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THE EFFECTIVENESS OF PROBLEM BASED LEARNING MODEL IN SCIENCE LEARNING ON CRITICAL THINKING SKILLS OF FIFTH GRADE STUDENTS

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Abstract

The development of the times requires students to master 4 skills, one of the skills that must be mastered is Critical Thinking. The reality that occurs at SDN Dukuh 01 is that the critical thinking skills of grade V students are low. This research is to determine the effectiveness of Problem-Based Learning model in Science Learning on Critical Thinking Skills of 5th Grade Students at SDN Dukuh 01 in the even semester of the 2022/2023 school year. The research method used is quantitative with a research design of Non-equivalent Control Group Design. The total population in this study was 130 students, with a total sample of 52 students. The data collection technique in this study was to use a test instrument with 10 essay questions. Data analysis techniques using the normality test, homogeneity test, and t test. The Validity testing used the Pearson Colleration formula with eight valid and two invalid questions. The calculation of critical thinking skills data according to the indicators obtained the following average results: the experimental class of 83.25 and the control class of 64.74. It can be seen that the percentage results in the experimental class are higher than in the control class. Testing the analysis requirements, namely the normality and homogeneity tests using the SPSS 22.0 program obtained a value (sig.) > 0.05, which means that the data is normally distributed and homogeneous. The hypothesis testing used the independent sample t-test on SPSS 22.0, obtaining a value (sig.) 0.000; thus, Ha is accepted, and H0 is not accepted. It can be concluded that the use of the Problem-Based Learning model in science learning is effective on the critical thinking skills of five grader students at SDN Dukuh 01.

Keywords: *critical thinking; problem based learning; science learning*

Abstrak

Perkembangan zaman menuntut siswa untuk menguasai 4 keterampilan, salah satu keterampilan yang harus dikuasai adalah Berpikir Kritis. Realita yang terjadi di SDN Dukuh 01 keterampilan berpikir kritis siswa kelas V rendah. Studi ini bermaksud guna mengetahui efektivitas model *problem based learning* pada pembelajaran IPA akan keterampilan berpikir kritis siswa kelas V SDN Dukuh 01 pada semester genap tahun ajaran 2022/2023. Sistem penelitian yang dipergunakan ialah sistem kuantitatif menggunakan desain penelitian dan berbentuk *nonequivalent control group design*. Jumlah populasi pada penelitian ini sebanyak 130 peserta didik, dengan jumlah sampel sebanyak 52 peserta didik. Teknik pengumpulan data dalam penelitian ini adalah menggunakan instrument tes dengan 10 butir soal essay. Teknik analisis data menggunakan uji normalitas, uji homogenitas, dan uji t. Pengujian validitas mempergunakan rumus Korelasi *pearson* sebanyak sepuluh butir soal esai dengan delapan soal valid dan dua soal tidak valid. Perhitungan data keterampilan berpikir kritis sesuai indikator diperoleh rerata hasil kelas eksperimen sejumlah 83,25 dan kelas kontrol berjumlah 64,74, maka tampak bila persentase kelas eksperimen di atas kelas kontrol. Pengujian persyaratan analisis, yaitu uji normalitas dan homogenitas mempergunakan program SPSS 22.0 didapat nilai (sig.) > 0,05 yang berarti data berdistibusi normal dan homogen. Pengujian hipotesis mempergunakan uji *independent sample t-test* pada SPSS 22.0 memperoleh nilai (sig.) 0,000, maka Ha diterima dan H0 tidak diterima. Hasil itu memberi simpulan bila pemakaian model *problem based learning* efektif terhadap keterampilan berpikir kritis peserta didik pada pembelajaran IPA siswa kelas V SDNegeri Dukuh 01.

Kata Kunci: berpikir kritis; *problem based learning*; pembelajaran IPA

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Introduction

Education plays a vital role for every human being for success in the future. The 21st century learning process makes teaching and learning activities centered on educators, now experiencing changes by making students the center. In accordance with the times, students are required to master four skills, such as critical thinking, collaboration, communication, and creativity which can train students to compete in the future. One of the 4C skills in 21st century learning is Critical Thinking Skills. Critical thinking skills that needs to be developed in natural science assessment procedures. Competence in solving problems is proof of someone's willingness to overcome all problems. In teaching activities, students who are able to deal with problems are students who think critically (Mardhiyah et al., 2021).

