The effect of problem based learning (PBL) model on fourth-grade students' learning outcomes of data presentation

Dwi Kartika Sari[1], Yarisda Ningsih[1*]
[1]Department of Elementary Teacher Education, Padang State University, Padang, Indonesia

Article Info	ABSTRACT
	The purpose of this study was to determine the effect of the Problem Based Learning model on the learning outcomes of data presentation in the form of a bar diagrams in Class IV SDN Cluster II, Lubuk Kilangan District, Padang City. This research is a quantitative research with the type of quasi-experimental research design. Using purposive sampling technique, we obtained 24 students from class IVA SDN 09 Bandar Buat as the experimental class and 25 students from class IVB SDN 09 Bandar Buat as control class. The results showed that the average experimental class was 82,81 and control class 69.50. The results of the t-test calculation with a significance level of 0.05 obtained $t_{count} > t_{table}$ is $4.493 > 2.012$, then H_0 is rejected and H_1 is accepted. The N-Gain test in the experimental class obtained an average of 0.67 while in the control class obtained an average of 0.43. So it can be concluded that the Problem Based Learning model has an effect on learning outcomes in presenting data in the form of bar diagrams in class IV SDN Cluster II, Lubuk Kilangan District, Padang City. *This is an open access article under the CC BY-SA license.*

Corresponding Author:

Yarisda Ningsih
Department of Elementary Teacher Education, Padang State University, Padang, Indonesia
Email: yasridaningsih@fip.unp.ac.id

INTRODUCTION

The learning model has an important role in learning in order to achieve the learning objectives. The learning model is a systematic conceptual framework concept that describes procedures for conditioning students' learning activities from learning experiences that can achieve the desired learning goals and designing teachers' learning to plan something in the implementation of teaching and learning activities (Ariani, et al. 2020).

One of the innovative learning models that can be used in learning is the Problem Based Learning model. The PBL model is able to require students to think critically in solving problems, actively work together in groups, be free to express their opinions, and relate students' real-life experiences to learning materials. Ningsih, et al (2019) stated that PBL is learning that uses problems as a basis for developing students' new knowledge.

The PBL model can facilitate students to be active in solving existing problems so that during the learning process they will not feel bored. This is in accordance with the opinion of Masniladevi (2017) that students feel bored and unmotivated due to the ineffectiveness of the learning carried out so that it is necessary to use a learning model that can overcome these problems.

The purpose of the PBL model is to help students learn knowledge that is directly related to problems in real life as well as have the skills to solve problems that will have a positive impact on learning outcomes (Nurfiyanti, et al 2018).

The PBL model is suitable for use in mathematics learning because mathematics learning is learning that is able to make students able to develop thinking skills and be able to communicate a problem and solve the problem (Ahmad, et al. 2018). Solving problems is not only a goal of learning mathematics but at the same time is the main tool for carrying out the learning process, to gain problem solving abilities one must have a lot of experience in solving various problems (Hendri & Kenedi, 2018).

The PBL learning model can be used in the learning process in class IV semester II, namely at Basic Competencies 3.11. Explaining students' self-data and their environment presented in the form of bar charts, and 4.11.Collect data on students and their environment and present it in the form of a bar chart. Data presentation material emphasizes the ability of students to find information from data that exists in everyday life.Learning to present data is expected not only for teachers to explain the meaning of data directly to students, but students are invited to carry out activities related to collecting information. After the required information is collected, the teacher can convey that the information collected is data (Lestari, 2019). For this reason, it is better for students, either independently or in groups, to be actively involved in data collection activities.

After the learning is carried out, the teacher can find out how far the students understand the material learned from the learning outcomes. Learning outcomes are benchmarks used to determine the level of success of students in understanding concepts in learning (Astimar, 2014).

