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the Effect of Implementing a Case Study-Based Problem Based Learning Model on Student Learning Outcomes at SMAN 2 Pulau Punjung

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ABSTRACT

This research was motivated by the low physics learning outcomes of students at SMA Negeri 2 Pulau Punjung. This is because in the learning process the teacher has not used a learning model that suits the characteristics of the material so that students are passive in following the learning process. The solution used to motivate and activate student learning in a pleasant learning atmosphere is to apply a case study-based problem based learning model. The type of research carried out was a quasi-experiment using a Randomized Possttest Only Control Group Design with sampling carried out using a census sampling technique (saturated sampling). Based on the results of the research and discussions that have been carried out, it can be concluded that there are differences in good physics learning outcomes for students in class done. From the conclusions above, we can obtain a significant difference in the use of a problem based learning model based on case studies on the physics learning outcomes of class XI Phase F students at SMA Negeri 2 Pulau Punjung for the 2023/2024 academic year.

Keywords: *Case Studies; Problem Based Learning Models; Physics Learning Outcomes*

I. INTRODUCTION

Education is an institution that is capable of giving birth to generations capable of developing science and technology through various learning activities. The learning process can help someone understand the skills they have and develop them according to the needs of the times. Therefore, education is not a choice in life but a need that must be met[1].

The government continues to strive to improve the quality of education, including expanding the existing curriculum. According to Law Number 20 of 2003, the curriculum is a series of plans and rules relating to objectives, content, teaching materials and methods used as guidelines for implementing learning to achieve national education goals [2]. The presence of the independent curriculum is an effort to improve the quality of education in Indonesia in accordance with the needs of the times. In the independent curriculum, you are not just trained to be smart. However, it also has characteristics that are in accordance with Pancasila values or what is called a Pancasila student profile. The Pancasila student profile describes Indonesian students as lifelong learners who are fully capable and act in accordance with Pancasila values, with six main characteristics: (1) Faith, devotion to God Almighty, and noble character (2) global diversity, (3) working together, (4) independently, (5) thinking critically, and (6) creatively.

Learning is a process of teaching and learning activities which also plays an important role in the success of student learning. During the learning process, interactive activities take place between teachers and students to further achieve goals. In learning, students must play an active role in mastering the material and understanding how to apply it in life so that learning is more meaningful. The real goal of learning is to acquire knowledge by developing students' intellectual abilities, stimulating their curiosity, and improving their skills [3].

One of the subjects in the learning process is physics. Physics is a science that studies natural phenomena and their contents [4]. Almost all human activities involve physics [5]. The aim of learning physics is to provide students with experiences that develop new knowledge, so that students can study and understand nature scientifically [6].The development of this knowledge can be achieved directly through research, using existing scientific facts, innovations, principles, theories and methods[7].

Therefore, in learning physics, students do not just know and remember but must also be able to learn how to do, understand concepts and make connections between one concept and other concepts so that a good discovery process is created[8]. According to Koes in Erlinawati et al.(2019), one of the keys to learning physics is that learning activities must make students actively interact with concrete objects. Considering the importance of learning physics, effective and interesting learning activities are needed to achieve the expected learning objectives. Learning activities that actively involve students not only make the material easier to understand but also improve student learning. Direct interaction with concrete objects allows students to connect theory with practice, thereby increasing understanding of physics concepts. In addition, fun and interactive learning can increase student motivation, which ultimately contributes to better learning outcomes [9].

One of the physics concepts with low learning outcomes is temperature and heat. This is supported by Ida Farida's research. (2016) which shows that the average student achievement in high temperature material is still below the minimum completeness criteria (KKM). This concept is one that we often encounter in everyday life. However, many students find this concept difficult because there are many mathematical equations that require a lot of analytical skills. The concepts of temperature and heat are related concepts with overlapping interpretations. This is considered relevant because to understand the concept of temperature and heat you have to study the concept of temperature first. Meanwhile, the meanings are said to overlap because the meaning of heat can be different to explain several sub-concepts related to temperature and heat. This concept is also important for learning other concepts. Based on these problems, it is necessary to build a learning model to train students to build knowledge based on experience studying the concepts of temperature and heat so that their learning outcomes increase. The learning model applied in this research is problem-based learning (PBL)[10].

