreted as the process to which students master learning after participating in learning activities (Handoyono, 2022). The teacher explained the students' learning outcomes in recent years that students' skills in lighting system practice were still lacking. This is evidenced by the use of practice tools that are still perfunctory that can damage practice tools, and only 13 out of 32 students achieve scores above completion of minimum criteria in daily tests. In order for this problem to be resolved, problem-based learning is needed because using PBL model can improve student learning outcomes in cognitive, affective and psychomotor aspects (Amin et al., 2020; Sari & Ardianti, 2021).

PBL methods learners are taught to collaborate with others in solving problems (Ariani, 2020). PBL is a method that focuses on changing the way learners think (Handoyono & Rabiman, 2019). When learners can adapt their learning styles effectively, it will be easier for them to understand the subject matter, which in turn will result in the best learning outcomes. PBL is a learning approach that begins by presenting problems that are relevant to students as the starting point of the learning process. Students then work together in groups to analyze the problem, the goal of which is to practice their critical thinking skills and problem-solving skills. Thus, PBL aims to enable students to understand the subject matter better. The PBL approach places emphasis on students as the primary focus of student-centered learning, encouraging them to develop an understanding of how to learn and work together in groups to find solutions to real-world problems. In order for PBL to be carried out, media is needed, because learning media refers to all components (individuals, instruments, materials, and environments) used in the learning process to communicate material to students and stimulate them in the learning process and achieve learning objectives (Levkoe et al., 2020).

In the implementation of PBL, simulator media is needed. The use of simulators is a major aspect that needs to be fulfilled by schools in order to facilitate the learning process. Simulators have an

important role in the implementation of the PBL method, especially in learning that requires the development of practical skills and real-world problem solving (Et. al., Yunesman, 2021). This is very much in line with the characteristics of learning in vocational schools which are oriented towards completing real work. The learning process of using random practice tools can result in damage to the practice media and lighting system practice tools. Therefore, in order to minimize the use of tools so that there is no damage to the tools, a simulator is needed (Dudyrev & Maksimenkova, 2020). Simulators in the implementation of the PBL method can be used as learning media that allow students to practice in conditions that resemble reality without high risk or cost, such as testing or repairing lighting systems virtually.

Based on the problems in class XI TKR, especially in learning lighting systems to improve the problem of low collaborative problem solving skills and learning outcomes, namely by using problem-based learning, collaborative problem solving skills will be realized because students are able to collaborate to solve a problem. So the results will be much better than using the previous method and of course the learning outcomes will also be better. The PBL method is better than the conventional method because it is able to provide a more relevant, in-depth learning experience, and is oriented towards developing important skills for the future (Handoyono & Rabiman, 2019). The PBL method allows students to become active learners who are independent, creative, and collaborative, which are very much needed in the era of globalization and the Industrial Revolution 4.0 (Mashuri, 2022). By using the problem-based learning method using a simulator, it is hoped that the results of collaborative problem solving and learning outcomes will be better than using the previous method, namely using the lecture method.

Method

This research method uses quasi-experiment research type or quasi-experiment with non-equivalent group design design, this design research objects are divided into two, namely the control group and the experiment group (Sirotová et al., 2021). In this study the experiment group uses PBL methods and uses simulators as learning media, while the control group uses the lecture method. This type of research was chosen considering that randomization of groups was not possible, so the research was still carried out by comparing existing groups.

Population is a generalized area consisting of objects or subjects, which have certain qualities and characteristics determined by researchers to be studied and then drawn conclusions (Armstrong et al., 2022). The population is not only people, but also obJek / subjects who have certain quantities and characteristics set by researchers to be studied and then drawn conclusions,

based on this statement obtained the population in this study is grade XI students of Vocational High School Muhammadiyah 1 Bambanglipuro, Bantul, Yogyakarta for the 2023/2024 academic year. Sample selection is done using a technique based on class or also called Cluser Random Sampling. Cluser sampling does not select individuals as members of the sample unit, but selects population clusters as members of the population unit (Djafar et al., 2021). One of the reasons for choosing this sample is because researchers do not allow it to take randomly, separately and make a new class. Based on the above provisions, the research sample obtained using the Cluser Random Sampling technique by randomization, from 4 classes, 2 classes were selected each as an experiment class and a control class, based on the randomized results, class XI TKR A as an experiment class and class XI TKR B as a control class. In order for the results of this study to be caused by the treatment of different learning methods, not from other factors, internal validity is attempted to be avoided in various ways, namely, students have the same background from the same school, the same initial abilities tested from the pre-test results, and between groups do not influence each other.