Based on observations and interviews conducted by researchers in class IV of SDN Gugus II Lubuk Kilangan, Padang City on October 25-8 November 2021, the following facts were found: (1) low mathematics learning outcomes compared to the average KBM, which is 75, (2) Teachers still dominate learning activities so that students have not been actively involved in the learning process, this can be seen where the teacher explains more so that students listen more (3) The learning process generally has not implemented varied learning models by guiding students to the process of getting learning experience and managing learning resources, so that the learning process is less than optimal, (4) The low skills of students in communicating express opinions or ideas,(5) Lack of motivation and creativity of students in learning because the learning atmosphere is not pleasant so that it has an impact on low student learning outcomes (Lely et al., 2020), (6) Students have not been able to collaborate well when working together in groups, so when discussing tend to create an atmosphere unfavorable classroom environment.

Referring to the problems above, a problem was found whether there is an effect of the Problem Based Learning Model on the Learning Outcomes of Data Presentation in the Form of Bar Diagrams in Class IV SDN Cluster II, Lubuk Kilangan District, Padang City?

Referring to the problems above, it is necessary to take an action that can create effective, fun and active learning for students in learning, and can also solve problems that depart and real

problems in the daily lives of students. Then it can be done by using an appropriate learning model, namely the problem based learning (PBL) model. The purpose of this study is whether there is an effect of the Problem Based Learning Model on the Learning Outcomes of Data Presentation in the Form of Bar Diagrams in Class IV SDN Cluster II, Lubuk Kilangan District, Padang City.

LITERATURE REVIEW
The Nature of Learning Outcomes
Definition of Learning Outcomes
Learning outcomes are assessments of the results of learning activities in students after carrying out the process of learning activities(Wahyuningsih in Hasanah & Ariani, 2021). Meanwhile, according to Supardi (2016) Learning outcomes are changes that occur in individuals who learn, not only changes in knowledge, but also knowledge to form skills, habits, attitudes, understanding and appreciation in individuals who learn. So it can be concluded that learning outcomes are a follow-up of the learning process that measures the extent to which students are able to understand the learning material properly.

Types of Learning Outcomes
According to Sanjaya (2017)learning outcomes consist of several types, namely: a) cognitive competence, is a competency related to aspects of intellectual or cognitive development in students. b) affective competence, is competence related to attitude or behavior in life. c) psychomotor competence, which relates to skills or skills. From the opinion above, it can be concluded that the types of student learning outcomes cover three domains, namely: (1) attitude aspects; (2) knowledge aspect; and (3) skill aspect.

The Nature of the Problem Based Learning Model
Definition of Problem Based Learning Models
The PBL model is a learning model that is expected to be applied by teachers in learning. Ningsih, et al (2019) stated that PBL as a learning model that uses problems as a basis in developing new knowledge of the students. Meanwhile, according to Lestari and Yudhanegara (2017) PBL is a learning model that challenges students to learn how to learn, work in groups to find solutions to real world problems. It can be concluded that the PBL model is a model that involves active students in the learning process by using authentic (real) problems so that it challenges students to learn how to learn and think critically in solving a problem related to everyday life.

Problem Based Learning Model Examination
The use of the PBL model can help students learn knowledge that is directly related to real-life problems while at the same time having the skills to solve problems which will have a positive impact on learning outcomes (Nurfiyanti, et al 2018). Based on expert opinion, it can be concluded that the purpose of the PBL model is to help students learn knowledge based on real problems, develop thinking skills and problem solving, learn the role of adults, become independent learners and autonomous learners.

Characteristics of Problem Based Learning Model

The PBL model has characteristics that distinguish it from other learning models, namely the existence of problem solving by students. The characteristics of the PBL model are: 1) learning begins with a problem, 2) the problem relates to the real world of students, 3) organizes lessons around problems, 4) gives great responsibility to students in forming and carrying out the learning process directly , 5) using small groups, 6) requiring students to demonstrate what they have learned in the form of a product or performance (Putra, 2013).

