

The Effect of Problem-Based and Discovery Learning Models with the Science Approach to the Understanding Concept and Science Process Skills of the Student

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Abstract—This research aims to determine the differences in science process skills between students who follow the learning with problem-based learning model with scientific approach and students who follow learning discovery learning with scientific approach; differences in physics learning result between students who follow learning with problem-based learning model with scientific approach and students who follow learning discovery learning with scientific approach. This research type is quasi experiment with 2x2 factorial design. Sampling using cluster random sampling technique, and research instrument in the form of essay test for science process skill and multiple choice test for physics study result tested validation, reliability, difficulty level, and different problem. The final data (post-test) was tested for normality, homogeneity, and hypothesis with two-t test samples, as well as further tests with the statistical manova Hotelling's Trace. Hypothesis test used is t-test polled variance. The results of t_Calculate are consulted with t-test table at 5% significance level. From the research results obtained as follows: (1) there is influence of discovery learning and problem-based learning model with scientific approach to understanding concept result ($t_{Calculate} = 4.1 > t_{table} = 1.99$); (2) there is influence of discovery learning and problem-based learning model with scientific approach to students physics science process skill ($t_{Calculate} = 5.01 > t_{table} = 1.99$); (3) there is influence of discovery learning and problem-based learning model with scientific approach to understanding concept and students physics science process skill ($F_{Calculate} = 15.57 > F_{Table} = 1,78$). This suggests that the problem-based learning model with a scientific approach is better than the discovery learning model with the scientific approach.

Keywords—problem-based learning, discovery learning, scientific approach, understanding concept, science process skills

I. INTRODUCTION

The learning process in the 2013 curriculum is carried out using a scientific approach. Here also in the physics subject in high school as stated in the 2013 curriculum aims that learning

with a scientific approach is to form students' ability to solve problems systematically and obtain high learning outcomes. The goal of implementing the 2013 curriculum is the formation of competence and character of students in the form of a combination of knowledge, skills and attitudes that students can demonstrate as a form of understanding of the concepts that are studied contextually [1]. So that learning outcomes are obtained based on predetermined goals. This goal is achieved when students are faced with a learning process that involves a cognitive process in solving problems and in the process of discovery.

But the reality so far in high school learning carried out by teachers has not led students to the learning process that presents contextual problems to find or solve a concept, theory or principle. The concepts of science and the environment around students can be easily mastered by students through observations of concrete situations. The positive impact of the application of a contextual environmental approach is that students can be stimulated by their curiosity about something in their environment. In addition, the orientation of physics learning is more towards planting knowledge of basic concepts, developing basic skills related to scientific processes, and developing logical thinking patterns [2].

On the other hand, the low student learning outcomes when associated with the implementation of the curriculum in general. Due to several factors including: 1) the curriculum load is too heavy; 2) affective education is difficult to program explicitly because it is considered to be part of the hidden curriculum, the implementation of which is highly dependent on teacher skills and experience; 3) attainment of educational outcomes, especially affective education, takes time so it requires persistence and patience of educators; 4) assessing educational outcomes, especially the affective domain, is not easy [3].

Based on the results of observations, the teacher did not involve students in solving contextual problems related to learning material so that it had an impact on students' physics scores and students' science process skills, especially in understanding the basic concepts of physics, which was still classified as very low. In addition, some of the problems that occur are: 1) the teacher only teaches physics in an abstract manner and focuses only on formulas so that students feel physics is difficult to understand; 2) students are not fully involved in the learning process; 3) teachers do not master various kinds of appropriate models, methods, or strategies in the learning process; 4) learning does not link real life problems from students so that students are less motivated; 5) students tend to be passive because they have not been motivated to be pro-active in discussion groups related to the problems faced in accordance with the learning material.