The instruments in this study are (1) questionnaire sheets or questionnaires for students' CPS skills, this questionnaire is adjusted to indicators and sub-indicators consisting of five indicators, namely contributing actively, working productively, responsibly, showing flexibility, and respecting others. The questionnaire or questionnaire sheet has 4 alternative answers, namely, always, often, rarely, and never. (2) Test questions divided into pretest and posttest. Pretest is used to measure students' knowledge before learning. Posttest is used to what extent the development of student learning outcomes during using the PBL method using simulators and lecture methods. The type of question used is multiple choice with 5 answer choices (a, b, c, d, e). Data analysis techniques use descriptive analysis, data analysis of test results in the form of scores seen from pretest and posttest results, while for questionnaires or questionnaires seen from the results of filling in students on questionnaire sheets or questionnaires after completing the posttest. The research data was then carried out normality test, homogeneity test, and t-test (hypothesis testing) and with the help of SPSS 29 software. SPSS 29 was chosen as a data processing tool because SPSS supports various statistical analysis methods, from descriptive analysis to inferential analysis, making it suitable for use in quasi-experimental research. Before the learning results and questionnaire sheets or questionnaires are processed, the research instrument data is tested for validity and reliability testing first.

Test validity is divided into two, namely: (1) Content, it is measured by comparing the content of the instrument with the subject matter that has been taught. Testing the validation of instrument

content in this study using expert opinions (exprets judgement), based on the results of the exprets judgement test instrument test and questionnaire obtained results "worthy of use with revisions according to suggestions". (2) Construct validity The formula used in that validity uses the moment preson product correlation coefficient. A question is said to be valid if rcalculate > rtable using a significant value of 5% or 0.05, if rcalculate < rtable then the question can be said to be invalid with a significant value of 5% or 0.05. Testing the validity of test instruments and questionnaires or questionnaires using trial techniques used construct validity test results are: test instrument from 40 questions there are 7 questions that are invalid because of the calculation of < rtable (0.279), Invalid numbers are: questions 1, 6, 7, 20, 21, 38 and 40, because the numbers are invalid will be discarded. The questionnaire or questionnaire instrument of 40 statements does not contain invalid statements because the calculation > rtable (0.279) therefore the questionnaire instrument can be said to be all valid.

A reliable instrument is an instrument that, when used multiple times to measure the same object, will produce the same data (Sugiyono, 2019). Reliability test based on guidelines Reliability coefficient guidelines according to got the results, (1) the test instrument got Cronbach's Alpha 0.695 which is at a reliability index value of 0.61 – 0.80 which means Reliable, (2) the questionnaire/questionnaire instrument got Cronbach's Alpha 0.948 is at a reliability index value of 0.81 – 1.00 which means Very Reliable.

Result and Discussion

Research Results

The main data obtained in this study are student learning outcomes score data in lighting system learning and the results of questionnaires for student responses using research instruments that have been tested for validity and reliability. Before proceeding to the treatment stage, both class groups were given a pretest first. After the pretest is completed, then proceed to give treatment to each class using the PBL method using a simulator in the experiment group, then a posttest is carried out with the aim of obtaining a final learning outcome score which will then be able to show the influence of the Problem-Based learning method by using simulators in improving student learning outcomes in lighting system learning and can produce CPS skills of better students. Before testing the research hypothesis, it will first be analyzed about the average score of students obtained both in the experiment class and in the control class.

Analysis of pretest results aims to assess students' abilities before they follow the learning process, or in other words, measure students' initial abilities in the material to be taught. After

collecting pretest scores from students in the experiment and control classes, the next step is to conduct an analysis to determine the final score of each student. In this context, descriptive statistical analysis of pretest scores obtained by students in experiment and control classes is given.