From several expert opinions it can be concluded that the PBL model has the characteristics of a student-oriented learning process, the teacher only acts as a facilitator, there are questions or problems related to the real world of students, giving great responsibility to students in forming and carrying out the process directly learning, some of the information needed to solve problems is not given, authentic investigations, produce products/works and showcase them, and collaboration in small groups.

The steps of the Problem Based Learning Model

The PBL model has implementation steps so that the learning process can be structured properly. The steps carried out in this study refer to the opinion of Fathurrohman (2016), namely: 1) orienting students towards problems, 2) organizing students for learning, 3) guiding individual and group investigations, 4) developing and presenting work, 5) analyze and evaluate the problem solving process.

Advantages of Problem Based Learning Models

The PBL model has many advantages including: 1) increasing understanding of the meaning/concept being taught, increasing independence, 2) increasing motivation, 3) a meaningful learning process for students where students learn to solve problems through the application of their knowledge, 4) students integrate knowledge and skills simultaneously and apply them in relevant contexts, 5) improve critical thinking skills, foster student initiative in work, 6) internal motivation for learning, 7) can develop interpersonal relationships in group work, 8) identify and evaluate investigations , 9) interpret and evaluate the results of observations, 10) can make education more relevant in life.

Scope of Data Presentation

Data Presentation in Bar Chart Form

The data that has been collected can be presented in various ways so that it can be read and understood. According to Winarni & Harmini (2015), data can be presented in the form of lists, tables, and diagrams (line charts, bar charts, pie charts, picture charts). Presentation of data has functions including: (1) showing the development of a situation, and (2) making comparisons at a time (Tjalla in Nasution, 2017).

Based onthe description above, the presentation of the data presented below is a bar chart, because it is adjusted to the material for presenting data contained in class IV Elementary School in the 2013 curriculum.

Presentation of data using bar or beam images is called a bar chart. The steps in presenting data in the form of bar charts according to Manullang (2019); Winarni & Harmini (2015), namely: 1) make two horizontal (horizontal) and vertical (vertical) axes. The horizontal

axis can usually be used to indicate the type of category, while the vertical axis is used to show the frequency number, 2) make each type of category according to the data, meaning we make several rectangles for each category name, 3) the frequency and the distance of each bar is the same, 4) each bar is numbered and the title of the diagram is placed above the diagram image, while notes and data sources are placed below the diagram.

METHOD

Types of Research

The type of research used is quantitative research. Research with a quantitative approach is research using numbers to describe research subjects (Masniladevi in Putri, et al. 2018). The method used in this research is experimental research. Arikunto (2014) that experimental research is research that is intended to determine whether there is a result of treatment on the subject under investigation.

The form of research design used is a quasi-experimental design, namely a nonequivalent control groups design model. According to Sugiyono (2019), quasi-experimental design is a development of true experimental design, this research model has a control class but does not really control external variables that can affect the experiment.

Time and Place of Research

The research was carried out in class IV at SDN 09 Bandar Buat with class IV A as the experimental class and class IV B as the control class. The time of the research is carried out in the even semester (January-June) of the 2021/2022 academic year.

Population and Sample of Research

The population in this study were all fourth grade students of SDN Cluster II, Lubuk Kilangan District, Padang City, which consisted of 7 elementary schools. The sampling technique used in this study is a non-probability sampling technique, purposive sampling type. According to Sugiyono (2019) Purposive sampling is a technique for determining a sample of certain considerations. Before determining the sample to be taken, first the normality test and homogeneity test were carried out. After the data is normal and homogeneous, then the school is determined to be taken as a sample. Based on these considerations, the researcher chose the IVA class at SDN 09 Bandar Buat as the experimental class and the IVB class at SDN 09 Bandar Buat as the control class.

Research Procedure

Data collection is related to the problem to be studied. Before collecting the research data, the stages were carried out, namely: preparation, implementation and completion. In the preparation stage, the researcher sets a research schedule, prepares a Learning Implementation Plan (RPP) and research instruments that have been validated by the validator and have been tested.