From observations made during the introduction to the school field (Pengenalan Lapangan Persekolahan 2) at SDN Dukuh 01 it shows that the critical thinking skills of fifth grade students in science learning are still low. Based on the results of observations of the activities that researchers carry out, students have not been able to develop their critical thinking skills, it appears that students have not been able to solve problems that are directly related to events that occur around them. Students have not been able to give reasons, are still not confident in asking and answering questions, students have not been able to conclude when the teacher orders and asks again what has been said before, and students are still not able to evaluate or assess the results of observations made. In the implementation of teaching and learning processes that tend to focus on understanding and memorizing material with conventional models can cause students to be less able to develop critical thinking skills to solve problems. Educators (teachers) are only fixated on using one model, have not tried various variations of development or use other models in learning. To ensure students are equipped with 21st-century skills, teachers need to be capable of seamlessly incorporating these skills into their teaching methods (Li, 2023).

People use their minds to solve problems, make decisions, and pick up new ideas using critical thinking (O'Reilly et al., 2022).Critical thinking is an intellectual process in conceptualizing, applying, analyzing, connecting, and evaluating the various information they obtain from observations, observations, and reflections: the results of this stage are applied as a basis for decision making (Nurfidaris, 2022). Critical thinking becomes a disciplined way of thinking that is used by humans in order to be able to evaluate the validity of something (questions, ideas, arguments and research) (Saputra, 2020). The idea of critical thinking is commonly associated with an individual's evaluation of external information, involving reflection and the application of one's existing knowledge. This process represents a highly intricate cognitive activity that draws upon various disciplines (Encabo-Fernández et al., 2023). The teaching program asserts that critical thinking comprises numerous sub-skills, including identifying cause-and-effect relationships, recognizing similarities and differences in details using diverse criteria, assessing the credibility of provided information, validating identification, conducting analysis, evaluation, interpretation, and identifying underlying assumptions (Aktaş & Ünlü, 2013). Critical thinking devel-opment should be given focused consideration as integral to science teaching and learning (Kirk et al., 2023).

Characteristics of students who are considered capable of critical thinking, such as (1) analyzing and determining problems; (2) examine as an opinion; (3) determine the formulation of questions; (4) draw conclusions; (5) and evaluate or judge. Aspects of critical thinking skills include skills in analyzing, synthesizing; identify or solve problems; able to draw conclusions; and skilled in conducting evaluations (Nurfidaris, 2022). In Critical Thinking you also have to take appropriate steps, steps - steps to think critically as follows: (1) Identifying and identifying problems, (2) Accumulating Information, (3) Analyzing and evaluating all collected data, (4) Identifying assumptions , (5) Paying attention to the logical relationship between problems and answers, (6) Using straightforward language, (7) Determining solutions and solving problems, and (8) Making conclusions or giving opinions on a problem (Rositawati, 2019). The ability to think critically is a crucial ability to be integrated into learning procedures, including learning natural sciences.

Science learning, namely the stage for students in analyzing and observing many factors related to nature and all elements on earth (Legina & Sari, 2022). In the science learning process, teaching and learning activities are carried out directly which direct learning in terms of the relationship between social and natural (Yulistiana & Setyawan, 2020). The importance of learning science in elementary schools is useful in providing opportunities for students to develop their ability to ask questions, instill curiosity naturally, develop scientific ways of thinking, and seek answers to natural phenomena based on evidence (Wedyawati & Lisa, 2019). The amount or kind of content knowledge that pupils gain in school is frequently positively connected with their science learning (Ayotte-Beaudet et al., 2023). Apart from that, it also fosters an attitude of truly believing in nature, objects that are arranged regularly, therefore science can be used as a product, method and attitude to elementary school students who teach problem-solving methods, train critical thinking skills and also practice being objective (Dewi et al., 2019).