The reality in the field shows that the learning outcomes obtained by students are still not optimal. This condition can be seen from the results of the final assessment of the second semester of physics at SMAN 2 Pulau Punjung, with details of the average physics score for each class in Table 1.

Table 1. Average Final Assessment Score for Semester 2 at SMAN 2 Pulau Punjung

Class	Averagescores Student
XI Phase F1	72,3
XI Phase F2	74

Source: (Physics teacher at SMAN 2 Pulau Punjung, 2022)

Student learning outcomes are classified as low because the average final assessment score for semester 2 in physics subjects is lower than the KKTP (Criteria for achieving learning objectives) set by the relevant school of 80. This is because in the learning process, the teacher has not used a learning model that suits the characteristics of the learning material, causing students to be passive in following the learning process.

To overcome these problems, teachers must be able to use learning models that are adapted to student characteristics, available equipment, subject characteristics, etc. during learning. One of the most important things in learning physics is that students have the opportunity to work with concrete objects. Case study-based learning requires students to apply the concepts learned in a clear and meaningful context. This process not only helps students better understand the material, but also develops critical and analytical thinking skills. By analyzing and solving case problems, students can see how physics concepts are applied to real-world situations. Case studies also allow students to work in groups, encouraging collaboration and communication[11]. This situation presents a challenge for teachers to choose the right learning model to facilitate student learning and present physical material to students in a way that is interesting and easy to understand. The solution to the problem above is that to improve student learning outcomes, efforts need to be made to improve physics learning through the application of case studies based on a problem-based learning model that is suitable for physics education [12].

High student learning outcomes can be achieved through combining this case study-based PBL model, because students not only master theoretical physics concepts, but are also able to apply them in real contexts. Thus, the use of this method not only prepares students to face challenges in the real world, but also strengthens their understanding of the learning material.

II. METHOD

The research method used was quasi-experimental. The design used in this research was only a randomized control group design. This design has two groups: an experimental group and a post-test control group. Researchers conducted this research using a two-branch design, where one class, namely the experimental group, received learning treatment using the problem-based learning (PBL) model. Meanwhile, the control class was carried out without treatment. Briefly, the research design can be seen in Table 4 below[12].

Table 2. Research Design

Group	Treatment	Posttest
Experiment	X	T
Kontrol Control	-	T

Information :

X: The treatment given to the experimental class is the influence of the problem based learning model based on case studies.

T: Final test given to the experimental class and control class.

The population of this study were all students in class XI Phase F of the Physics program at SMAN 1 Pulau Punjung, totaling two classes, totaling 60 students. Table 3 shows the number of students in each class.

Table 3. Number of students in class XI Phase F of SMAN 2 Pulau Punjung

Class	The number of students
F phase 1	30
F phase 2	30
Amount	60

(Source: Educators at SMAN 2 Pulau Punjung)

The experimental and control classes were determined by using one coin worth 500 rupiah using census sampling techniques (saturated sampling). The research sample was divided into class XI phase F 1, totaling 30 people and class XI phase F 2, totaling 30 people based on the number of classes. One way to model a class is to look at the previous learning outcomes of students and the entire population. Taking the experimental class and the control class refers to the average value of student learning outcomes which is almost the same. Previously, analysis of the two classes was also carried out by carrying out normality tests, homogeneity tests and hypothesis tests for the two sample classes and it was found that both classes had the same average student learning outcomes in the cognitive aspect, namely 64.

The independent variable in this research is a problem based learning model based on case studies. The dependent variable in this research is the Physics learning results for class XI Phase F at SMAN 2 Pulau Punjung on temperature and heat. The data used is primary data, namely data collected directly from samples in the form of students' physics learning outcomes after using a case study-based problem based learning model.

