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The Effect of Problem-Based Learning Models with Experimental Scientific Methods and Attitudes Towards Learning Outcomes in Elementary School Students

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Abstract

This study aims to describe the differences in student learning outcomes using the Problem-based Learning model with the experimental method and the Problem-based Learning model, to describe the differences in the learning outcomes of students who have a high scientific attitude and students who have a low scientific attitude. The research method used is quasi-experimental. The research sample was class IVA which consisted of 23 students as the experimental class and IVB which consisted of 22 students as the control class. Retrieval of data through tests of learning outcomes and scientific attitude questionnaires. The results of the study found differences in student learning outcomes using the Problem-based Learning model with the experimental method and the Problem-based Learning model, this is in accordance with the post-test scores, namely the experimental class got an average score (75.90) while the control class (62.50). There are differences in high and low scientific attitudes, this corresponds to the average score of high scientific attitudes (82.92), while students with low scientific attitudes have an average score of 73.70.

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Introduction

The most important function of education is to train someone to be confident, curious, creative, innovative, and also able to understand differences. How to see students who have characteristics to be brought to a point where they can think about the sources of problems and how to solve them (Esen, 2013).

All of these functions can be realized through educational practice or the teaching and learning process, where teachers and students both feel the differences that will occur before and after the learning process, which of course in this teaching and learning process the teacher plays an important role in the realization of this educational function.

The low learning outcomes of students in a lesson, especially in science learning, are due to ineffective learning. Teachers prioritize completing learning material without paying attention to the abilities of each student. So students tend to be passive and accept learning without prioritizing the level of understanding of the material that has been taught. Based on observations in grade IV at SD Negeri 4 Dampelas, conventional learning is still being applied. Conventional learning in question is learning in which the delivery of the material is described by the teacher using standard media. The problems experienced by grade IV teachers state that the obstacles faced in achieving learning objectives are due to several factors, including (1) The teacher's lack of understanding of learning methods, models, and approaches, so that learning is still teacher-centered, (2) the use of teacher materials less interesting and less varied teaching, (3) Minimal use of media during the learning process.

Therefore, teachers in the learning process are expected not only to use the lecture method but to try to teach student-centered, so that students actively participate in science subject matter in the classroom. Some students have not dared to ask the teacher, let alone express their opinion in front of the class. The independence of students in learning, especially in solving problems is lacking. So that the low quality of the science learning process has an impact on the low learning outcomes of students. Therefore, the teacher has a role to improve this situation, by choosing the right model in the learning process so that student concentration focuses on the lesson so that it can improve learning outcomes. Janah et al. (2018) said that one of the efforts to improve student-centered learning and be able to generate curiosity from students is through a problem-based learning model.

In principle, in the PBL learning model, students themselves are actively looking for answers to problems given by the teacher. In this case, the teacher acts more as a mediator and facilitator to assist students in constructing their knowledge effectively. Problem-based learning is learning that presents students with real problem situations, which are open (Lestari, 2012).

Problem-based Learning is a learner model that uses problems as a first step in gathering and integrating new knowledge. Problem-based learning is a learning model that presents contextual problems that stimulate students to learn. In a class that implements Problem-based Learning, students work in teams to solve real-world problems (Major et al., 2001).

In addition to a model in the teaching and learning process, the effectiveness of teaching methods also needs to be considered so that they can provide good processes and results in teaching and learning activities in the classroom. One of the appropriate learning methods that can be developed in the teaching and learning process, among others, is experiment-based learning, (Setiono, 2013).

The Problem-based Learning model that is collaborated with learning that contains elements of the experimental method has the aim of making it easier for students to understand the problems given by the teacher so that it can improve student understanding and spur students to think critically and creatively and develop ideas so that they can solve problems through experiments. The experiment in question is learning using tools and materials both individually and in groups so that students can develop students ideas (Suriana et al., 2016). The experimental method combined with the Problem-based Learning model, provides an innovative learning experience that can improve student learning outcomes. This experimental method is suitable for application in science learning. This experimental method is rarely used in the learning process because sufficient preparations are needed to design and present a scientific phenomenon in learning. (Setiono, 2013).