At the implementation stage, the researcher gave a pre-test and then carried out the learning process in the experimental class using the Problem Based Learning (PBL) model while the control class used conventional learning. At the completion stage, the researcher gave a post-test then processed the post-test results and drew conclusions from the students' post-test results for later analysis.

Data, Instruments, Data Collection Techniques, and Data Analysis Techniques

This research information is quantitative, namely pretest data and posttest data. The instrument used in this study was an objective test consisting of 20 questions. The try-out was carried out on subjects who were at least one level more than the subjects used as samples or subjects who had received or obtained the material to be studied (Lestari K.E & Yudhanegara, 2017).

Then before the test was tried out, the test was tested for construction validity (construction validity) by the Padang State University Mathematics Lecturer with a validation result of 90%. Trials were conducted to determine the characteristics of good items based on validity, reliability, discriminating power and item difficulty index. Of the 20 questions tested, 16 questions were selected to be used as research instruments.

RESULTS

The learning carried out in the experimental class used the Problem Based Learning (PBL) model. The application of the Problem Based learning model in learning, students are given problem orientation regarding data collection and asked to pay attention to pictures of several data presentations in the form of vertical and horizontal bar charts. Then students ask and answer questions about these problems and are oriented to study individually or in groups. During learning activities, the teacher guides students in solving problems that exist in LKPD. After that students present their work and provide feedback between groups. The activity ends with evaluating the results and giving reinforcement by the teacher.

Description of Data the Experiment and Control Classes' pre-test and post-test

The results of the pre-test and post-test of the data presentation material in the form of a bar chart for the experimental class and the control class can be seen in table 1 below.

Table 1. Recapitulation of the results of pre-test and post-test data presentation material

Variable	Pre-test		Post-test	
	Experiment Class	Control Class	Experiment Class	Control Class
N	24	25	24	25
The highest score	64.75	75	93.75	87.5
Lowest Value	25	31.25	62.5	50
Mean/Average	44.79	47.75	82.81	69.50
Standard Deviation	11.90	12.74	8.50	12.01
variance	141.53	163.37	72.18	144.27

Based on the data analysis of pre-test and post-test learning outcomes of the experimental class and the control class, there are differences in the acquisition of learning outcomes between the experimental class and the control class. The average pre-test value of the experimental class was 47.14 and the average pre-test of the control class was 42.85. While the post-test value of the experimental class was 81.25 and the post-test value of the control class was 69.71. The comparison of pre-test and post-test scores between the experimental and control classes can be seen in the graph in Figure 1 below.
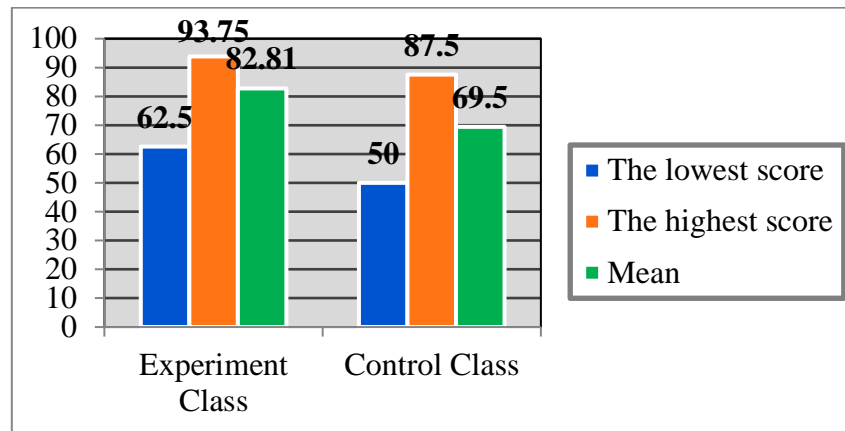
Figure 1. Comparison the results of the pre-test and post-test

Normality Test and Homogenity Test

Normality test is a test carried out to determine whether or not the distribution of the data to be analyzed is normal. Test the normality of the pre-test and post-test of the sample class using the Liliefors test. The sample class normality test can be seen in table 2 below.