The instrument in this research is a test consisting of multiple choice physics questions. This test is in the form of a series of questions that are used to measure the learning outcomes of the students' knowledge aspects. This test consists of physics questions in the form of multiple choices with cognitive levels C1 to C6. 20 These questions are given in the form of a posttest after the treatment is applied. The skills aspect uses a psychomotor assessment format that has been designed by researchers. Before collecting data, the questions were first tested for validity, reliability, distinguishing power and level of difficulty on other objects outside the predetermined population, namely class XI Phase F students at SMA Negeri 2 Pulau Punjung for the 2023/2024 academic year. The instrument has valid $t_{count} > t_{table}$, sufficient differentiating power, moderate difficulty index, and reliability level of 0.60-1.00 (medium to very high criteria).

This research uses a data collection technique in the form of a posttest which is used to determine the final cognitive learning outcomes of students after carrying out treatment for the experimental class and control class. Meanwhile, to determine psychomotor learning outcomes using a psychomotor assessment format that has been designed by researchers. Data analysis techniques include normality tests, homogeneity tests and hypothesis tests. Data Analysis on Psychomotor Aspects takes the form of analysis of observation sheets as an assessment tool that is widely used to measure individual behavior or the process of an activity that can be observed, both in actual situations and in artificial situations which are collected and will be analyzed further.

III. RESULTS AND DISCUSSION

Cognitive Aspect Learning Outcomes

The research was carried out by researchers from January 8 2024 to January 27 2024 at SMA Negeri 2 Pulau Punjung.This researcher used two classes as samples, namely class XI Phase F1 as the experimental class which was given treatment using a case study-based PBL model while class The implementation of this research was carried out for approximately 3 weeks, where one week consisted of two meetings in each class with an allocation of 2 x 45 minutes. The following describes the implementation of the Problem Based Learning model based on case studies during the learning process.

1. Description of Cognitive Physics Learning Results Data

Table 4. Average Value, Highest Value, Lowest Value, and Sample Class Variance

Class	Mark		N	$\bar{X}$	S^2
	Xmaks	Xmin			
Eksperiment	90	65	30	83	134.74
Control	90	60	30	74	153.85

There are differences in the average learning outcomes of experimental class and control class students. The average knowledge score of students in classes that apply the case study-based PBL learning model is higher than classes that apply the learning model implemented in school.

2. Analysis of Physics Learning Results Data Aspects of Knowledge

Data analysis was carried out to determine the improvement in physics learning outcomes of class The application of the problem based learning model based on case studies can be seen statistically. Hypothesis testing is a test of the equality of two averages from two sample classes which previously carried out a normality test and a homogeneity test.

Normality test

The normality test was carried out to determine whether the test data on student learning outcomes in the two experimental classes was normally distributed. The results of the normality test carried out showed that the Lh and Lt values were at a real level (α) of 0.05 for N = 30 as shown in Table 5

Table 5. Normality Test Calculation Results Final Test Sample Class Knowledge Aspects

Class	A	N	L_h	L_t	Information
Eksperiment	0.05	30	0.793	0.161	Normal
Control		30	0.127	0.161	Normal

Table 5 shows that both sample classes have a value of Lh < Lt at a significance level of 0.05, meaning that the final test result data for the two sample classes is normally distributed.

Uji Homogenitas

The homogeneity test was carried out to see whether the two experimental classes had homogeneous data variance. The homogeneity test carried out is the F test. The homogeneity test was calculated on both samples and obtained results as shown in Table 6.

Table 6. Homogenitas test

Class	A	N	S^2	F_h	F_t	Information
Eksperiment	0.05	30	560.647	1.21	1.80	Homogen
Control		30	404.414	1.06	1.80	

The results of the homogeneity of variance test carried out on the final test data for the two sample classes turned out to be Fcount = 1.21 and Ftable with a significance level of 0.05 at dk in the numerator of 30 and dk in the denominator of 30 which was 1.80. The results show Fh < Ft, this means that the data from both sample classes have homogeneous variance.