Problem-based Learning has a way of presenting learning materials where students conduct experiments by experiencing to prove a question or hypothesis being studied. This means that in the experimental method, students are given the opportunity to experience and do it themselves, follow a process, observe an object, analyze, prove, and draw their own conclusions about an object, phenomenon, or concept. This is in line with Simbolon (2015), who stated that problem-based Learning is a learning model that can provide direct experience to students to introduce, familiarize, and train students to carry out scientific steps and procedural knowledge.

In addition to the problem-based learning model combined with experiments to support student learning outcomes, there are still many things that need to be considered, one of which is student attitudes. The attitude that students must have in science learning is a scientific attitude because students' scientific attitudes can grow when combined with problem-based learning in order to increase thinking and systematic ability to find alternative problem-solving through exploration or experimentation in order to obtain empirical data. Gunada et al. (2015) argue that a scientific attitude is an attitude that a scientist or academic must have when dealing with scientific problems.

The scientific attitude of students is a certain attitude taken and developed by scientists to achieve the expected results. The development and mastery of scientific attitudes and science process skills are also important goals in science learning. Students' scientific attitudes can be improved by creating a learning process that allows students to explore and improve their scientific attitudes. Experimental learning methods that motivate and improve students' scientific attitudes can improve student achievement (Astuti et al., 2016).

Based on the above problems, therefore a learning model is applied that is able to direct students to solve problems through direct observation to improve students' scientific attitudes through scientific problems and improve student learning outcomes in science learning.

Materials and Method

The research design used was a quasi-experiment or quasi-experiment using one group pre-test and post-test design. The form of the research design and design used in this study is a 2 x 2 factorial design. The population in this study were students of grade IV SD 4 Dampelas who were registered in the 2019/2020 school year with 2 classes. The research sample was taken by using a purposive sampling technique. The research sample was class IVA totaling 23 students as the experimental class and IVB totaling 22 students as the control class.

The analysis technique used in this study consists of 2 techniques, namely:

1. Analysis of research instruments, namely analysis of validity by experts (learning outcomes test, on the questionnaire sheet, RPP, and LKPD), The research instrument consisted of a learning outcome test consisting of 20 objective test numbers (multiple choice) regarding the material of force and motion, a scientific attitude questionnaire consisting of 18 statements regarding student responses to the learning used, RPP and LKPD regarding material style and motion.
2. Analysis of the validity of learning outcome test items with the acceptance criteria for each item is fulfilling if $0.21 \leq rpbi \leq 1.00$, (2) Analysis of the distinguishing power of the test items with the criteria for distinguishing power of the test items used $0.21 \leq D \leq 1.00$. (3) Analysis of the difficulty level of the test item with the test item difficulty index criteria used was $0.31 \leq P \leq 0.70$, and (4) Analysis of the reliability of the test with the test criteria if rl l> 0.70 can be concluded that the test is reliable.
3. Analysis of research data. This analysis uses quantitative descriptive analysis techniques with statistical tests using the SPSS version 23 program, to see the normality, homogeneity of variance, scientific attitudes, and student learning outcomes.

Results and Discussion

A. Instrument test results

The learning outcome test instrument is made based on the learning outcome test grid using objective tests, which have been validated by expert validators to see the suitability of the material, context, and language. The validated objective test was retried to see the validity, reliability, difficulty index, and differentiation of the test. In this study, to measure the validity of the items using the biserial Point Correlation formula, the criteria for the test items were said to be valid if 0.21 pbi 1.00. The validity test that has been carried out, obtained 17 valid questions, and 3 questions were revised from the 25 questions tested, so that the same 20 questions were used in the study, namely in the initial test and the final test.

The difficulty index test of this test is to find out whether the questions used fall into the difficult, medium/enough, and easy categories. The 25 items tested belonged to the medium category (0.31 P 0.70) because most of the test scores were in the medium category. The distinguishing power in this study obtained good categories of 9 questions (question numbers (4, 5, 8, 15, 16, 18, 21, 22, 25) with a distinguishing power of 0.45 and 0.55, just 14 questions (question number 1, 2, 6, 7, 9, 10, 13, 14, 17, 23, 24) with the distinction of 0.25, 0.27, and 0.36, and bad 5 questions (question numbers 3, 11, 12, 19, 20) with a distinguishing power of 0.09 and 0.18 After validating the items, the reliability test was then carried out to measure the level of confidence. The reliability test used in this study was the Kuder Richardson (KR-20) test. Testing r11> 0.70 and the test results in this study showed a reliability of 0.77 which means reliable (Arikunto, 2008).