Based on Table 1, the average Pretest results of student learning outcomes in the experiment class were 9.20 with minimum and maximum scores of 7 and 12, while in the control class the average Pretest student learning outcomes were obtained at 9.16 with minimum and maximum scores of 6 and 12. Judging from the results of these data, there was no significant difference between the experiment class and the control class in the initial ability before treatment. To substantiate the conclusions, an average difference test was carried out with a significance level of 5%. However, before performing such tests, it is important to verify whether the data has a normal and homogeneous distribution. The normality test aims to test whether in a regression model, confounding or residual variables have a normal distribution. Provided that the data is normally distributed if the significance > 0.05 and the data are not normally distributed, if the significance < 0.05, the normality test result of the experiment class and control class pretest data is the experiment pretest gets SIG. 0.129 > 0.05, pretest control gets SIG. 0.197 > 0.05 which means that both the pretest data of the experiment class and the control class are normally distributed due to the sig value. > 0.05.

Table 1. Descriptive statistics data pretest student learning outcomes in lighting system learning

Class	N	Mean	Minimal	Maximum
Experiment	25	9,20	7	12
Control	25	9,16	6	12

Pretest homogeneity test, a test performed to determine that two or more groups of sample data come from populations that have the same variance (homogeneous). Homogeneity test can be done by levene, fisher test or bartlet test, homogeneity rule if p > 0.05 then the test is declared homogeneous, if p < 0.05 then the test is said to be inhomogeneous. The results of the pretest homogeneity test between the experiment class and the control class received a sig score. 0.675 > 0.05, based on these results means that the pretest data is homogeneous because of the SIG value. > 0.05.

After confirming that the pretest data for the experiment group and the control group have a normal and homogeneous distribution, the next step is to test the difference between the two averages using SPSS software version 29. The results of the analysis will be presented below.

Based on Table 2, p = 0.926 and tcalculate = 0.093. By comparing the p value (0.926) > ∝ (0.05) and tcount 0.093 < ttable (df 48) 2.010, it can be concluded that there is no significant difference

between the pretest score of the experiment class and the control class, meaning that the initial ability of experiment class students with the kotrol class is balanced.Analysis of posttest results, posttest questions are given at the end of learning activities, to find out student knowledge after following the learning process which is treated in the form of a PBL method using simulators in experiment classes and with learning using lecture methods in control classes. After knowing the posttest scores of experiment class and control class students, then an analysis was carried out to determine the scores of each student. The following is a descriptive statistical analysis of the posttest scores of the experiment class and the control class.

Table 1. Calculation results test t (independent sample t-test) pretest

Group	Average	T-Test For Equality of Means			
		t_{count}	t_{table}	Sig. Two-Sided *p*	Difference
Experiment	9.20	0,093	2,010	0,926	0,040
Control	9,16				

Based on Table 3, the average Posttest results of student learning outcomes in the experiment class were 27.80 with minimum and maximum scores of 23 and 33, while in the control class the average Posttest student learning outcomes were obtained at 25.16 with minimum and maximum scores of 19 and 33. Based on these results, there is a significant difference between the experiment class and the control class, which means that the learning outcomes of the experiment class are better than the chat class. To substantiate the conclusions, an average difference test was carried out with a significance level of 5%. However, before performing such tests, it is important to verify whether the data has a normal and homogeneous distribution. Normality test with the provision of normally distributed data if the significance > 0.05 and the data are not normally distributed, if the significance < 0.05, the normality test results of the experiment class and control class posttest data are experiment posttest gets sig. 0.200 > 0.05, posttest control gets SIG. 0.127 > 0.05 which means that both the experiment class pretest data and the control class are normally distributed due to the SIG value. > 0.05. Test postest homogeneity, the rule of homogeneity if sig. P > 0.05 then the test is declared homogeneous, if Sig. p < 0.05 then the test is said to be inhomogeneous. The results of the pretest homogeneity test between the experiment class and the control class received a sig score. 0.116 > 0.05, based on these results means that the posttest data is homogeneous because of the SIG value. > 0.05.