Table 2. The results of the calculation of the sample class normality test

Data	Class	L_0	L_{table}	N	α	Information
Pre-test	Experiment	0.1599	0.1766	24	0.05	Normal
	Control	0.1494	0.1726	25	0.05	Normal
Post-test	Experiment	0.1678	0.1766	24	0.05	Normal
	Control	0.1649	0.1726	25	0.05	Normal

From the table above, it can be seen that the pre-test value in the experimental class L_0=0.1599 with L_{table}=0.1766 and in the control class L_0=0.1494 with L_{table}=0.1726. While the post-test scoresin the experimental class L_0=0.1678 with L_{table}=0.1766 and in the control class L_0=0.1649 with L_{table}=0.1726. With a significant degree= 0.05 the two sample classes show the value of $L_0 < L_{table}$, then the two sample classes are normally distributed.

The homogeneity test is only carried out if the distribution of the data shows that the data is normally distributed.

. Homogeneity test is needed to prove the basic data to be processed is homogeneous. The homogeneity test of the pre-test and post-test of the sample class used the Fisher test. The calculation of the F test with a significance level of = 0.05 from the distribution table F, in the pretest data obtained $F_{count} < F_{table}$ is 1.147 < 2.005 and in post-test data $F_{count} < F_{table}$ is 1.999 < 2.005 so that the sample has a homogeneous variance. The sample class homogeneity test can be seen in table 3 below.

Table 3. The results of the sample class homogeneity test

Statistics	Score			
	Pre-test		Post-test	
	Experiment Class	Control Class	Experiment Class	Control Class
Variant	141.53	162.37	72.18	144.27
Biggest Variant	162.37		144.27	
Smallest Variant	141.53		72.18	
F_{count}	1.147		1,999	
F_{table}	2,005		2,005	
Conclusion	Homogeneous		Homogeneous	

Hypothesis Testing

Hypothesis testing can be done if the data is normally distributed and homogeneous. After testing for normality and homogeneity, the hypothesis is then tested. To test the hypothesis of this study, the researcher used the t-test formula to test the difference in the average post-test scores of the two groups. The results of hypothesis testing with t-test can be seen in Table 4.

Table 4. The results of the calculation of the hypothesis test (T test)

No	Class	N	mean	T_{count}	T_{table}	Conclusion
1	Experiment	24	81.81	4,493	2.012	Hypothesis Accepted
2	Control	25	69.5			

From the distribution list t with a significance level of 0.05 and dk = n_1 + n_2 - 2 = 24 +25 – 2 = 47, we get t_{table} = 2.012 while t_{count} = 4.202. Based on the above calculation, it turns out that $t_{count} > t_{table}$, is 4.493 > 2.012, means that H_1 is accepted and H_0 is rejected. It can be concluded that there are differences in the learning outcomes of students who are taught using the Problem Based Learning (PBL) model with the learning outcomes of students who are taught using conventional learning in learning to present data in the form of bar charts for grade IV Elementary Schools.

N-Gain Test

The N-Gain test is used to determine the increase in the ability of students between before and after being given treatment. In this study, the researcher set the maximum value = 100, so that the possible gain value for students was between 0 and 100. The results can be seen in Table 5 below.

Table 5. N-Gain Value of Experiment Class and Control Class

Value Criteria N-Gain	Experiment Class	Control Class
Tall	16 students	0 students
Currently	8 students	18 students
Low	0 student	7 students
Average	0.7	0.42
Category	Currently	Currently

DISCUSSION

The purpose of this study was to determine the effect of the Problem Based Learning model on the learning outcomes of presenting data in the form of a bar chart in Class IV SDN Cluster II, Lubuk Kilangan District, Padang City.