B. Analysis of research data.

1. Descriptive student pretest results

The description of the data generated from this study is to provide a general description of the data obtained from the field. The data presented is raw data which will be processed using descriptive statistics. The data described are pretest data both in the experimental class and in the control class to see the mastery of science material before the problem-based learning model is carried out with the experimental method in the experimental class and the problem-based learning model in the control class. The pretest results are presented in Table 1.

Table 1. Description of the results of the IPA pretest for the experimental class and control class

Description	Pretest Experiment class	Pretest control class
Sample	23	22
Lowes	10	10
Highest	40	40
Avarage	28.18	27.27
Ideal	100	100
StDev	7.62	8.27

Based on Table 1, it is described that in the experimental class, the lowest score is 10, while the highest score is 40. The average score of the pretest results in the experimental class is 28.18. The deviation of data from the average score can be seen in the large standard deviation of the experimental class of 7.62. Whereas in Table 4.2 it is described that the control class is the lowest score is 10, while the high score is 40. The average pretest score in the control class is 27.27. The deviation of data from the average score can be seen in the value of the control class standard deviation 8.27.

Pretest normality test results

The data normality test is used to determine whether the data population is normally distributed or not. The data to be tested for normality is the data from the pretest results in the experimental class and the control class. The results of the calculation of the pretest normality test analysis using the Lilliefors (Kolmogorov Smirnov) normality test through the SPSS version 23 program can be seen in Table 2

Table 2. Normality test of pretest results data tests of normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experimentn	.160	22	.149	.944	22	.235
Control	.199	22	.023	.938	22	.178

Based on Table 2, information is obtained that the two test requirements are met. The p-value of the normality test results in the experimental class has a significant value (0.235)> 0.05 and the control class (0.178)> 0.05, based on the established normality test criteria, it can be concluded that the pretest result data is normally distributed.

Pretest data homogeneity test results

A data homogeneity test is used to determine whether the data is homogeneous or not. The data to be tested for homogeneity is the pretest data, both the experimental class and the control class. The results of the calculation by testing the homogeneity using the SPSS program version 23 seen as the output of the homogeneity of variance test are presented in Table 3.

Table 3 Results of the pretest data homogeneity test of homogeneity of variances

IPA learning outcomes

Levene Statistic	df1	df2	Sig.
0.428	1	43	0.517

Based on the information from Table 3, obtained p-value (0.517) > 0.05, so it can be concluded that the pretest data in the experimental and control classes have a homogeneous variance.

2. Description of post-test results based on scientific attitudes

Posttest data based on scientific attitudes are categorized into two parts, namely: posttest data with high scientific attitudes and posttest data with low scientific attitudes. Posttest score grouping is based on the total score obtained by students on the scientific attitude questionnaire with the average score of scientific attitudes. The distribution of post-test data based on scientific attitudes is presented in Table 4.

Table 4. Description of post-test results based on scientific and class attitudes

Description	High Scientific Attitude	Low Scientific Attitude
Sample	24	21
Lowest	80.00	68.00
highest	90.00	80.00
avarage	82.92	73.70
Ideal	100	100
Stdev	2.73	3.28

Based on Table 4. described that students with a high scientific attitude category in the experimental class had the lowest score of 80.00, while the highest score was 90.00. The average post-test score on a high scientific attitude is 82.92. Deviation of data from the average can be seen in the high standard deviation of scientific attitudes of 2.73.

The posttest description of the low scientific attitude category in the experimental class. The lowest score was 68.00, while the highest score was 80.00. The average post-test score was 73.70. Deviation of data from the average can be seen in the standard deviation of low scientific attitudes of 3.28

Normality test of scientific attitude post-test results

The normality test of the posttest data results based on a high scientific attitude and a low scientific attitude both in the experimental class and in the control class was carried out to determine whether the pretest data population was normally distributed or not. The results of pretest data testing based on interest in learning are presented in Table 5.