Uji Hipotesis

Prerequisite tests, namely normality and homogeneity tests, have been carried out and show that the data in the class uses the learning model PBL based on case studies and classes that use learning models implemented in schools is normally distributed and has homogeneous variance. If the data is proven to be normal and homogeneous, then a hypothesis test is carried out which aims to prove the truth or answer the hypothesis proposed in the research. The t test results for the two sample classes can be seen in Table 7.

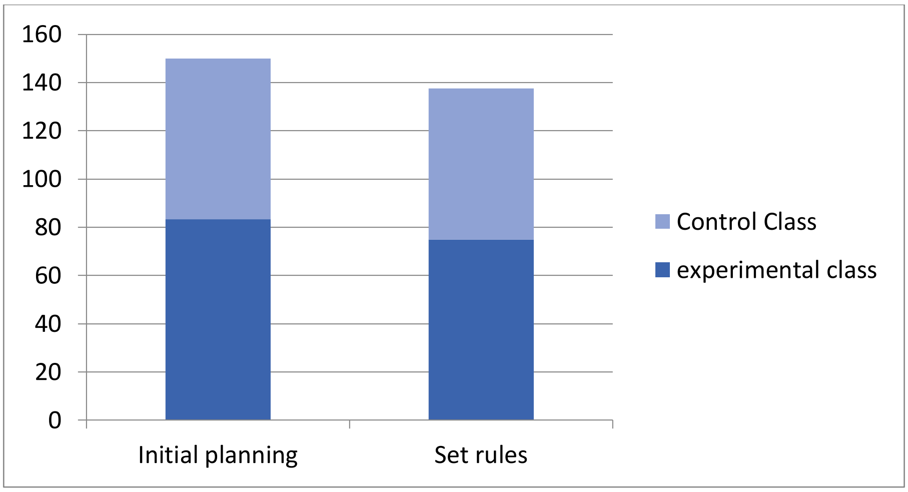
Table 7. Hipotesis test

Class	1-α	N	$\bar{X}$	S^2	t_h	t_t
Eksperiment	0.95	30	83	134.74	1.792	1.667
Control		30	74	153.85		

In table 7 it can be seen that th = 1.792 while tt = 1.667 with the test criteria H0 is accepted if th < tt and H0 is rejected if it has another value at a significant level of 0.05 with degrees of freedom dk = (n1 + n2) – 2. Because the t value is not is in the area of acceptance of H0. It can be concluded that H1 is accepted at a significance level of 0.05. Based on statistical analysis carried out on data from the two sample classes, it can be seen that there is a significant positive difference in the application of the case study-based PBL model in the knowledge aspect.

Psychomotor Aspect Learning Outcomes

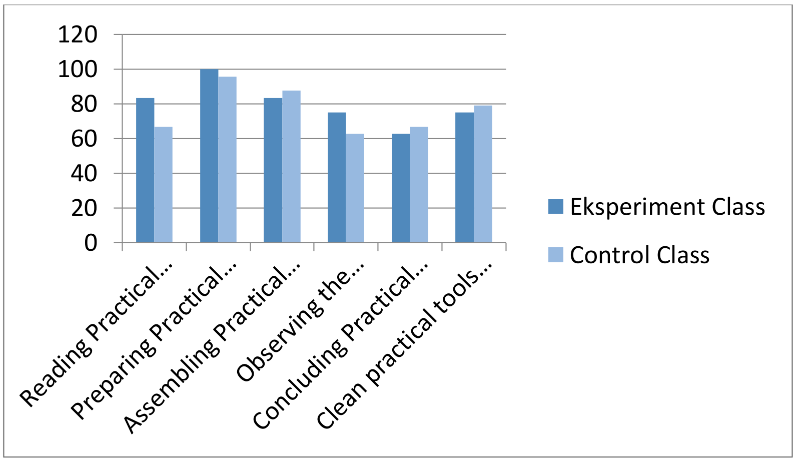
Observation results of the Moving Aspect



Graph 1 Observation results of the Moving Aspect

The graph it shows that students' psychomotor abilities, the sub-aspect of setting learning rules, shows that students' abilities are 75%. The average percentage of both sub-aspects describes the percentage of moving aspects during the learning process of 79.1%. Class XI Phase F1 on the moving aspect during practical activities. The initial planning sub-aspect shows that students' abilities are 83.3%. Meanwhile, in the table above, the percentage of psychomotor abilities of class XI Phase F2 students in the moving aspect during practical activities takes place. In the sub-aspect of initial planning, the student's ability was 66.6%. Meanwhile, the sub-aspect of setting regulations shows that students' abilities are 62.5%. Then the average percentage obtained from the existing sub-aspects depicts the percentage of moving aspects during the learning process of 64.5%.