In addition, physics teachers still have not applied, especially models that can develop problem solving abilities or the process of investigating students. Teachers are still more focused on how students are able to understand the material. This makes learning more likely to be the end result (product), not the process by which students acquire knowledge or concepts. Although in essence learning is to shape student knowledge, teachers should also be able to develop learning activities using different models, so that learning does not stick to the learning model that is usually applied every day. Among them are using problem-based learning models and discovery learning, which can train students to develop their own knowledge.

Starting from this problem, the researcher will apply a learning model that involves students to take an active role through the learning process which presents contextual problems related to learning material through a scientific approach. The learning models in scientific learning include discovery learning models and problem-based learning models. The characteristics of these learning models are suitable to support the learning objectives mentioned above where discovery learning will provide opportunities for students to organize a learning process in the form of discovery of previously unknown concepts or principles [4]. In addition, the learning process with discovery learning will emphasize students to construct their own knowledge, unlike direct learning that provides ideas or theories about the world [5]. Meanwhile, on student problem-based learning actively identifies and researches the concepts and principles needed to know and solve problems. In addition, problem-based learning students will make learning more meaningful so that students have high self-confidence and are able to learn independently and increase student motivation to be more active in learning [6].

The syntax of discovery learning model consists of 6 phases, namely explaining objectives, student orientation to problems, formulating hypotheses, carrying out discovery activities, presenting the results of discovery activities, and evaluating discovery activities [7]. Meanwhile in the problem-based learning model the learning phase consists of orientation

to the problem; define problems and organize students to learn; guide independent and group investigations; developing and presenting works; and reflection and assessment.

The purpose of this study was to determine the effect of differences in discovery learning models with scientific approaches on student learning outcomes and science process skills.

II. METHODS

This research was conducted at SMA Negeri 2 Mataram in class X-13 as experimental class I who studied with discovery learning and X-14 as experimental class II who studied with problem-based learning. This research is a quasi-experimental type of quantitative research so that the researcher does not have the flexibility to manipulate the subject [8]. The research design that will be used is a factorial design 2×2 (Figure 1).

TABLE I. THE RESEARCH DESIGN A FACTORIAL DESIGN 2×2

Variable		Independent Variable (B)	
		Science Process Skills (B1)	Understanding Physics Concepts (B2)
Dependent Variable (A)	PBL with a scientific approach (A1)	A ₁ B ₁	A ₁ B ₂
	Discovery learning with a scientific approach (A2)	A ₂ B ₁	A ₂ B ₂

The data obtained in this study were in the form of student science process skills score data in the aspects of observing, clarifying, measuring, asking questions, formulating hypotheses, planning investigations, interpreting information, and communicating [9]. Meanwhile, the data on physics learning outcomes in the cognitive domain consists of 25 multiple choice questions in the cognitive domains C1 to C6 (remembering, understanding, applying, analyzing, evaluating, and creating). Data that were normally distributed and homogeneous for each variable obtained were analyzed using t-test analysis, and further tests with Hotelling's Trace's Manova statistics. The value of the increase in the two measured variables is analyzed based on the mean N-gain score with the following classifications: (1) if the N-gain is $> 70\%$, then the resulting N-gain is in the high category; (2) if $30\% \leq N\text{-gain} \leq 70\%$, then the N-gain generated is in the medium category; and (3) if the N-gain is $< 30\%$, then the resulting N-gain is in the low category.

III. RESULTS AND DISCUSSION

The data obtained in this study came from two classes which were the object of research, namely the experimental class I which consisted of 31 students and the experimental class II which consisted of 34 students. The data collected consisted of data on learning outcomes and student physics science process skills on dynamic electricity material.

The results of the Normality Test using the Liliefors Test show that the value of χ^2_{count} in each class is 1.38 and 8.95

while of χ^2_{table} shows a value of 11.07 with a significant level of 0.05. Based on these data, it shows that χ^2_{count} is smaller than χ^2_{table} so that the two learning outcomes are normally distributed. The homogeneity test results show that the value of F_{count} is 1.33 with F_{table} is 1.76, because the value of F_{count} is smaller than F_{table} so the two data are homogeneous.

