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Article

Application of Problem Based Learning Model to Student Learning Outcomes on Heat Material and Its Transfer

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ABSTRACT

Students preparation to compete in 4.0 era based on curriculum implementation make it the teachers job to help students develop their problem solving skills, analytical process and critical thinking skills. It was necessary to have a supportive learning model, which is by choosing a problem based learning model. This article research used a problem based learning model in heat material and its transfer. The aim was to determine the implementation of learning, student learning outcomes and student responses after attending this lesson on heat material and its transfer. Types of research was a quasi-experimental research design, which is by one group pretest-postest design for 14 students of seventh grade junior high school. Research instruments used in this study was implementation observation sheets, pretest posttest and response questionnaire. The data analysis technique used in this study was observation sheet on the implementation of learning, n-gain and student response in questioning. The research results showed that the n-gain value was in high category, meaning there was a difference between pretest and postest scores and improved student learning outcomes.

INTRODUCTION

Natural Sciences (IPA) is the same as learning discovery. Learning science is the same as learning to find out (inquiry) about nature and its entirety, students themselves must be active in order to build the knowledge they have so that learning becomes meaningful. The essence of science is the meaning of various natural phenomena that produce a theory through a scientific process, from this theory, inspiration is obtained to create technology for benefit in society (Mariana & Praginda, 2009). Students preparation to compete in 4.0 era based on curriculum implementation make it the teachers job to help students develop their problem

solving skills, analytical process and critical thinking skills (Kunanti, 2020). The problem solving skills acquired by students are new experiences that are useful as a solution to each problem. Supporting aspects such as critical thinking skills that make the development of problem-solving skills important for teachers to carry out during learning (Hidayatulloh et al., 2020).

The condition in the field behind the holding of this research because many student in the intended school as learning experience delays in good problem solving methods, lack of confidence in discussing and weakness in the problem analysis process. Therefore, it is necessary to have a learning model that supports achieving quality science learning outcomes, one of which is by choosing the Problem Based Learning (PBL) model. Assessment is a way to measure the level of knowledge, skills and attitudes that have been achieved by students which here is the result of learning science (Kuswanto, 2008).

This research is carried out in the learning process, the process of teaching and learning activities and when learning is a determinant of student learning success. Through this learning, there is a beneficial interaction between teachers and students, and contains educational elements to achieve learning targets on that day. Classroom learning between teachers and students must be complete, because it can support the final grade in students (Ratnasari & Masruhin, 2019). Learning is essentially a process, where the process of organizing and providing guidance to learners to encourage them to be willing to learn. The learning process can be interpreted as the transfer of knowledge between teachers to students and clearly the purpose, with this interaction the appropriate learning process is produced. According to the Law of the Republic of Indonesia Number 20 of 2003 challenges the National Education System, that learning is the process of interaction of educators with students and learning resources that take place in a learning environment. The learning process is characterized by the presence of educational interactions that occur, that is, interactions that are aware of goals. This interaction is rooted in teachers and pedagogical learning activities in students, processing systematically through the stages of design, implementation, and evaluation (Pane & Dasopang, 2017).

Learning in the classroom there is a learning process that occurs between students and teacher guidance, learning the essence of the process experienced by a learner with the final result in the form of changes in a person. Learning is a process that can change a person's performance in the skills of abilities, perceptions, emotions, thought processes for the better. Learning in students is defined as the impact of the interaction between stimulus and brain response (Sihombing, 2018). Learning can be said to be a mental process that is formed in the individual until a change in behavior is produced. Learning as the process of an individual changing himself because of an experience gained, what is seen is a change of self and a change in attitudes that are different before the learning process (Sumarni, 2019).