Observation results of the Manipulating Aspect

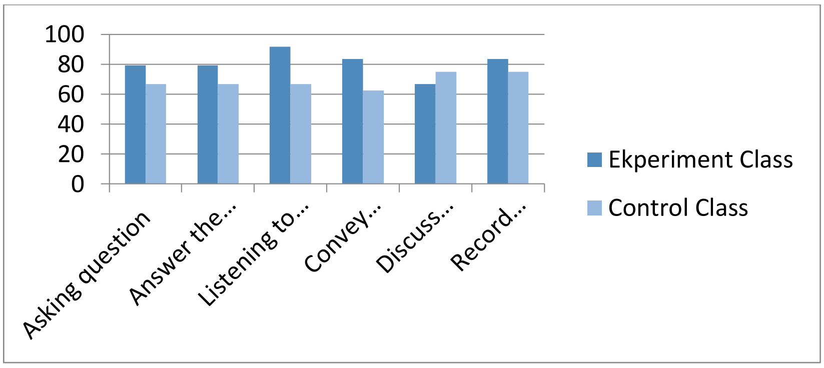


Graph 2 Observation results of the Manipulating Aspect

The graph shows the psychomotor abilities of class XI Phase F1 students in the manipulation aspect during practical learning activities.In the sub-aspect of reading practical steps, the student's ability is 83.3%. In the sub-aspect of preparing practical materials, the student's ability is 100.0%. In the sub-aspect of observing experiments, the student's ability is 75%, in the sub-aspect, concluding the practicum results show the student's ability is 62.5%. The average percentage of existing sub-aspects describes the percentage of manipulating aspects during the learning process of 81.5%.

Based on the table above, it shows that the psychomotor abilities of class XI Phase F2 students are in the Manipulating aspect during practical activities. In the sub-aspect of reading practical steps and concluding the results of the practicum, the student's ability is 66.6%. In the sub-aspect of preparing practical materials, the student's ability is 95.6%. In the sub-aspect of assembling practical equipment, the student's ability is 87. 5%, in the sub-aspect of observing experiments, the student's ability was 62.5%, in the sub-aspect of cleaning tools and practical materials, the student's ability was 79.1%, meanwhile. The average percentage that describes the percentage of manipulating aspects during the learning process is 79.1%.

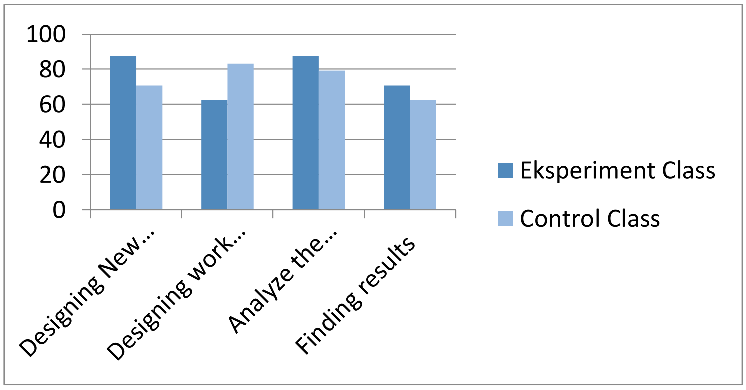
Observation results of the Communicating Aspect