Learning with learning patterns that are in harmony with the conditions of the students themselves is a step in improving critical thinking skills, *problem based learning* model into a pattern that is able to optimize critical thinking skills. Problem-Based Learning (PBL) is an educational method that prioritizes student-centeredness and focuses on learning through problem-solving (Liu & Pásztor, 2022). Pattern Problem Based Learning refers to a sequence of educational activities centered around scientifically solving problems (Kalsum, 2022). This learning model involves using real-world problems as a platform for students to develop critical and competent thinking while gaining a deeper understanding of subject matter and concepts through problem-solving (Evi & Indarini, 2021). PBL develops crucial communication and teamwork skills while prompt-ing students to develop an explorative approach to problem-solving (Houghton, 2023). Effectiveness of *problem based learning* trigger students to be able to think critically by learning to observe problems in real life so as to get a deep and meaningful impression. Problem Based Learning also aims to useimprove critical thinking skills and expertise to form their own understanding (Khasanah et al., 2021). Besides helping students examines the concept of knowledge and expertise in solving problems by correlating the conditions of problems that occur in the real world (Mucharom, 2022). The Problem-Based Learning model comprises the following components: (1) Introducing Students to Problems, (2) Arranging Students for Learning, (3) Guiding Individual or Group Investigations, (4) Formulating and Presenting Findings, and (5) Assessing and Evaluating the Problem-Solving Process (Dwilestari, 2022).

Based on the background, this research is to know the effectiveness of the problem based learning model in science learning on the critical thinking skills of fifth grade students at SDN Dukuh 01.

Research Methods

The method that the researcher uses is quantitative as a procedure with research data in the form of numbers, as well as using analysis *statistics* (Sugiyono, 2021: 16). Quantitative research is highly valuable for examining the presence and magnitude of connections even makes it easier to make predictions based on the correlations between the variables (Wallwey & Kajfez, 2023).

This study's methodology is *quasi experiment design* that has a control group, although it does not have a full role to regulate external variables that affect the application of the study (Sugiyono, 2021: 118). In this study, the researcher wanted to take two classes as the experimental class as well as the control class. The study's non-equivalent control group design is as follows: Pre-tests will be administered to the experimental and control classes, then the experimental class received treatment using the model*problem based learning*, then the control class was not treated, and finally the two classes were given*Posttest.*

Time and place of research, namely at SDN Dukuh 01 which is located at Jalan H. Bokir bin Dji'un No.10 RT 001 RW 001, Kramat Jati, East Jakarta, DKI Jakarta. The even semester of the 2022–2023 academic year was the time for the research to be conducted, 08 to 10 May 2023. The population is a group or individual who inhabits a place and has a distinctive personality that is in the spotlight (Hernaeny, 2021). The population that the researcher used was all fifth grade students at SDN Dukuh 01 East Jakarta for the 2022/2023 school year. The total number of students in class V is 130 students divided into 5 classes:

Table 1.
Total Student Population

Class	Number of Students
Kelas 5A	26 students
Class 5B	26 students
Class 5C	26 students
Class 5D	26 students
Class 5E	26 students

The sample is half or representative of the number and personality in the population to be used for a study (Hernaeny, 2021). Techniques in taking samples using*simple random sampling*. This technique for taking a single sample is carried out randomly, so that all populations have an equal chance of being sampled (Amin et al., 2023). All classes that enter the population have an equal chance of being sampled. The sample in this research was class V B with 26 students as the experimental class, and class VD with 26 students as the control class.

Procedure

Before taking action, the researcher made preparations first. The procedures for conducting this research are: (1) Determine the schedule for conducting the research; (2) Making learning implementation plans (RPP); (3) Preparation of questions for needs*pretest* nor*posttest*based on indicators of critical thinking; (4) Sharing*pretest* to the control and experimental classes with the same questions; (5) The implementation of the treatment or learning procedures in this study

was carried out according to the sequence of activities in the lesson plan based on the syntax of the model*problem based learning* which has been prepared; (6) Sharing*posttest* in the control class and experimental class. Results*posttest* that is what will be seen later whether the application of the PBL model is effective for critical thinking skills; (8) Research data obtained by researchers through the results of the score*pretest* nor*posttest* which have been submitted to the control and experimental classes. (9) The results of the study are concluded based on the calculations that have been done.