Table 2. Descriptive statistics data posttest student learning outcomes in lighting system learning

Class	N	Mean	Minimal	Maximum
Experiment	25	27,80	23	33
Control	25	25,16	19	32

After confirming that the pretest data for the experiment group and the control group have a normal and homogeneous distribution, the next step is to test the difference between the two averages using SPSS software version 29. The results of the analysis will be presented below.

From table 4 of the t test results above, it can be seen that the tcount is 2.548 and ttable (df = 48) = 2.010, while the magnitude of the significance value p is 0.14. Since tcount 2.548 > ttable = 2.010 and sig, 0.014 < 0.05, means that there is a significant difference. Thus showing that the PBL method using simulators has a better effect than the lecture method on student learning outcomes in learning the lighting system XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro. Analysis of the results of the questionnaire was carried out with the aim of measuring the response of students' CPS skill after being treated for experiment and control classes. Before testing the research hypothesis, it will first be analyzed about the average score of students obtained both in the experiment class and in the control class. A questionnaire statement sheet is given at the end of the learning activity after the posttest test, to determine the response of students' CPS skills after following the learning process which is treated in the form of a PBL method using a simulator in the experiment class and with learning using the lecture method in the control class. After knowing the scores of questionnaires responding to CPS skills of experiment class and control class students, then an analysis was carried out to determine the scores of each student. The following is a descriptive statistical analysis of questionnaire/questionnaire scores, CPS skill response questionnaires, skills, experiment and control class students.

Table 3. Calculation results test t (independent sample t-test) posttest

Group	Average	t-Test for Equality of Means			
		t_{count}	t_{table}	Sig. Two-Sided *p*	Difference
Experiment	27,80	2,548	2,010	0,014	2.720
Control	25,08				

Based on table 5, the average results of the student CPS skill questionnaire in the experiment class were 132.92 with minimum and maximum scores of 120 and 132.92, while in the control class, the average student CPS skill questionnaire was obtained at 99.56 with minimum and maximum scores of 90 and 106. Based on these results, there is a significant difference between the experimental class and the control class, which means that the average CPS Skill questionnaire for experimental class students is better than that of the control class. To substantiate the conclusions, an average difference test was carried out with a significance level of 5%. However, before performing such tests, it is important to verify whether the data has a normal and homogeneous distribution. Normality test with the provision of normally distributed data if the significance > 0.05

and the data are not normally distributed, if the significance < 0.05, the normality test results of the questionnaire data CPS skill experiment class and control class are questionnaire CPS skill experiment gets sig. 0.200 > 0.05, CPS questionnaire data control skills got sig. 0.127 > 0.05 which means that both the questionnaire data CPS skill experiment class and control class are normally distributed because of the sig value. > 0.05. Test the homogeneity of the CPS skill questionnaire, the rule of homogeneity if sig. P > 0.05 then the test is declared homogeneous, if Sig. p < 0.05 then the test is said to be inhomogeneous. The results of the homogeneity test of the CPS skill questionnaire between the experiment class and the control class received a sig score. 0.116 > 0.05, based on these results, it means that the CPS skill questionnaire data is homogeneous because of the sig value. > 0.05.

Table 4. Descriptive statistics of CPS skill Questionnaire Data

Class	N	Mean	Minimal	Maximum
Experiment	25	132,92	120	132,92
Control	25	99,56	90	106

After confirming that the pretest data for the experiment group and the control group have a normal and homogeneous distribution, the next step is to test the difference between the two averages using SPSS software version 29. The results of the analysis will be presented below.

From table 6 of the t test results above, it can be seen that tcount is 25.662 and ttable (df = 48) = 2.010, while the magnitude of the significance value p is 0.001. Since tcount 25.662 > ttable = 2.010 and sig, 0.001 < 0.05, means there is a significant difference. Thus, it shows that the PBL method using simulators has a better effect than the lecture method on students' CPS skills in learning the lighting system XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro.

Table 5 Results of calculation test t (independent sample t-test) CPS skill

Group	Average	t-Test for Equality of Means			
		t_{count}	t_{table}	Sig. Two-Sided *p*	Difference
Experiment Control	132,92 99.56	25,662	2,010	0,001	33,360

Discussion

The influence of PBL methods using simulators on student learning outcomes

Based on the results of the t test with independent ttest posttests show that tcount 2.548 > ttable (df 48) = 2.010 and sig, 0.014 < 0.05, then Ha which reads "The PBL method using simulators has a better effect than the lecture method on student learning outcomes in learning the lighting system XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro." accepted. Based on the results of

the analysis, the experiment class posttest average was 27.80, and the control class posttest average was 25.08.