Graph 3 Observation results of the Communicating Aspect

The graph you can see the psychomotor abilities of class XI Phase F1 students in the communication aspect during practicum activities.The sub-aspect of asking questions and answering questions shows that students' psychomotor abilities are 79.1%. In the sub-aspect of listening to other people's opinions, the student's ability was 91.6%. In the sub-aspect of conveying ideas, the students' ability was 83.3%. In the sub-aspect of discussing data/problems, students' ability was 66.6%. In the sub-aspect of recording data/information, the student's ability is 83.3%. Meanwhile, in the sub-aspect, adding the results of the practicum conclusions shows that the student's ability is 100.0%. The average percentage of existing sub-aspects describes the percentage of communicating aspects during the learning process of 83.2%. Based on the results of the data above, it shows that the psychomotor abilities of class XI Phase F2 students are in the aspect of communicating during practical activities. In the sub-aspect of asking questions, answering questions, listening to other people's opinions and adding results, the student's ability is 66.6%, in the sub-aspect of conveying ideas, the student's ability is 62.5, while in the sub-aspect of discussing data/problems and taking notes The data shows that the remaining ability is 75. The average percentage shows that the percentage of communicating aspects during the learning process is 68.4%.

Results of observations of the Creating Aspect (Creativity).

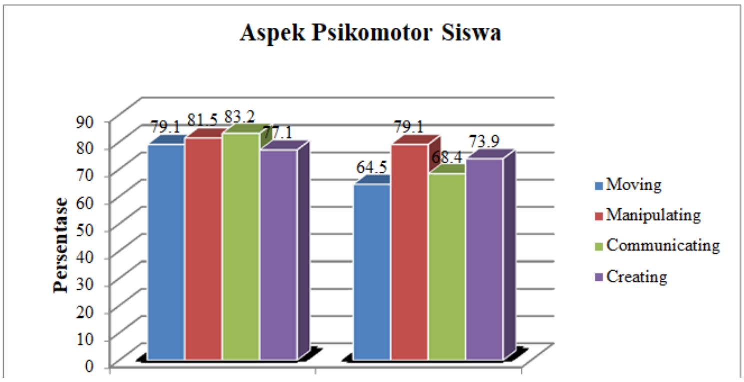


Graph 4 Observation results of the Creating Aspect

Based on the data in graph 4, it shows that the psychomotor abilities of class XI Phase F1 students are in the creating aspect during the practicum activities. In the sub-aspect of designing new work and analyzing problems, the student's ability was 87.5%. In the sub-aspect of designing work steps, students' ability was 62.5%. Meanwhile, in the sub-aspect, the results showed an ability of 70.8%. The average percentage of existing sub-aspects describes the percentage of creating aspects during the learning process of 77.1%.

Based on the table above, it shows that the psychomotor abilities of class XI Phase F2 students are in the creating aspect during practical activities. In the sub-aspect of designing new work, the student's ability was 70.8%. In the sub-aspect of designing work steps, the student's ability was 83.3%. In the sub-aspect of analyzing the problem, it shows that the student's ability is 79.1% and in the sub-aspect, finding the results shows that the student's ability is 62.5%.

Results of the Average Percentage Difference between Class XI Phase F1 Students and Class XI Phase F2 Students



Class XI Phase F1 Class XI Phase F2

Graph 5 of Psychomotor Aspects of Students During the Practical Observation Process

Discussion

The research was conducted at SMA Negeri 2 Pulau Punjung, namely class XI Phase F and Phase F2. The experimental class uses a case study-based PBL model. In the experimental class the learning process uses the PBL model with LKPD given at each meeting. When filling in the LKPD, students seemed confused because they had never been given LKPD using the PBL model before. This caused many students to ask questions, this made the researcher feel overwhelmed in dealing with the situation. However, the researcher can overcome this by providing further instructions or explanations about the steps in filling out the LKPD, then the researcher gives them time to have a discussion with their respective group friends. If there are still questions, the researcher will investigate each group and help direct them so that gradually the students can understand them well. The LKPD helps students to discover a new concept to solve a problem. Where in the LKPD there are stages that help students to solve a problem so that it can improve student learning outcomes.[13]