Student learning outcomes are the focus achieved in this study, according to (Dakhi, 2020) learning outcomes are the same as student achievement in academic terms either through assignments, activity or participation. Indicators of student learning outcomes can be known from the absorption of students and it will be seen which students understand. Learning outcomes are the abilities obtained by students through learning activities both in educational institutions and are determined in the form of numbers to find out the absorption of students after receiving learning materials (Muflihah, 2021). Learning outcomes are changes in students' abilities due to learning experiences and can be known through daily test scores and final grades. Good learning outcomes are certainly supported by success factors, these factors include parents and families of students (Karmatang et al., 2021).

The PBL model begins with a real-life problem and students have the opportunity to choose or do any investigation to solve the problem (Prasetyo, 2019). As educators who can choose the PBL model during learning, students can feel the benefits because the problems

provided by the teacher are encountered in real life, so that students will be automatically motivated to follow the learning to the end (Robiyanto, 2021). The learning model applied in this study, namely PBL on the heat material and its displacement. The PBL learning model is learning that focuses on problem solving, students actively seek answers to problems whose problems come from the teacher.

The advantages of the PBL Learning Model are:

1. Problem solving in PBL is good enough to understand the content of the lesson, problem solving takes place during the learning process challenging the abilities of the students as well as providing satisfaction to the students.
2. PBL can increase learning activities, help the student transfer process to understand problems in daily life, help students develop their knowledge and help students to take responsibility for their own learning, help students to understand the nature of learning as a way of thinking, not just understanding learning by teachers based on textbooks.
3. PBL creates a learning environment that is fun and favored by students, allows application in the real world, stimulates students to learn continuously.

Disadvantages of the PBL Learning Model, namely:

1. If the student experiences failure or lacks confidence with low interest, the student is reluctant to try again.
2. PBL requires sufficient time for preparation, a lack of understanding of why the problems are solved then students are less motivated to learn (Yulianti & Gunawan, 2019).

The purpose of this study is to describe the implementation of learning, student learning outcomes and student responses after being given learning with the PBL model on heat material and its transfer. The benefit of this research for the intended school is that it can make progress in aspects of student learning outcomes and make the school's academic integrity increase because the graduates are getting better. The benefit of this research is for students, that is, students can have good problem-solving abilities. It is hoped that students who have participated in this learning can evaluate the learning outcomes on each material obtained, because it will affect the report card score.

METHODS

This study uses a quasi-experimental type of research with a one-group pretest postest design research design, according to (Hastjarjo, 2019) quasi-experimental design is a non-randomized design. The number of population is scrimpy by using only one class for experimental research, with 9 male students and 5 female students. The sample used in this study was as many as 14 students, because at the time when the data was taken at the intended school the learning was not 100% face-to-face after the condition of the Covid-19 pandemic hit some time ago. Learning at the school still uses a system of 50% of students who attend face-to-face and be rolled in the next week. The selection of samples in this study was purposive sampling, the participants selected from the school because of their affordable location and learning outcomes on the calorific material and its displacement were categorized as low. The beginning of learning is distributed pretest sheets to find out the basic abilities that each student has before being given treatment. In this study, the validation instruments used include the Student Worksheet (LKPD) validation sheet, Implementation Plan (RPP) validation sheet, student learning outcomes instrument validation sheet and student response questionnaire validation instruments which is signed by the science teacher at the school where the learning is being carried out.

Data collection techniques on the implementation of learning with the PBL model on heat material and its transfer using observation. Data collection techniques on student learning outcomes after being given a test in the form of pretest and posttest with PBL learning model on heat material and its transfer using tests. Data collection techniques on student responses after participating in learning with the PBL model on heat material and its transfer using questionnaires. The reason for using the response questionnaire is because the instruments used can find out how students respond after participating in learning.

An instrument to determine the implementation of learning with the PBL model on the heat material and its transfer, namely using an implementation observation sheet. The instruments used after being given learning with the PBL model on the heat material and its displacement, namely using pretest and posttest. The reason for using pretest and postest is because the instruments used are indicators achieved in this study in the form of student learning outcomes. The instrument used to determine the student's response after learning PBL on the heat material and its transfer using a response questionnaire. In the implementation of learning, there are categories of learning implementation that have been integrated by (Indah, 2014) as presented in table 1.