Meanwhile, the results of hypothesis testing on the aspects of learning outcomes for the two classes were tested after the two classes were normally distributed and homogeneous. Based on the data above, the hypothesis analysis test in the two classes used the Volled Varias t-test to compare or distinguish whether the two data (variables) are the same or different, so that the t_{count} value is 4.1 with t_{table} is 2, because the value of t_{count} is greater than t_{table} , then the null hypothesis is rejected and the alternative hypothesis is accepted. This shows that there are differences in the effect of discovery learning and problem-based learning models with a scientific approach on student physics learning outcomes. The summary of the value of the hypothesis test of learning outcomes in the two classes is shown in table 2.

The difference in the effect of the two learning models on learning outcomes can also be analyzed using the normal N-Gain test by looking at the increase in the value of the pre-test and post-test results in the two classes with the criteria if the N-Gain value ≥ 70 is categorized as high, $30 \leq \text{N-Gain} \leq 70$ is in the medium category, and $\text{N-Gain} \leq 30$ is in the low category as stated by Hake [10]. Based on the test results, it was found that the percent value of N-Gain for the experimental class I was 50.39 and the experimental class II was 59.27. This shows that the increase in the effect of the problem-based learning model on students' physics learning outcomes is better than the discovery learning model. Complete data on the summary of the N-gain test can be seen in table 3.

While the results of the normality test for science process skills show that of χ^2_{count} in each class is 1.38 and 8.95 while χ^2_{table} shows a value of 11.07. Because of χ^2_{count} is smaller than χ^2_{table} the data for science process skills are normally distributed. The homogeneity test results show that the value of F_{count} is 1.33 with F_{table} is 1.76, so that the of F_{count} value is smaller than F_{table} so the two data are homogeneous.

The results of the hypothesis testing of the science process skills of the two classes showed that the of t_{count} value was 4.1 with the t_{table} , because the of t_{count} value was greater than t_{table} , so the null hypothesis was rejected and the alternative hypothesis was accepted. This shows that there are differences in the effect of discovery learning and problem-based learning models with a scientific approach on students' physics science process skills. The summary of the value of the hypothesis test of learning outcomes in the two classes is shown in table 2.

The result of the N-Gain test for the experimental class I was 57.29 and the experimental class II was 68.06. This shows

that the increase in the effect of the problem-based learning model on students' physics science process skills is better than the discovery learning model. Complete data on the summary of the N-gain test can be seen in table 3.

TABLE II. RESULTS OF HYPOTHESIS TESTING FOR EXPERIMENTAL CLASS I AND II

Class	Data	Average	t_{count}	T_{Table}	summary
Eks I	UC	66.97	4.1	1.99	H_a received
Eks II		74.94			
Eks I	SPS	78.22	5.01	1.99	H_a received
Eks II		10.16			

TABLE III. THE RESULTS OF THE N-GAIN TEST FOR EXPERIMENTAL CLASS I AND II

Class	Data	Pre-test	Post-test	N-Gain	Category
Eks I	UC	31.78	66.97	50.39	middle
Eks II		37.54	74.94	59.27	
Eks I	SPS	30.04	70.16	57.29	middle
Eks II		31.08	78.22	68.06	

If there are only two groups of dependent variables, then you can use Hotelling's Trace's manova test statistics (Rahayu, 2014) so that the value of $F_{\text{count}} = 17.57$ is greater than $F_{\text{table}} = 1.78$. This shows that there are differences in discovery learning and problem-based learning models with a scientific approach to student understanding concepts and physics science process skills. A summary of Hotelling's Trace manova test can be seen in table 4.