Instruments are tools that researchers use to obtain data so that data collection activities are structured and easier (Makbul, 2021). In this study, researchers used test and non-test instruments. The test instrument is useful as a measure of critical thinking skills. The test is in the form of an essay regarding the material for ecosystem balance which will be handed over to students. The test to be submitted is*pretest* nor*posttest* with the same type and number of questions. The non-test instrument in this study is documentation. Documentation is a record of events in the past, usually in the form of writing, pictures, videos or other works produced (Sugiyono, 2021). This study uses documentation, (RPP), student attendance lists, and photos of learning activities in class. The instrument grids according on the indicators of critical thinking skills by Arikunto are:

Table 2.
Research Variable Indicator

No	Critical Thinking Skills Indicator	Question Number
1	Evaluate or assess the results of observations	1,2
2	Ask and Answer Questions	3,8
3	Make a Conclusions	4,6
4	Ability to Give Reasons	5,10
5	Problem Solving	7,9

Validity test, which is a scale that shows the level of validity of the instrument (Makbul, 2021). The validity test in this study uses the Pearson Correlation formula.

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\{N\sum X^2 - (\sum X^2)\}\{N\sum Y^2 - (\sum Y^2)\}}}$$

A test that is said to be reliable is not necessarily said to be valid but if a test is said to be valid, then it can automatically be said to be reliable (Aini, 2018). For questions of shape*essay* using the Alpha formula as a measure of the reliability of the questions. In this study, reliability testing was carried out using SPSS 22.0.

The normality test is carried out to clarify if the sample data is obtained from a normally distributed population. If the data operates abnormally, a Parametric Test is carried out (Quraisy, 2020). The normality test employs the Kolmogorov-Smirnov test in SPSS 22.0. This test for distributions, proposed by Kolmogorov and Smirnov, is founded on smoothed distribution functions (Zhou et al., 2023). The homogeneity test is a prerequisite test in statistical analysis to ascertain whether the two data have different or the same variants (Usmadi, 2020). This test uses SPSS 22.0. Hypothesis testing is a conjecture or theoretical supposition that cannot be accepted or accepted empirically (Wardani, 2020). that is, to make sure the test is accepted or not accepted, then you can do a hypothesis test. In testing the hypothesis, it can use*independent sample t-test* on the SPSS 22.0 program.

Results and Discussion

The test instrument in the study consisted of 10 essay questions after testing the validity with the correlation formula*pearson* the results obtained were eight valid questions, and two invalid questions. Each question has a score of one to five, the assessment is carried out by accumulating the total score obtained plus 10 and multiplied by 2. Data Description Results for class VB as many as 25 students with 1 student not present when conducting research on natural science material. Based on results *posttest* in the post-treatment assessment class using patterns*problem based lerning*, obtained a maximum value of 94 and a minimum value of 44,*mean* a total of 74.72, a median of 78, a mode of 86, a standard deviation of 15.95. In this way, the frequency distribution table is obtained as follows:

Table 3.
Data Frequency Distribution*Posttest* Experiment

Interval		Middle value	Real Limits	Frequency		
				Absolutely	**Cumulative**	**Relatively(%)**
44	52	48	43,5 - 52,5	3	3	12%
53	61	57	52,5 - 61,5	2	5	8%
62	70	66	61,5 - 70,5	3	8	12%
71	79	75	70,5 - 79,5	5	13	20%
80	88	84	79,5 - 88,5	7	20	28%
89	97	93	88,5 - 97,5	5	25	20%
		Total		25		

Referring to the explanation above, a histogram can be made*polygon* result frequency*posttest* in the experimental class like this graphic image:

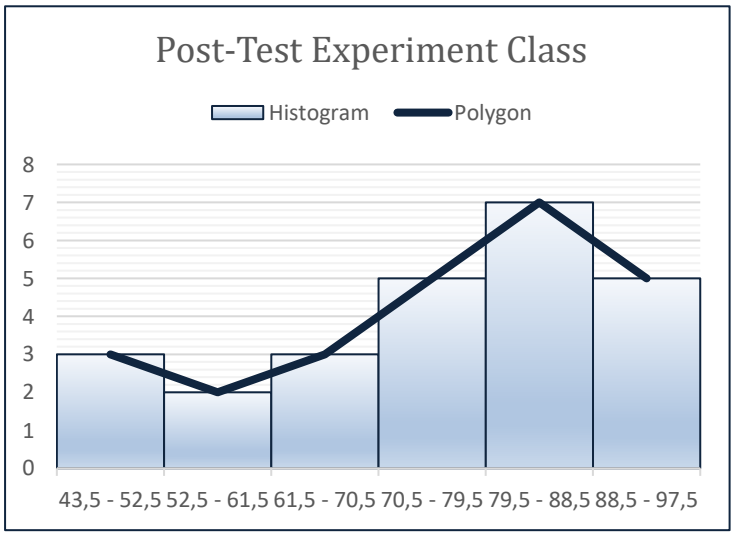

Figure 1.
Histograms and*Polygon* results*Posttest* Experiment Class

On the histogram as well*polygon* above, clarify when the results*posttest* experimental class after use*problem based learning* the score range is between 79.5 – 88.5 or has the highest frequency, namely 7 students.

The results of the VD class value data for a total of 25 students with 1 student not present when conducting research on natural science material. Based on results*posttest* control class without any model treatment*problem based learning*, the maximum value is 82, the minimum value is 36,*mean* a total of 62.88, a median of 66, a mode of 70, a standard deviation of 13.18. That way, the researcher gets a frequency distribution table like:

Table 4.
Data Frequency Distribution*Posttest* Control

Interval		Middle value	Real Limits	Frequency		
				Absolutely	**Cumulative**	**Relatively(%)**
36	43	39.5	35,5 - 43,5	2	2	8%
44	51	47.5	43,5 - 51,5	5	7	20%
52	59	55.5	51,5 - 59,5	1	8	4%
60	67	63.5	59,5 - 67,5	7	15	28%
68	75	71.5	67,5 - 75,5	4	19	16%
76	83	79.5	75,5 - 83,5	6	25	24%
		Total		25		100%

Referring to the description above, a histogram can be made *polygon* result frequency *posttest* in the control class like the following graph:

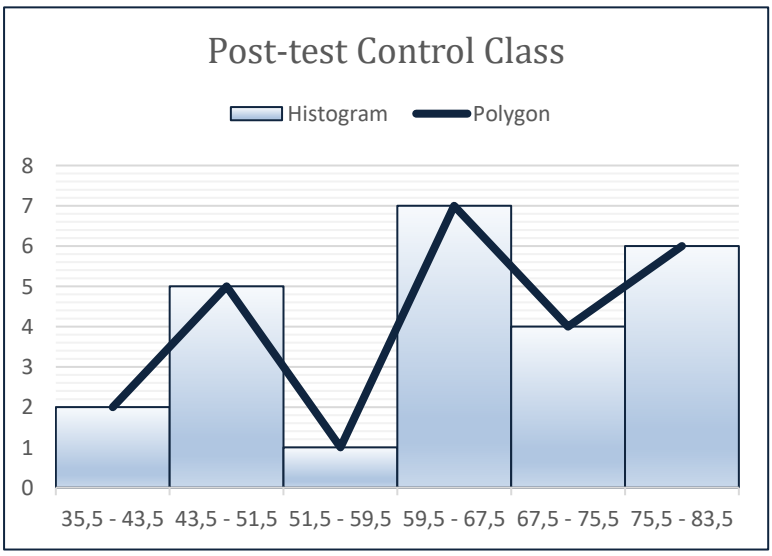

Figure 2.
Histograms and*Polygon* Experiment Class Post-Test results

Histograms as well*polygon* above, it appears when the results*posttest* control class without treatment with a range of scores between 59.5 – 67.5 or having the highest frequency, namely 7 students.

Statistical information about each indicator's average value of critical thinking skills, seen from the total score of all students in each indicator which is calculated in percentage form. The

subsequent description presents a comparison of the average values for the difference in each indication between the experimental class and the control class.