Table 5. Data normality test results posttest results

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
scientific attitude. high	.210	21	.016	.869	21	.009
scientific attitude. low	.118	21	.200*	.975	21	.835

Based on Table 5, information is obtained that the two test requirements are met. The p-value of normality test results on high scientific attitude is 0.016> 0.05 and low scientific attitude is 0.200> 0.05, so it is concluded that the scientific attitude data on the post-test is normally distributed.

Homogeneity test of scientific attitude post-test results

A homogeneity test is used to determine whether the data is homogeneous or not. The data to be tested for homogeneity is posttest data based on the high and low scientific attitudes of the experimental and control classes. The results of calculations using the SPSS version 23 program are presented in Table 6.

Table 6 Table of scientific attitude homogeneity

Test of Homogeneity of Variances

scientific attitudes

Levene Statistic	df1	df2	Sig.
1.628	1	43	.209

Based on Table 6, it is obtained a p-value of 0.209> 0.05, it can be concluded that the post-test data based on high and low scientific attitudes have homogeneous variance.

3. Description of learning post-test results

The description of the posttest learning data presented from the results of this study is to provide a general description of the data obtained from the field. The data presented is raw data which will be processed using descriptive statistics. The data described is the science learning outcome data in the experimental class with the problem-based learning model with the experimental method and the control class with the problem-based learning model. The post-test results are presented in Table 7.

Table 7. Description of science posttest results for experiment class and control class

Description	*Posttest* experiment class	*Posttest* control class
Sample	23	22
Lowest	65	45
Highest	90	75
Avarage	77.17	62.50
Ideal	100	100
Stdev	7.66	7.52
Control	77.17 (enough)	62.50 (less)

Based on Table 7, it is described that the experimental class is the lowest score of 65, while the highest score is 90. The average score of the Posttest results in the experimental class is 77.17. The deviation of data from the average score can be seen in the large standard deviation of the experimental class of 7.66. Based on the average Posttest data acquisition the experimental class is in the pass category.

Descriptions in Table 7 in the control class the lowest score is 45, while the highest score is 75. The average post-test score in the control class is 62.5. The deviation of data from the average score can be seen in the large standard deviation of the control class of 7.52. Based on the average post-test data acquisition, the control class is in the pass category.

Post-test normality test results

The data normality test is used to determine whether the data population is normally distributed or not. The data to be tested for normality is the data from the pretest results in the experimental class and the control class. The results of the calculation of the pretest normality test analysis using the Lilliefors (Kolmogorov Smirnov) normality test through the SPSS version 23 program can be seen in Table 8.

Table 8 Data normality test post-test results

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Experiment	.180	22	.062	.918	22	.069
Control	.188	22	.042	.942	22	.213

Based on Table 8, information is obtained that the two test requirements are met. The p-value of the normality test results in the experimental class has a significant value (0.062)> 0.05 and the control class (0.042)> 0.05, based on the established normality test criteria, it can be concluded that the post-test result data is normally distributed.

Pretest data homogeneity test results

A data homogeneity test is used to determine whether the data is homogeneous or not. The data to be tested for homogeneity is the pretest data, both the experimental class and the control class. The results of the calculation by testing the homogeneity using the SPSS program version 23 seen as the output of the Homogeneity of Variance Test are presented in Table 9.

Table 9 Results of the pretest data homogeneity test

Test of Homogeneity of Variances

IPA learning outcomes

Levene Statistic	df1	df2	Sig.
.344	1	43	.561

Based on the information from Table 9, it is obtained P-value (0.561)> 0.05, so it can be concluded that the pretest result data in the experimental and control classes have homogeneous variance.

4. Hypothesis

The results of the requirements test show that the data obtained on the research variables qualify for further implementation, namely hypothesis testing using the two-difference test and average statistical testing using SPSS version 23.

The research hypothesis consists of three formulations used to see the effect of the experimental-based problem-based learning model in the experimental class and problem-based learning in the control class, then the decision to derive the research hypothesis is done by comparing the probability (p-value) of the source of variance and the significance level. which is used in this study ($\alpha = 0.05$). The results of the two-way ANOVA test through the SPSS version 23 program are presented in Table 10.