TABLE IV. RESULTS OF ANALYSIS OF MANOVA HOTELING'S TRACE TEST

Class	Average Post-Test		F_{Count}	F_{Table}
	SPS	UC		
Eks I	78.22	74.94	17.57	1.78
EksII	70.16	66.97		

A. *The Influence of Differences in Learning Model Discovery Learning and Problem Based with Scientific Approach on Students' Understanding of Physics Concepts*

Before being given the treatment, the two groups were given a pre-test to determine the students' initial abilities and after being given treatment, the two groups were given a post-test to determine the effect of treatment on student learning outcomes. The pre-test mean score for the experimental class I was 31.78 and the experimental class II was 37.54. After the homogeneity test of the pre-test data on the learning outcome data was carried out, it showed that the two classes were homogeneous, this indicates that the experimental class I and the experimental class II had the same initial ability. The post-test average score of the results of learning physics in the experimental class I was 66.97 and the experimental class II was 74.94. Based on these data, it appears that there are significant differences in learning outcomes after being given treatment. To analyze the hypothesis, a hypothesis test was carried out using t-test statistics. The results of the calculation

of the two-sample t-test obtained that the t-test value is greater than the t-table value, namely $4.1 > 1.99$.

This shows that there is a significant difference in the effect between discovery learning and problem-based learning models with the scientific approach on student physics learning outcomes. The increase in better scores for students who learn with problem-based learning models on the results of the N-Gain test of learning outcomes as shown in table 3 shows that the use of problem-based learning models is more effective in improving student physics learning outcomes. This can also be compared to the increase in each sub-material, where in the 5 dynamic electricity sub-materials it shows that the increase in the value of students who learn with problem-based learning models is higher, both in value or category of improvement compared to students who learn with discovery learning. This is because in the first experiment class students fully take part in learning to obtain basic information, concepts, or theories on learning activities before students get reinforcement and deepening of material in subsequent activities in the form of reflection. The results of the calculation of the N-Gain test for students' physics learning outcomes in each sub-material can be seen in table 5 and Figure 1.

TABLE V. COMPARISON OF THE N-GAIN VALUE OF THE CONCEPT UNDERSTANDING OF EXPERIMENT CLASS I AND EXPERIMENT II

Sub Material	Experiment I		Experiment II	
	Values	Category	Values	Category
How to Read and Use Electrical Measuring Instruments	44.74	middle	48.78	middle
Quantities of Electricity and Ohm's Law	38.22	middle	37.44	middle
Kirchoff's I and II laws	95.59	high	97.30	high
Energy and Electrical Power	53.49	middle	85.30	high
Utilization of AC and DC electricity	85.72	high	96.15	high

The graph in figure 1 of the increase in each dynamic electricity sub-subject can be seen as follows.

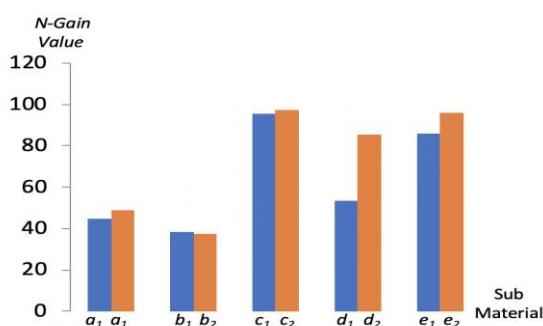


Fig. 1. N-Gain per sub material learning outcomes student physics.

Where:

a₁, a₂ = How to Read and Use Electrical Measuring

Instruments

b₁, b₂ = Quantities of Electricity and Ohm's Law

c₁, c₂ = Kirchhoff's I and II laws

d₁, d₂ = Energy and Electrical Power

e₁, e₂ = Utilization of AC and DC electricity

The post-test mean score of experimental class I, experimental class II, hypothesis test results, and N-Gain test showed that the learning outcomes of students who received lessons with a problem-based learning model with a scientific approach were better than those of students who received learning with discovery learning model with a scientific approach.