Table 1. Categories of Learning Implementation

No	Percentage of Implementation (%)	Interpretation
1	0,0 - 24,5	Very lacking
2	25,0 - 37,5	Lacking
3	37,6 - 62,5	Keep
4	62,6 - 87,5	Good
5	87,6 – 100	Very good

Data analysis techniques on the implementation of learning with the PBL model on the heat material and its transfer using observation sheets on the implementation of learning. The reason for using the implementation observation sheet is because the instrument used is very accurate with the identity of the observer. Data analysis techniques on student learning outcomes after being treated using the PBL learning model on heat material and its transfer using N-gain normality. Data analysis techniques on student responses after participating in learning with the PBL model on heat material and its transfer using response questionnaires. The category of N-gain values as described by (Dzahabiyah et al., 2021) is presented in table 2.

Table 2. Categories of N-gain Values

No	Normalized Gain Value	Interpretation
1	$-1,00 \leq g < 0,00$	There is a decline
2	$g = 0,00$	Remain
3	$0,00 < g < 0,30$	Low
4	$0,30 \leq g < 0,70$	Keep
5	$0,70 \leq g < 1,00$	High

Pretest and postest indicators on the question with calorific material and its displacement are presented in table 3.

Table 3. Pretest and Postest Indicators

No	Indicators	Item Number	
		Pretest	*Postest*
1	Explaining the meaning of heat	1	1
2	Implement the relationship of heat with changes in object temperature	2	2

No	Indicators	Item Number	
		Pretest	*Postest*
3	Implementing the relationship between heat and changes in the state of matter	3	3
4	Explain the different types of heat transfer	4	4
5	Analyzing the concept of heat in everyday life, including the mechanism for maintaining a stable body temperature in humans and animals	5, 6	5, 6

Indicators of student response questionnaires after participating in learning with the PBL model on the heat material and its transfer according to the research objectives are presented in table 4.

Table 4. Indicators of Student Response

No	Indicators	Item Number
1	Increase interest and interest in learning	1, 2
2	Follow learning and adapt to learning at school	3, 5, 9
3	Increase learning motivation	6, 8, 10
4	Improve understanding and learning outcomes	4, 7

RESULTS AND DISCUSSION

This learning was carried out at one of the State Junior High Schools in Kediri Regency with a research sample consisting of 14 students of class VII-B as a control class as well as an experimental class on the heat material and its transfer applied. This learning was carried out as many as two meetings, with the context of the discussion at the first meeting was to give pretests to students and in the second meeting, namely giving posttest to students. The study was completed after the two meetings were held. The issue raised at the first meeting was about the change in the form of ice cubes if left in the open room and the events of heat displacement in everyday life. The issues raised at the second meeting were about the analysis of changes in the form of heated ice cubes and the length of time required and the temperature obtained. The percentage of observation results of the implementation of learning with the PBL learning model of heat material and its displacement is presented in figure 1.
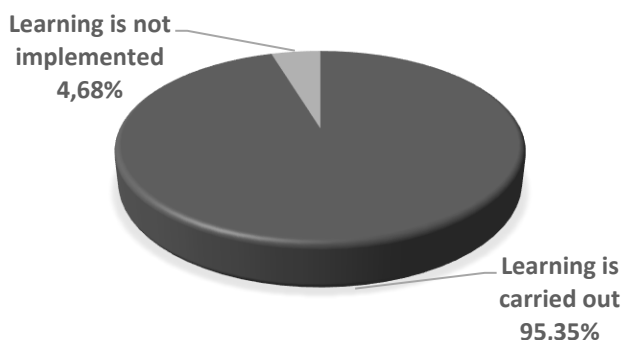
Figure 1. Percentage of Observation ff The Implementation of Learning with The PBL Model on Heat Material and Its Displacement

The purpose of the first study, which is to describe the implementation of learning with the PBL model on heat material and its transfer to students, obtained the results of the percentage of learning carried out by 95.35%, and the percentage of learning that was not carried out was 4.68%. The percentage number figure is obtained based on the calculation of filling out the observation sheet for the implementation of learning by the observer. From the observations of the three observers, there is no reason for the learning that was not carried out and there was no criticism or suggestion in the description of the observation sheet (Palufi & Fauziah, 2022). The following table of calculation data from the pretest and postest scores of students is presented in table 5.