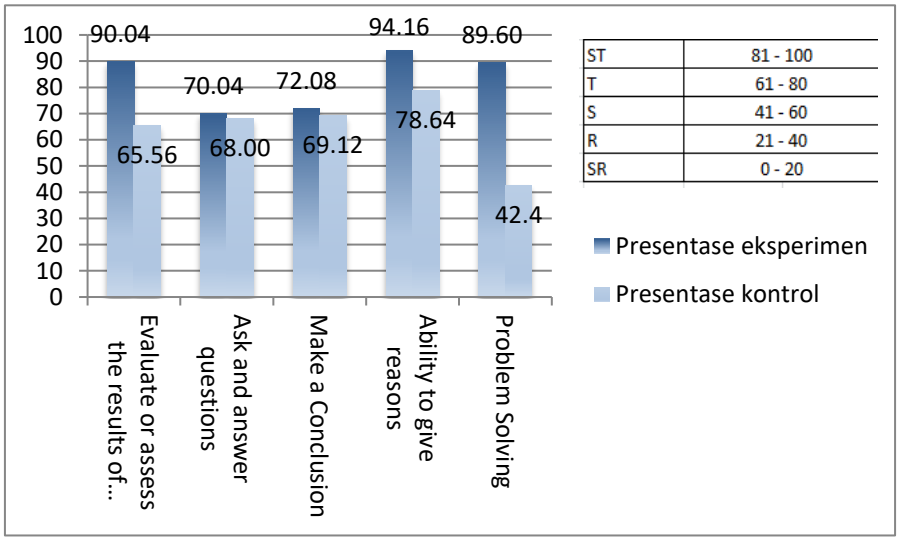

Figure 3.
Critical Thinking Skills data according to indicators

The research data based on the picture above shows that in the experimental class the ability to give reasons has the highest percentage value reaching 94.16 and being able to ask and answer questions has the lowest percentage value of 70.04. In the control class, the largest percentage is in the ability to give reasons indicator of 78.64 and the lowest percentage value is in the problem solving indicator of 42.40. According to the average percentage of each indicator in the experimental class, it is 83.25. Based on the interval in (image 3), the critical thinking skills of the experimental class with *problem based learning* very high. The average obtained from the percentage of each indicator in the control class is 64.74, so the critical thinking skills of the control class are high. From the explanation above, the comparison of the percentage values for each critical thinking skill in the assessment class or the control class is very visible. The percentage value of each critical thinking ability in the experimental class is above the control class.

Test requirements that two tests are conducted: the normality test and homogeneity test. The normality test involves using the Kolmogorov-Smirnov test at a 5% significance level. If the significance (sig.) is greater than 0.05, the data is considered normally distributed.

According to the calculation above, getting a significance value between variables 0.097 > 0.05 denotes a regularly distributed distribution for all data.

Table 5.
Test of Normality

		Kolmogorov-Smirnov[a]		
	Kelas	Statistic	df	Sig.
Hasil Keterampilan Berpikir Kritis	PreTest Eksperimen	.145	25	.189
	PostTest Eksperimen	.160	25	.097
	PreTest Control	.115	25	.200*
	PostTest Control	.153	25	.132

Homogeneity test makes a decision through a homogeneity test, that is, if the sig. > 0.05, means it is said to be homogeneous. Based on the results of the homogeneity test, the significance value (sig.) 0.350 > 0.05. The results give a conclusion if the group variance *posttest* experimental class with *posttest* the control class is homogen.

Tabel 6.
Test of Homogeneity of Variances Critical Thinking

Levene Statistic	**df1**	**df2**	**Sig.**
.891	1	48	.350

Testing the hypothesis using the test*independent sample t-test* SPSS 22.0 program (Table 6). Based on the calculated results, a significance value (sig) of 0.000 was obtained. According to the criteria, it can be concluded that if the value *sig.* <0.05 Ha is accepted and H0 is not accepted, so A considerable disparity exists in critical thinking skills of fifth grade students at SDN Dukuh 01, between the experimental class whose learning uses the*problem based learning* with the control class using the conventional model. It can be concluded the use of patterns *Problem Based Learning* model effective in science learning on critical thinking skills of 5th grade students at SDN Dukuh 01.