In the problem-based learning model students emphasize the ability to think and master the subject matter, where knowledge comes from outside oneself, is given or transferred from others, but is formed and constructed by the individual himself, so that the student is able to develop intellectually. The same thing was also expressed that problem-based learning is not designed to help teachers provide as much information as possible to students, but to help students develop thinking skills, problem solving, and intellectual skills [11]. Therefore, problem-based learning models are able to construct knowledge and develop it based on the experiences they receive in the learning process at school and in everyday life. The problem-based learning model encourages students to try to learn to solve problems by developing the ability to analyze and manage information based on their experiences or new experiences faced by students themselves [12].

The existence of problems in the learning material proposed by the teacher in the learning process is able to give students interest in solving these problems, so that students are more excited and motivated to learn. Through discussion groups in learning, students are free to express their opinions to solve problems, of course after they know the facts that occur during learning activities, especially when doing experiments. So that students will get their own new knowledge in the form of concepts, or laws in the learning material. The involvement of the teacher in reflection activities is able to strengthen various new knowledge obtained by students in learning activities. In the end the student learning outcomes obtained at the end of the learning material can increase.

Learning activities that are quite interesting in problem-based learning are reflection activities. In this section the researcher explains the final opinion (closing statement) of the research activity, plus an explanation of the learning material. In this activity, experimental class students paid close attention to the researcher's explanation regarding the learning material, namely about dynamic electricity. This is due to the interest of students from the beginning of learning to solve simple problems that have been proposed by researchers. The explanation given by the researcher certainly builds students' understanding to relate the concepts that have been obtained from a series of scientific activities both during discussions or investigations.

Compared to the discovery learning model, the active activities of students in learning activities are lower than problem-based learning. This is of course because this learning model requires students to independently discover facts, concepts, and laws in learning activities without first stimulating real problems. In reflection activities students do not follow the researchers' explanation carefully, as a result the understanding of the material for the whole student is classified as less when compared to problem-based learning.

B. The Effect of Differences in Learning Model Discovery Learning and Problem Based with Scientific Approach on Students' Physical Science Process Skills

After the post-test was carried out in the experimental class I and the experimental class II, the average value in each class was 78.22 in the experimental class I and 70.16 in the experimental class II as in table 2. Based on the average value of the results Analysis of science process skills there is a significant difference between the average value of discovery learning and problem-based learning models with a scientific approach to students' science process skills. The results of the t-test calculation in the two research samples show that the t-test value is smaller than the t-table, namely $5.01 > 1.99$. The results of the analysis show that $t_{count} \geq t_{table}$, so H_0 is rejected and H_a is accepted so that there is a difference in the effect of discovery learning and problem-based learning models with a scientific approach on students' science process skills.

Meanwhile, the increase in better scores in students who learn with problem-based learning models on the results of the N-Gain test of science process skills shows that the use of problem-based learning models is more effective in improving students' science process skills. It can also be compared in more detail on the improvement of each indicator of science process skills, in general the overall indicators of science process skills show that the increase in the value of students who learn with problem-based learning models is better than students who learn with discovery learning.

This is because the assessment of the improvement of every aspect of student sian process skills is calculated as a whole sample, so that when compared between the two classes, the increase is better for students who learn with problem-based learning models. Moreover, the students were more active in following each learning step and the experimental procedure in the experimental class I was very influential on this increase, such as the measuring aspect in collecting data and communicating in interpreting data, pictures, including graphics on the questions to describe science process skills. So that the effect of stimulation proposed at the beginning of learning including the student worksheets that has been solved is very influential on the motivation of students in the group to discuss and carry out the process of finding solutions to students' contextual problems. Different things happen to students who learn with the discovery learning model, the different N-Gain scores are significantly smaller because the student's involvement in a series of investigative activities is not fully followed by all students.