Table 10. Two-way ANOVA test result

Tests of Between-Subjects Effects

Dependent Variable: learning outcomes

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	3831.439[a]	3	1277.146	49.003	.000
Intercept	216062.548	1	216062.548	8290.184	.000
Class	2453.791	1	2453.791	94.150	.000
Science attitude	1359.158	1	1359.158	52.150	.000
Class * Science attitude	38.537	1	38.537	1.479	.231
Error	1068.561	41	26.062		
Total	225400.000	45			
Corrected Total	4900.000	44			

a. R Squared = .782 (Adjusted R Squared = .766)

Based on Table 10, the results of testing the research hypothesis can be described as follows

1. There are differences in student learning outcomes using the problem-based learning model with the experimental method and the problem-based learning model.

The research hypothesis about the effect of treatment states that there are differences in learning outcomes between the problem-based learning model and the experimental method in the experimental class and problem-based learning in the control class. The decision-making towards the research hypothesis is carried out by comparing the significance level with α. The source of class variance has sig. (0.000) <α (0.05) then H0 is rejected. From the test results it is concluded that there is an influence of the experimental-based and problem-based learning model and the problem-based learning model.

2. There are differences in the learning outcomes of students who have a high scientific attitude and those who have a low scientific attitude.

The research hypothesis about the effect of scientific attitudes is that there are differences in learning outcomes between students who have high scientific attitudes and students who have low scientific attitudes. This hypothesis can be accepted because the significant source of variance in learning interest is 0.000 <α (0.05) meets the criteria for rejection of H0. So it is concluded that there is an influence of scientific attitudes on the influence of student learning outcomes

At the beginning of the research, the experimental and control classes were given a pretest to determine the extent of students' initial knowledge of the material of force and motion. While the final test (posttest) is given to determine the final ability of students as research data analysis which is then used as a comparison to see if there is an increase in learning outcomes related to material style and motion, besides that, a scientific attitude questionnaire is given to find out how much influence students have on learning using the problem-based learning model both in the experimental and control class which were treated differently, namely the experimental-based experimental class and the control class performed demonstrations in front of the class.

1. The effect of problem-based learning

The mean posttest result in the experimental class was 77.17 with a standard deviation of 7.66, while the mean posttest score in the control class was 62.50 and a standard deviation of 7.52. If seen, the average post-test data acquisition is in the pass category. Based on the results of the post-test, it is known that the learning outcomes of students who get the problem-based learning model with the experimental method are increased than students who get the problem-based learning model with the demonstration method.

The increase in learning outcomes in the experimental class rather than the control is influenced by the phases of problem-based learning used in both classes. In the initial phase of problem orientation, the experimental and control class students were given the same treatment, namely given apperception to increase the level of students' curiosity for the next material besides being given information about the objectives of the learning. The second phase is organizing students to learn, in this phase the experimental and control class students are given reinforcement in order to find a concept based on the problem, which is linked between the initial problem in the form of perception with the material to be given in learning.

The third phase is helping to investigate independently and in groups, in this phase, the experimental and control class students are given different treatments, namely in the phase of conducting an investigation, the experimental class is given a tool and material to design or conduct their own experiments, this can lead to confidence in do a job in order to make it easier for students to work on the problems given. This is according to the opinion (Suriana et al. 2016) that the problem-based learning model that is collaborated with learning that contains experimental elements has the aim of making it easier for students to understand the problems given by the teacher so as to increase student understanding and to trigger students to think critically and creatively and develop ideas. Ide so as to solve problems through experimentation.

The experiment in question is an experiment using tools and materials either individually or in groups. In the control class in the third phase, they are given a problem to find new ideas but do it in a way to understand a problem without experimenting with tools and materials, which is only given a demonstration of the problem.

The fourth phase is developing and presenting the work, in this phase, students are guided to work on student worksheets based on their observations and teachers are required to guide students in presenting the work results. And the last phase is analyzing and evaluating the results of problem-solving, in this phase, the experimental and control classes are treated differently, and the teacher plays a role in helping students review the results of problem-solving and motivating students to be involved in problem-solving, in the control class the teacher reviews it again in the form of an explanation regarding problem-solving that has been done, but in the experimental class the teacher provides explanations assisted by visual media in the form of videos, this can trigger students' enthusiasm to better understand the material provided.