Tabel 7.
Independent Samples Test

		t-test for Equality of Means						
		T	**Df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**	**95% Confidence Interval of the Difference**	
							Lower	**Upper**
Results of Critical Thinking Skills	Equal variances assumed	-7.483	48	.000	-32.240	4.308	-40.903	-23.577
	Equal variances not assumed	-7.483	47.562	.000	-32.240	4.308	-40.905	-23.575

The highest score obtained in Pre-Test Experimental class before treatment using the Problem Based Learning model which is equal to 64 and the lowest score is 0. The highest score obtained in*Post-Test* Experimental class after the treatment given using the Problem Based Learning paradigm, the highest value is 94, and the lowest value is 44. The highest value obtained at *Pre-Test* control class without being given treatment using a *Problem Based Learning* model which is equal to 70 and the lowest value is 0. The highest value obtained at *Post-Test* the control class after learning using the conventional model is equal to 82 and the lowest is 36. The results of calculating the percentages for each indicator show that the experimental class gets a

greater percentage result than the control class. For indicators evaluating or assessing results, the experimental class has a percentage of 90.04 while the control class has a percentage of 65.56. The indicator of being able to ask and answer questions for the experimental class has a percentage of 70.04 and the control class has a percentage of 68.00. The indicator for making conclusions in the experimental class has a percentage of 72.08 and the control class has a percentage value of 69.12. The indicator of the ability to give reasons in the experimental class has a percentage of 94.16 and the control class has a percentage of 78.64. The last indicator, namely solving problems in the experimental class, has a percentage of 89.60 and the control class has a percentage of 42.4.

Calculation by an independent *sample test* which has been analyzed shows that the significance value (sig) < 0,05. Based on sig. (2-tailed) obtained i.e. 0.000 <0.05 states that Ha is accepted and Ho is not accepted or rejected, then there is a significant difference in the experimental and control classes due to differences in treatment, namely the use of the model *Problem Based Learning* on students' critical thinking skills on ecosystem balance for fifth grade at SDN Dukuh 01.

Students enrolled in the experimental class who make advantage of the *problem based learning model*, as well as being involved in study groups to be more active in discussing, giving opinions, asking questions, and presenting results. Students in study groups put more emphasis on analyzing and solving problems presented by educators so that students gain their own understanding. Just like Evi & Indarini (2021), mention if the model*problem based learning* is a learning model that uses real problems as a forum for students to be able to learn to think critically and be able to overcome a problem so that students get an understanding or concept of the subject.

These results are similar to previous studies that clarify when*problem based learning* effective on students' critical thinking skills, namely Nurfidaris' research (2022) with the title "Effectiveness of Applying the Learning Model*Problem Based Learning* on Students' Critical Thinking Ability in Class V Civic Education at SD Negeri 1 Dena". This research clarifies if the increase in critical thinking skills of fifth grade elementary school students in Civics learning uses a model *problem based learning*. This is clarified by the percentage of the first cycle of 61.9% and increased in the second cycle with the percentage of 85.7%. On that basis, by applying the learning model*problem based learning* effective, of course able to optimize students' critical thinking skills in Civics learning.

Use of *problem based learning* model make students able to work well together in study groups through various experiments. Students become more active because of their high curiosity about everything they encounter. It can also direct students to think critically in solving real problems.

From the aforementioned description, it is evident from the data analysis and study results discussion that a notable distinction exists in the mean scores in the experimental or control classes. In addition, according to the indicators, the experimental class has higher results than the control class. These results give a conclusion when using *problem based learning* model effective in science learning on the critical thinking skills of 5th grade students at SDN Dukuh 01.

Conclusion

Derived from conducted research in 5th grade SDN Dukuh 01 East Jakarta in the subject of Sciences learning, the findings from the research lead to the conclusion that the impact of the

problem-based learning model on students' critical thinking skills is highly significant.. This can be proven through the results of the ability to think critically according to the average obtained from the percentage of each indicator of the experimental class which is equal to 83.25 then according to the interval in Figure 4.5 it is concluded that the critical thinking skills of the experimental class use the model*problem based learning* very high. While the average obtained from the percentage of each control class indicator is equal to 64.74 then according to the interval in Figure 4.5 it is concluded that the critical thinking skills of the control class are high. Another thing seen from the results of hypothesis testing with a significance value of 0,000 < 0,05. Therefore the application of the problem-based learning model is an effective learning model for students' critical thinking skills and adds to educator innovation in the use of learning models.

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