The more abstract stimulation of learning made students less motivated in following a series of scientific procedures in the investigative activities of the experiments carried out so that especially in the aspect of measuring and communicating, there was a significant difference in the N-gain value even though the two classes carried out the same experimental activities. Meanwhile, in the classification aspect, it is found that the increase in the average score of the class that learns with the discovery learning model is better in the class that learns with problem-based learning. This is because the questions tested on researchers are quite simple and can be found in the lives of students, each student's initial knowledge of electronic devices that use electricity as an energy source is very influential.

This is not fully obtained from the results of the observations made but the real life of each student, even though the problem posed in the experimental class I is an electronic device that uses AC power. The questions asked by researchers on the aspect of observing can be obtained from the experiences of students in everyday life. The results of the calculation of the N-Gain test for each aspect of science process skills can be seen in table 6 and Figure 2.

TABLE VI. COMPARISON OF N-GAIN VALUE PER INDICATOR SCIENCE PROCESS SKILLS

Aspect	Experiment I		Experiment II	
	Values	Category	Value	Category
Observe	54.54	middle	54.71	middle
Clarify	95.12	Tinggi	65.96	middle
Measure	45.79	middle	96.66	Tinggi
Asking question	66.30	middle	71.42	Tinggi
Formulating Hypotheses	51.85	middle	64.70	middle
Planning an Investigation	86.67	Tinggi	86.37	Tinggi
Interpreting Information	27.55	middle	33.01	middle
Communicate	40.43	middle	80.81	Tinggi

The graph of skill improvement in each aspect is shown in the following figure 2.

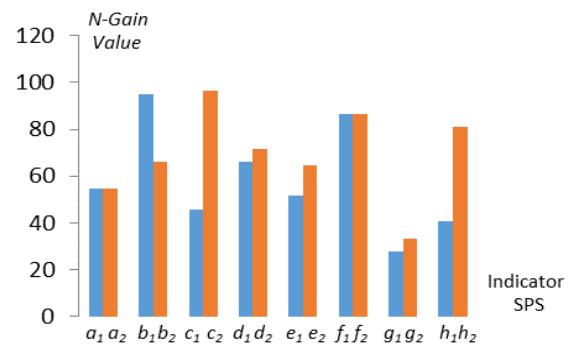


Fig. 2. N-Gain per indicator of student's science process skills.

Where:

a ₁ , a ₁	= Observe
b ₁ , b ₁	= Clarify
c ₁ , c ₁	= Measure
d ₁ , d ₁	= Asking question
e ₁ , e ₁	= Formulating Hypotheses
f ₁ , f ₁	= Planning an Investigation
g ₁ , g ₁	= Interpreting Information
h ₁ , h ₁	= Communicate

The analysis shows that the problem-based learning model with a scientific approach shows an influence on students' science process skills, this is based on the average value of the experimental class I which is categorized as good. Based on research that has been done previously, it shows something similar to the results of this study, such as research conducted, showing that problem-based learning models affect students' science process skills. Contextual problems that occur in students' daily lives make students trained to formulate problems and find solutions to problem solving, in contrast to learning with discovery learning models that pose problems without providing real stimulation to student life [13], [14].

The problem-based learning model with a scientific approach that is treated in the experimental class I aims to train students to work in group discussions to solve problems related to students' daily lives, especially those related to dynamic electrical material. The training of students to discuss and think to solve a problem will form students who have the ability to connect a problem-solving concept with the learning material being taught.

Besides, students will know the theoretical basis of learning materials by discussing when solving a problem that is relevant to the lives of students. The problem-based learning model with the scientific approach accommodates students to be active in discussing solving the problems posed so that students gain knowledge through a series of scientific procedures carried out. Problem-based learning is constructivism learning that engages students in learning and is involved in contextual problem solving [15].