The students better understand the material taught by the experimental method combined with visual media, namely video, compared to learning using the demonstration method. The video displayed is also a means for students to build their knowledge, namely by linking the knowledge they already have with the new knowledge they have acquired so that it will form new meanings in their knowledge.

These results are in line with the research Sumalee et al. (2012) stated that learning media such as visual images and videos support students in the process of building knowledge because the information in the media helps students construct or elaborate on the knowledge they previously had. In addition, Sam et al. (2018) said that the application of the PBL model assisted by video media is effective in improving critical thinking skills.

Experimental-based learning involving visual media, namely video as the final explanation of learning, makes it easier for students to remember and know abstract physics concepts, especially in the material of force and motion because of the active students in developing thinking skills and training students in investigating important problems contextual to make individuals independent. In accordance with the statement of Mulyani et al. (2020) who argue that problem-based learning helps students to develop thinking skills, how students solve problems, and their intellectual skills. So problem-based learning provides opportunities to build (life skills), metacognitive thinking (reflection with thoughts and actions), communication, and various related skills. With the application of problem-based learning models assisted by instructional videos, students experience many changes, especially in understanding. These changes are what bring students to get increased learning outcomes.

The advantage of this learning model is student activity. Through this learning model students are guided and involved to actively think, be creative, find directly the meaning or concept they want to know through a given problem and can find out various abstract concepts through experimental methods or simple practicum. In addition, the problem-based learning model includes almost all students active in the learning process so that the teacher only acts as a facilitator, namely by providing orientation about problems to students, then the teacher motivates students to be involved in problem-solving activities, organizing students to research, define and organize tasks-tasks related to the problem. The teacher also encourages students to get the right information through experiments and looking for explanations, and solutions and helps develop, analyze and evaluate the process of overcoming problems related to the material being taught.

In addition to these advantages, there are also disadvantages of this problem-based learning model, which is that it takes a long time to complete activities or problems related to the material being taught, besides those teachers are required to have good abilities in managing the class.

2. The influence of students' scientific attitudes on student learning outcomes

To find out how much scientific attitude each student is given a questionnaire containing 18 statements about student responses to the learning used. A scientific attitude questionnaire is given at the end of the lesson. The results of statistical tests showed different learning outcomes between students in the experimental class and the control class. Likewise, the value of the scientific attitude of students who have a scientific attitude is low, where the statistical test using the SPSS version 23 program shows a significant result, namely (0.000) $<\alpha$ (0.05) so it can be said that Ho is rejected. This means that the scientific attitude of students affects the value of student learning outcomes who have high and low motivation in the experimental and control classes.

The scientific attitude affects the value of student learning outcomes when using a problem-based learning model, besides that it is also combined with supporting methods such as this learning combined with experimental methods so that it can improve students' scientific attitudes, this is in accordance with the statement (Azmi et al. 2016) that the problem-based learning model uses experimental and discussion methods, the learning outcomes of students who have a higher scientific attitude than those who have a low scientific attitude. In addition, according to (Wulandari. & Rohaeti. 2017) the learning process uses a problem-based learning model which emphasizes the process of solving problems scientifically, allowing solving a problem through experiments so as to increase understanding and develop students' scientific attitudes.

A scientific attitude will be awakened in students during learning which stimulates the aspects contained in a scientific attitude so that it affects student learning outcomes as well. This is in accordance with the statement of Yuliana et al. (2013) that in the initial test, the scientific attitude of students was in the moderate category, but after being given treatment or a supporting learning model, the student's scientific attitude increased into a high category, planting scientific attitudes had a positive impact on students. Good at learning to understand or discover the concept yourself.

The application of problem-based learning models and other supportive learning models can have a positive effect and increase students' enthusiasm for learning to find new things for students and influence students' curiosity attitudes, this can prove that students' scientific attitudes have an effect on the final results of students. This is in accordance with the opinion (Imron et al. 2019) that one form of effort that can be made to improve learning outcomes in students can be done by cultivating and instilling a positive scientific attitude toward subjects, especially subjects that lead to experiments because someone who has a positive scientific attitude in learning, especially learning natural science, will learn more actively so that it can get good learning results.