Based on these data, it shows that the experiment class with treatment with PBL methods using simulators is better than control classes with lecture learning method treatment on learning outcomes in learning the lighting system of class XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro, thus the PBL method using simulators is suitable for improving learning outcomes in accordance with the results of the study by implementing PBL in the learning process, there will be an increase in learning outcomes for students (Umar et al., 2021), and using a simulator can improve students' learning skills (Abizar et al., 2020).

Therefore, learning with PBL methods and using simulators the learning outcomes are both increasing, because PBL methods Learners are taught to collaborate with others in solving problems (Simanjuntak et al., 2021). PBL is a learning approach that starts the process by utilizing problems that are relevant to students. Learners then work together in groups to analyse the problem, with the aim of developing critical thinking skills and skills in overcoming challenges, so that they can gain a better understanding of the subject matter (Ling et al., 2021). PBL method can improve the learning outcomes of basic automotive electrical engineering, while the simulator as a learning medium is a tool in education and training that provides alternative solutions to students to gain an understanding of teaching material and improve their competence. With the problem-based learning method and using simulators, the learning outcomes of the lighting system of class XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro are better than the previous learning, namely the lecture method.

The influence of PBL methods using simulators on students' CPS skills

From the results of the t test with an independent ttest shows that tcount 25.662 > ttable (df 48) = 2.010 and sig, 0.001 < 0.05, then Ha which reads "The PBL learning method using simulators has a better effect than the lecture method on students' CPS skills in learning the lighting system XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro." Accepted. Based on the results of the analysis, the average experiment class was 132.92 and the average control class was 99.56.

Based on these data, it shows that experiment classes with PBL method treatment using simulators are better than control classes with lecture learning method treatment on the achievement of students' CPS skills, because students' PBL methods are more skilled in communicating in learning and students' skills in solving problems are more developed in accordance with (Hidajat, 2023). The application of the PBL method is to understand and develop

problem-solving skills so as to emphasize explicit instruction or provide special direct learning to develop student learning with a step-by-step pattern (Rojas et al., 2021). besides that simulator support can also affect CPS skills because at the time of learning each group in the practice of lighting systems with simulators is very Because practice with simulators has never been felt by students, students are no longer shy about asking group mates or asking questions with teachers and are not afraid to try assembling lighting system components. Simulator as a learning medium is a tool in education and training that provides alternative solutions to students to gain an understanding of teaching material and improve their competence (Dudyrev & Maksimenkova, 2020). The simulator itself is a means that approaches the original replica of the equipment, system, phenomenon, or process. With the PBL method and using simulators, the CPS skills of students in learning the lighting system of class XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro is better than the previous learning, namely the lecture method.

Conclusion

Based on research obtained by data analysis and hypothesis testing using the independent t test, the following conclusions can be drawn: (1) The PBL learning method using a simulator has a better effect than the lecture method on student learning outcomes in learning the lighting system XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro. This is shown by the results of the independent t samplee t test which has a calculated value of 2.548 and ttable (df = 48) = 2.010, while the magnitude of the significance value p 0.14. Because tcount 2.548 > ttable = 2.010 and sig, 0.014 < 0.05. Thus, it shows that the PBL method using simulators has a better effect than the lecture method on student learning outcomes in learning the lighting system XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro. (2) The PBL method using simulators has a better effect than the lecture method on students' CPS skills in learning the lighting system XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro. This is shown by the results of the independent sample t test which has a calculated value of 25.662 and ttable (df = 48) = 2.010, while the magnitude of the significance value p 0.001. Because tcount 25.662 > ttable = 2.010 and sig, 0.001 < 0.05. Thus, it shows that the PBL learning method using simulators has a better effect than the lecture method on students' CPS skills in learning the lighting system XI TKR Vocational High School Muhammadiyah 1 Bambanglipuro.

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