In the problem-based learning model with a scientific approach, students are guided by an experimental activity sheet to investigate and solve a problem in the learning material. With a series of scientific activities, students analyze the facts of an incident through investigative activities. Starting from students understanding the problem being confronted, analyzing the problem, making problem formulations, so that from the problem formulation students make hypotheses based on the formulation of the problems compiled, then students carry out observational activities, analyze the observed data, make conclusions, and finally communicate the results of the observations. The series of scientific activities can help students in general understanding of the learning material. This can be firmly attached to either the concept, theory or the origin of the formula being studied. This will certainly provide an interesting experience for students, especially if the concepts that have been learned through problem solving activities are

asked through questions in evaluation activities or learning outcomes tests.

Compared to the discovery learning model, the students' science process skills were seen to be lower. This is because in this learning model, it focuses on independent discovery in students without any stimulation that encourages students to want to think. As a result, not all students want to be involved in the discovery activities to be carried out. In fact, to achieve learning objectives, learning activities require student activeness in each series of learning, especially in terms of group discussions.

This group discussion activity is certainly an important part of the discovery learning model for students to exchange ideas and solutions for what has been done in investigative activities. As a result, only some students fully understand the learning material that has been delivered even though at the end of the activity the researcher explains learning material related to the investigative activities that have been carried out. This will be different if students fully follow step by step in the discovery activities that have been carried out, so that the understanding of the learning material obtained through a series of scientific activities is strongly embedded, coupled with a final explanation.

C. The Effect of Differences in Learning Model Discovery Learning and Problem Based with Scientific Approach on Students' Understanding of the Concept and Process of Physics Science Process Skills

In this section there is a discussion of the different effects of the two learning models together on science process skills and learning outcomes. This is done to determine the differences together in the dependent variable of the study. Based on the test analysis used is the Hotelling's Trace test statistic, it is found that F_{count} is greater than F_{Table} as in table 4, so that with these criteria it is found that together there are differences in the effect of discovery learning and problem-based learning models with scientific approaches on science process skills. and student physics learning outcomes.

This difference is due to a relationship in the final result data both on science process skills data and on student physics learning outcomes. Facts, concepts, or theories obtained by students in learning activities in each phase assist students in applying these theories in the final evaluation. In experimental activities in the form of investigation and data collection, students gain concrete learning experiences so that the facts or concepts obtained are firmly embedded. An example is the fact that the amount of voltage affects the amount of current flowing in the circuit. These facts become new knowledge for students to understand the material being studied, and reflection activities at the end of learning are able to provide reinforcement for students regarding the theories or facts obtained.

The comparison of the differences in the effect of the two learning models on science process skills and learning

outcomes shows that the problem-based learning model is better than the discovery learning model. This is influenced by how the learning process of the two classes takes place where students who learn with problem-based learning models as a whole follow the learning carefully, follow problem-solving procedures well, actively discuss in groups so that the theory or facts obtained by students are understood as a whole. The activeness of students with problem-based learning models gives different results due to problems that are raised then students deepen their knowledge of what is known and what needs to be known to solve problems [16].

Meanwhile, only a small proportion of students who learn with discovery learning models are motivated by the stimulation and learning process in finding new theories in investigative activities. This affects the ability of students to understand learning material and further explanation in reflection activities. Differences in understanding between the two classes affect the final test results both on science process skills and student learning outcomes. As a result, in both aspects, students who learn with problem-based learning models are better than students who learn with discovery learning models.

IV. CONCLUSIONS

Based on the research results, it was found that the effect of learning with a problem-based model was better for student learning outcomes and science process skills. The percentage of the N-Gain value shows that the increase in student learning outcomes and science process skills is higher in students who learn using a problem-based learning model with a scientific approach. The problem-based learning model provides motivation to students to find solutions to real problems in student life so that it becomes an active role in the learning process. Meanwhile, stimulation that is still abstract to be investigated in the discovery learning model is a factor that needs to be considered in the use of this model in learning so that it takes mental storage for students to start new learning. Thus, the problem-based learning model can be a solution to improve student learning outcomes and science process skills in dynamic electrical material. It is advisable for teachers or further research to try this learning model for further research on different materials.

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