Table 5. Pretest and Posttest Value Calculation Data

	$\bar{x}$	Me	Mo	Max	Min	S
Pretest	31,42	45	20	60	20	117,59
Postest	90,42	98	98	100	50	338,35

The second purpose of the study, namely to determine student learning outcomes with the PBL model on the calorific material and its transfer, obtained a recapitulation of data on pretest and postest scores of class VII-B students as many as 14 students with the majority of postest scores that increased compared to pretest scores because they had been given treatment, namely following learning with the PBL model. There are six students in the learning process getting a pretest score of 20. Even so, there is one student with a high posttest score with a score of 60. There is an increase in the results of affective and psychomotor assessments in students, through the PBL learning model with the realm of a scientific approach can improve student learning outcomes for temperature and heat materials (Nasution et al., 2020).

Posttest scores after being given treatment there was an increase in scores in all students when compared to pretest scores before being given treatment. Analysis on students who get low pretest scores there are five students, but get high posttest score because when learning with the PBL model takes place, students who actively participate in material discussions and stand out in discussions during heat practicum. There is one student whose pretest score is low but gets a significant posttest score because before learning were passive students both in material discussions and in collaborative initiatives with their practicum groups. Activeness is the most important component during the teaching and learning process with the PBL model which is proven to help improve student learning outcomes in science subjects (Parimpasa et al., 2018). The average score of N-gain students through pretest and postest results is presented in table 6.

Table 6. Student N-gain Average Score

No.	Average		N-gain average score	Category
	Pretest	*Postest*		
1	31,42	90,42	0,87	High

The analysis in table 6 of the average N-gain score of class VII-B students obtained an overall average number of students of 0.87 with a high N-gain category, the amount is based on the calculation of pretest scores and postest scores. N-gain is theoretically divided into two, namely the medium category and the upper category with 16 students in the medium N-gain category with an N-gain value of 0.56-0.69 and 18 students in the upper N-gain category with an N-gain value of 0.71-0.85 (Muslimah & Fauziah, 2021). The Ha hypothesis in this study was accepted and the Ho hypothesis was rejected, meaning that there was an influence by applying the PBL learning model to the heat material and its transfer with improved student learning outcomes. The percentage of student responses after participating in learning with the PBL model on the heat material and its displacement is presented in figure 2.
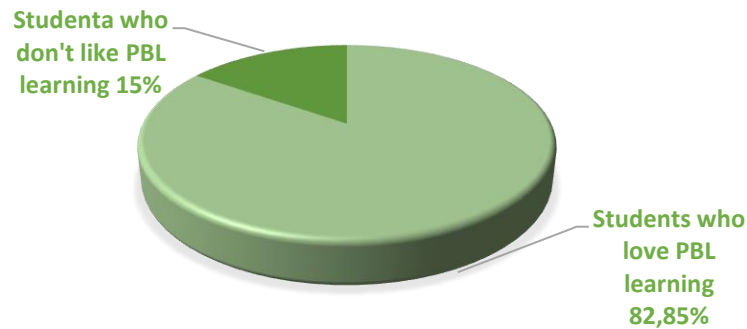

Figure 2. Percentage of Student Responses to PBL Learning on Heat Material and Its Transfer

The third research objective, namely to describe student responses using the PBL learning model on heat material and its transfer, obtained an average percentage of student responses with "yes" answers of 82.85% and with "no" answers of 15%. The value in this percentage is obtained by calculating the average number of each answer to the question contained in the student response questionnaire after participating in learning with the PBL model. The answer "yes" with an average percentage number of 82.85% proves that almost all students like learning with the PBL model, and students can know that the learning outcomes on a material have an effect on the final score of the report card. Meanwhile, the "no" answer with an average percentage figure of 15% shows that there are some students who do not like learning with the PBL model.