3. **The interaction between learning models and scientific attitudes toward learning outcomes**

There is an interaction between learning models and scientific attitudes, this can be seen based on the increase in the value of learning outcomes and students' scientific attitudes, namely the post-test scores of the experimental class students who have an average of 75.90 and have a scientific attitude value (79.99) while the control class has an average value (62.50) and a scientific attitude (76.54), this value proves that the interaction between the problem-based learning model and scientific attitude is very influential, the greater the student learning outcomes, the better the student's scientific attitude also.

The statement above is in accordance with the research conducted by Israfiddin et al. (2016) which states that the high learning outcomes of students who are taught using problem-based learning models are also in accordance with the increase in students' scientific attitudes because learning using problem-based learning models can stimulate a scientific attitude of students so that students are more active and enthusiastic in responding to students.

The increase in the learning process is in line with the increase in student learning outcomes where several aspects are assessed, namely cognitive, affective, and skills. In this case, the affective aspect, namely student attitudes, is in accordance with research conducted by Aprillianti et al. (2018) said that the affective aspect of students (competency attitudes) of students, namely students' scientific attitudes in the learning process can improve student learning outcomes combined with the learning model problem-based learning so that student learning outcomes increase accompanied by increased student scientific attitudes. In addition, it is also supported by Rohman (2013). The application of problem-based learning is able to encourage group cooperation in solving problems, encouraging students to make observations and investigations that allow them to understand and explain the phenomena of real-world problems, in addition to the involvement of three domains (affective, psychomotor) and cognitive) is balanced so that the understanding of the concept of the material will be long remembered by students because they themselves build the knowledge.

Conclusions

Based on the research results it can be concluded that: There are differences in student learning outcomes using the problem-based learning model with the experimental method in the experimental class with the problem-based learning model in the control class in science subjects in class IV SD Negeri 4 Dampelas, this is in accordance with the post-test scores of learning outcomes where the experimental class got an average value (75.90) while the control class had an average value (62.50). There are differences in the learning outcomes of students who have high scientific attitudes with students who have low scientific attitudes in science subjects in class IV SD Negeri 4 Dampelas, this is shown from the learning outcomes, namely students who have a high scientific attitude get an average score (82.92), while students with low scientific attitudes have an average score (73.70). And there is an interaction between the problem-based learning model and scientific attitudes, in the learning outcomes of physics, in grade IV SD Negeri 4 Dampelas, this is shown based on the increase in student learning outcomes which affects how students' scientific attitudes, such as student post-test scores experimental class which has an average (75.90) and has a scientific attitude value (79.99) while the control class has an average score (62.50) and a scientific attitude (76.54), this value proves that the interaction between problem-based learning model and scientific attitude are very influential, the greater the student learning outcomes, the better the student's scientific attitude.

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References

Aprillianti, L., Irawati, S., & Kasrina. (2018). Meningkatkan sikap ilmiah dan hasil belajar siswa dengan model pembelajaran berbasis masalah. *Jurnal Pendidikan dan Pembelajaran Biologi, 2*(1), 58-67.

Arikunto, S. (2008). Dasar-dasar evaluasi pendidikan. Jakarta: Bumi Literasi.

Astuti, R., Sunarno., & Sudarisman. S.(2016). Pembelajaran IPA dengan pendekatan KPS menggunakan metode eksperimen bebas termodifikasi dan eksperimen terbimbing ditinjau dari sikap ilmiah dan motivasi belajar siswa. *Jurnal Penyelidikan, 1*(1), 51-59.

Azmi, M.K., Rahayu, S., & Hikmawati. (2016). Pengaruh Model Pembelajaran Berbasis Masalah dengan Metode Eksperimen dan Diskusi terhadap Hasil Belajar Fisika Ditinjau dari Sikap Ilmiah Siswa Kelas X Matematika dan IPA SMA Negeri 1 Mataram. *Jurnal Pendidikan Fisika dan Teknologi, 2*(2), 86-94.

Esen, E., & Neş'e, B. (2013). The effects of problem-based learning method in higher education creative thinking (WCES). *Procedia, Social and Behavioral, Turkey, 116*(2014), 3494-3498.