When students had a group discussion and then continued with a presentation in front of the class, at first it seemed like the students were embarrassed and not used to it because usually the teacher directly informed or explained the learning material in front of the class, so this caused students to be less active in conducting group discussions. In this case, the researcher tries to make all students actively involved in group discussions by providing opportunities for each student in turn to express their own opinions from the results of the previous group discussion. Then the researcher will give a reward by adding 1 point to students who are involved in the discussion, so that students will be motivated to be more involved in the discussion. As time went by there was an increase in each meeting. The next meeting, students were getting used to the application of the case study-based PBL model, where this model requires students to be actively involved in the learning process. Students have begun to be able to discuss in their respective groups and begin to respond and provide conclusions on learning at each meeting. So that learning becomes more meaningful.[14]

This assessment includes physics learning outcomes in the knowledge aspect and skills aspect. The assessment of physics learning outcomes in the knowledge aspect is carried out by conducting a posttest. The questions given were tested first in a class that was not the sample class and a normality test, reliability test, differential power and level of difficulty were carried out, resulting in 20 questions that would be used for the posttest questions for the two sample classes.

The research results stated that the analysis of the posttest results contained differences. Based on the results of the analysis, it shows that the average score of students in the experimental class is higher than the control class. Where the experimental class itself uses a case study-based PBL model so that students' interest in learning increases and has an impact on student learning outcomes and fosters critical ideas to solve problems during learning. If we review the students' scores on the diagnostic test scores at the beginning of learning, there is an increase in the average in the two sample classes when compared with the initial sample data, indicating that students' motivation to learn has begun to grow. This is in accordance with research by Paradina et al (2019), who stated in their research that there is an influence of learning using the PBL model on students' physics learning outcomes.[15]

This is because after being treated with the case study-based PBL learning model, students understand the subject matter and students play an active role in the learning process. Apart from that, it can foster students' curiosity about physics lessons with the topic of Temperature and Heat. This is in accordance with research by Agusmin et al (2018) which states that learning using the PBL model can improve learning outcomes, learning motivation and student learning activities. According to Hasanah et al (2021), when implementing the PBL learning model, students are faced with problems that commonly occur in life which must be solved by discussing in groups consisting of seven to eight members. Then, to draw conclusions from the results of the discussion, each group summarizes the results of the discussion and presents it to the class.[16]

Students are interested in the activities that take place during the learning process. The problem set by the teacher asks students to solve the problem. Students and their groups want to succeed in solving the problems presented by the teacher, so they try to solve them as hard as they can. According to Hassana et al. (2021), this learning presents students with real-world problems that can be solved through collaboration between groups and allows them to learn at their own pace. This kind of learning process requires students to play an active role in learning activities that are not only teacher-centered, thereby improving student learning outcomes on the topics presented[17].

From the discussion above, it can be seen that the case study-based PBL model has a greater impact on the development of student learning outcomes regarding temperature and heat material compared to using the learning model used in schools. Learning in the experimental class with the PBL learning model is more fun because it involves group work and exploration. Differences in student physics learning outcomes arise from differences in control and experimental class treatment.[18]

One of the obstacles faced by researchers in this research was that when carrying out experiments it was difficult to control time and all student activities because students felt interested and curious about the experimental equipment that would be used[19]. To overcome this, during experimental activities, efforts are made to supervise students closely, so that the time for carrying out experiments can be used effectively and efficiently. [20]

The second obstacle is that when conducting an experiment it is carried out in class so it takes time to prepare the experimental equipment, learning also takes quite a long time, when group learning is not carried out optimally because there are still students who do not participate enough in groups. To overcome this, During experimental activities, efforts are made to supervise students closely, so that the time for carrying out experiments can be used effectively.[21]

IV. CONCLUSION

Based on the results of the research and discussions that have been carried out, it can be concluded that there are differences in good physics learning outcomes for students in class done. From the conclusions above, we can obtain a significant difference in the use of a problem based learning model based on case studies on the physics learning outcomes of class XI Phase F students at SMA Negeri 2 Pulau Punjung for the 2023/2024 academic year.

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