Students who are active in participating are directly proportional to their postest results, the postest score gain in each student will be accumulated to produce an N-gain score. Students not only learn individually, but also in groups. Students are required to be active in problem solving and students can develop their knowledge (Khairunisa et al., 2020). Students who were taught using the PBL model got an average score of 84.53 this was higher than students taught by the conventional model who got an average score of 59.0 (Maryana, 2019). The average N-gain score of 0.87 obtained in this study is due to the large number of students who are active in participating and collaborating in their groups and learning with the PBL model can be said to be in accordance with the characteristics of each student. This can be proven in the response questionnaire that has been filled out by students, there are 82.85% of "yes" answers to students using the PBL learning model and 15% of students who "do not" like the PBL learning model.

The literature review used in this study refers to previous research from (Nisa & Widodo, 2021) which used a one group pretest-posttest design, with a pretest before being given treatment and a posttest after being given treatment. The data analysis used to improve the literature learning outcomes using N-Gain is the same as the data analysis used in this study. The instrument used in the literature uses observation sheets, test sheets and student response sheets (questionnaires). The learning that was carried out in the literature was 87% and the learning that was not implemented in the literature was 13%. The N-Gain analysis obtained in

the literature obtained an average of 0.39 with a medium category. Questionnaire analysis of student responses after learning in the literature obtained an average percentage of 86% with "yes" answers and 14% for "no" answers.

The data in this study that has been processed, can be concluded that the PBL learning model is suitable to be applied in the school, especially in the heat and transfer material. The PBL learning model applied makes student learning outcomes improve, with a higher postest score than the score during the pretest. PBL is a learning model that emphasizes solving problems scientifically (Mariati, 2021). In line according to Mirdad (2020) who said that the learning model is actually a plan used so that the educational curriculum becomes perfect, learning materials, guiding learning in the classroom and can be used as an efficient option to achieve learning objectives. The results of this study are also relevant as in the study (Nisa & Widodo, 2021) in the study, resulting in an average moderate N-gain score with the postest score of all students increasing to be better than the pretest score and student response questionnaire to learning of 87%, with the number of student samples in the study as many as 15 people.

CONCLUSION

The conclusion obtained from this research is that the learning model is actually a plan used so that the educational curriculum becomes perfect, learning materials, guiding learning in the classroom and can be used as an efficient option to achieve learning objectives (Mirdad (2020). The learning outcomes obtained in this study are in the form of an average N-Gain score is 0,87 with high category. The average result of student response to learning shows results of students who love PBL learning is 82,85% and studenta who don't like PBL learning is 15%. This study are also relevant as in the study (Nisa & Widodo, 2021) in the study, resulting in an average moderate N-gain score with the postest score of all students increasing to be better than the pretest score and student response questionnaire to learning of 87%, with the number of student samples in the study as many as 15 people.

The advantage of this study is in the data collection process using junior high school students during learning, so that the length of learning time can adjust to the class hours at the school. In addition, the advantages of this study only use data analysis techniques in the form of N-gain normality so that it is easy to analyze the data that has been obtained. The shortcoming of this study is that the observation sheet for the implementation of forgetful learning writes the PBL syntax, but at the time of learning, it has applied the PBL syntax according to the article title.

The advice from this study is first aimed at subsequent researchers so that the learning process remains guided by the PBL syntax with student-centered learning. The second suggestion is aimed at civil service teachers to apply the PBL model, especially in science materials because the use of the right learning model will certainly support student learning outcomes. The last suggestion is aimed at students after participating in learning with the PBL model, students should be able to evaluate their learning outcomes so far, if it is still incomplete, then their problem-solving skills need to be improved.

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