Gunada, w. I., sahidu. & H, Sutrio, (2015). Pengembangan perangkat pembelajaran fisika berbasis masalah untuk meningkatkan hasil belajar dan sikap ilmiah pada siswa. *Jurnal Pendidikan Fisika dan Teknologi, 1*(1), 9-14.

Imron. R.H., & Sahyar. (2019). Analisis pengaruh motivasi belajar dan sikap ilmiah terhadap hasil belajar fisika siswa SMA. *Jurnal Ikatan Alumni Fisika Universitas Negeri Medan, 5*(2), 27-34.

Israfiddin., Gani, A., & Saminan. (2016). Penerapan model problem based learning untuk meningkatkan sikap ilmiah dan hasil belajar siswa pada materi gerak di SMP Negeri 2 Delima. *Jurnal Pendidikan Sains Indonesia, 4*(1), 43-51.

Janah, M. C., Widodo, A.T., & Kasmui. (2018). Pengaruh model pembelajaran problem based learning terhadap hasil belajar dan keterampilan proses sains. *Jurnal Inovasi Pendidikan Kimia, 12*(1), 2097-2107.

Lestari, N. S. (2012). Pengaruh Model Pembelajaran Berbasis Masalah (Problem Based Learning) dan Motivasi Belajar terhadap Prestasi Belajar Fisika Siswa Kelas VII SMP. *Jurnal teknologi pembelajaran Indonesia, 1*(2), 1-21.Major,

Claire, Palmer, & Betsy. (2001). Assessing the effectiveness of problem-based learning in higher education. *Academic Exchange Quarterly, 5*(1). Retrieved November, 21, 2018. from the Literature.http://www.rapidintellect.com/AEQweb/mop4spr01.html.

Mulyani, S., Gani, A., Syukri, M., & Tarmizi. E. (2020). Application of problem based learning model to optical instrument material to increase confidence and ability to solve contextual problems. Indonesian *Journal of Science Education, 8*(1), 105- 113.

Rohman, Arif. (2013). *Understanding education and educational sciences.* Yogyakarta: LaksBang Mediatama Yogyakarta.

Sam, N. C. L, Syahrul & Jaya, H. (2018). Keefektifan penerapan model pembelajaran berbasis masalah dengan media video untuk meningkatkan kemampuan berpikir kritis siswa pada mata pelajaran jaringan dasar. *Jurnal Teknologi dan Media Komunikasi Pendidikan Kejuruan, 5*(2), 112-123.

Sumalee, C., Charuni, S. & Issara, K. (2012). The learner's creative thinking learning with learning innovation to encourage human thinking. *European Journal of Social Sciences 28*(2), 213-218.

Setiono, F. E. (2013). Pembelajaran berbasis masalah dalam pembelajaran menggunakan metode eksperimen melalui SBL (simulation based laboratory) dan VBL (video Based Laboratory) ditinjau dari kemampuan analisis dan berpikir kreatif. Tesis. Program Pascasarjana. Universitas Sebelas Maret. Surakarta.

Simbolon, D. H. (2015). Pengaruh model pembelajaran inkuiri terbimbing berbasis eksperimen nyata dan laboratorium virtual terhadap hasil belajar fisika siswa. Pascasarjana Universitas Negeri Medan. *Jurnal Pendidikan dan Kebudayaan, 21*(3), 299-316.

Suriana, Halim. A., & Mursal. (2016). Penerapan model problem-based learning (pbl) berbasis eksperimen untuk meningkatkan pemahaman konsep usaha dan energi ditinjau dari gaya berpikir siswa. *Jurnal Pendidikan Sains Indonesia, 4*(2), 127-139.

Wulandari, A., & Rohaeti. E. (2017). Pengaruh penerapan metode eksperimen pembelajaran berbasis masalah terhadap sikap ilmiah dan prestasi belajar kimia. *Jurnal Pembelajaran Kimia, 6*(1), 1-9.

Yuliana, E., Nuroso, H., & Siswanto, J. (2013). Pengaruh Model Pembelajaran Inkuiri Menggunakan Media Kartu Bergambar Terhadap Sikap Ilmiah Siswa Kelas VIII SMP Sayung 2 Tahun Pelajaran 2012/2013. *Jurnal Penelitian Pembelajaran Fisika, 4*(2), 21-27.