This data collection was carried out in two sample groups consisting of the experimental class and the control class. The experimental class is class IVA State Elementary School 09 Bandar Create with a total of 24 students, while the control class is class IVB State Elementary School 09 Bandarbuat with a total of 25 students. In the learning process, the experimental class was given treatment by applying the Problem Based Learning model, while the control class by applying conventional learning.

Based on the results of research that has been done by researchers, it can be seen that there are differences in student learning outcomes in the experimental class using the Problem Based Learning (PBL) model with the learning outcomes of students who are taught using conventional learning.

After analyzing the data, the post-test results were obtained in the experimental class with 24 students, the highest score was 93.75 and the lowest score was 62,5. Thus the results of the study indicate that the learning outcomes of data presentation in the form of bar charts in the experimental class are higher than those of the control class.

Based on the results of data processing using t-test, obtained t_{count} of 4.493 and t_{table} of 2.012. Thus, $t_{count} > t_{table}$ is $4.493 > 2.012$. Then H_1 is accepted and H_0 is rejected. This proves that there is a significant influence from the use of the Problem Based Learning (PBL) model on student learning outcomes in the material of presenting data in the form of bar charts in class IV of State Elementary School 09 Bandarbuat.

This is supported by previous research, namely research by Dewi & Ariani (2020) with the research title "The Effect of Problem Based Learning Models on Learning Outcomes of FPB and KPK in Grade IV SD". The results showed that the experimental class learning outcomes that applied the Problem Based Learning model were 38.26 higher than the control class that applied conventional learning, which was 19.35. It was concluded that there were differences in student learning outcomes using the Problem Based Learning model with student learning outcomes using the conventional approach to the material of the Largest Common Factor and Smallest Common Multiple in Grade IV Elementary School. Furthermore, research conducted by Rahmah & Zainil (2021) with the research title "The Influence of Problem Based Learning Models on Comparative Learning Outcomes of Two Different Quantities in Grade V Elementary School". The results showed that the calculation of the data analysis of the t-test results with a significant level of 0.05 obtained t_{count} of 2.27 and t_{table} of 1.68195. So that t_{count} is greater than t_{table} ($2.27 > 1.68195$). It was concluded that Ha was accepted, that is, there was an effect of the Problem Based Learning model on learning outcomes in the comparison of two different quantities in class V SD Cluster II Bunga Pasang.

Using the PBL model can increase understanding of meaning, increase independence, improve the development of higher-order thinking skills, increase motivation, facilitate relationships between students and improve skills in building teamwork (Sofyan in Dewi & Ariani, 2020). This is in line with Sumantri's opinion (in Ratu & Ahmad, 2021) that the advantages of PBL include (1) it can train students to design inventions, (2) think and act creatively, (3) students can solve problems realistically, (4) identify and evaluate investigations,

(5) interpret and evaluate the results of observations, (6) stimulate the development of students' thinking progress to solve a problem faced appropriately.

CONCLUSION

Based on the results of the research data analysis that has been done, the average pre-test results for the experimental class are 44.79 and the control class is 47.75. After being given treatment to the experimental class using the Problem Based Learning (PBL) model and the control class using conventional learning, the average post-test results for the experimental class were 82.81 and the control class was 69.50. Based on the results of hypothesis testing using the t-test that has been carried out, it is obtained that t_{count} is 4.493 and t_{table} is 2.012. This means that $t_{count} > t_{table}$ is 4.493 > 2.012. Then H_1 is accepted and H_0 is rejected.

This is also supported by the difference in the N-Gain test of the experimental class and the control class where the experimental class has an average of 0.7 with moderate criteria and the control class is 0.42 with moderate criteria. So it can be concluded that the Problem Based Learning (PBL) model has a significant effect on learning outcomes in presenting data in the form of bar charts in class IV SDN Cluster II, Lubuk Kilangan District, Padang City.

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