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Improving Students' Mathematical Problem-Solving Skill and Self-Efficacy through Problem-Based Learning Models with Scientific Approaches

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Abstract

This study aims to determine (1) the mathematical problem-solving skills of students who receive the PBL model compared to students who receive conventional learning, (2) improving the mathematical problem-solving skills of students who receive the PBL model with a scientific approach compared to students who receive conventional learning, (3) self-efficacy of students who receive the PBL model with a scientific approach compared to students who receive conventional learning, (4) improving the self-efficacy of students who receive the PBL model with a scientific approach compared to students who receive conventional learning. The research method used was a quasi-experimental method with a population of all VIII grade students at one of the junior high schools in Cilegon. Sampling was carried out by cluster random sampling technique. This results showed that the mathematical problem-solving skill of students who received the PBL model with a scientific approach was better than students who received conventional learning, improved problem-solving skills of students who get the PBL model with a scientific approach are better than students who get conventional learning, the self-efficacy of students who receive the PBL model with a scientific approach is better than students who receive conventional learning, and the improving in self-efficacy of students who get the PBL model is better than students who get conventional learning. Based on the research results, learning the PBL model with a scientific approach can be an alternative learning to improve students' problem-solving skills and self-efficacy.

Keywords: *Problem-Based Learning, Scientific Approach, Mathematical Problem-Solving Skill, Self-Efficacy*

Abstrak

Penelitian ini bertujuan untuk mengetahui (1) kemampuan pemecahan masalah matematis siswa yang memperoleh model PBL dibandingkan dengan siswa yang memperoleh pembelajaran konvensional, (2) meningkatkan kemampuan pemecahan masalah matematis siswa yang memperoleh model PBL dengan pendekatan saintifik dibandingkan siswa yang mendapat pembelajaran konvensional, (3) efikasi diri siswa yang mendapat model PBL dengan pendekatan saintifik dibandingkan siswa yang mendapat pembelajaran konvensional, (4) meningkatkan efikasi diri siswa yang mendapat model PBL dengan pendekatan saintifik dengan siswa yang menerima pembelajaran konvensional. Metode penelitian yang digunakan adalah metode kuasi eksperimen dengan populasi seluruh siswa kelas VIII di salah satu SMP di Kota Cilegon. Penarikan sampel dilakukan dengan teknik *cluster random sampling*. Hasil penelitian ini menunjukkan bahwa kemampuan pemecahan masalah matematis siswa yang mendapatkan model PBL dengan pendekatan *scientific* lebih baik daripada siswa yang mendapatkan pembelajaran konvensional, peningkatan kemampuan pemecahan masalah siswa yang mendapatkan model PBL dengan pendekatan *scientific* lebih baik daripada siswa yang mendapatkan pembelajaran konvensional, *self-efficacy* siswa yang mendapatkan model PBL dengan pendekatan *scientific* lebih baik daripada siswa yang mendapatkan pembelajaran konvensional, dan peningkatan *self-efficacy* siswa yang mendapatkan model PBL lebih baik daripada siswa yang mendapatkan pembelajaran konvensional. Berdasarkan hasil penelitian, pembelajaran model PBL dengan pendekatan *scientific* dapat menjadi alternatif pembelajaran untuk meningkatkan kemampuan pemecahan masalah dan *self-efficacy* siswa.

Kata kunci: *Problem-Based Learning,* Pendekatan *Scientific*, Kemampuan Pemecahan Masalah, *Self-Efficacy*.

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Introduction

Education is a very important need, which must be fulfilled by humans (Siswono et al, 2018). This is due to its large role in socio-economic development, both individually and at the national level. The progress of a nation will be directly proportional to the level of educational progress. In addition, every individual is required to continuously develop science and technology in order to face all problems, challenges, and be able to compete in life. According to Indrawati (2020) mathematics has a very large and important contribution in everyday life. The life of the 21st century is full of rapid changes. Warsono and Harianto (2012) argue that nowadays there is an increasing awareness of the need to form young people who are skilled at solving problems, wise in making decisions, thinking creatively, deliberating, being able to communicate their ideas effectively, and able to work efficiently, both individually and in groups. This causes problem- solving skills needed by students. One of the lessons that can develop problem-solving skills is learning mathematics.

Mathematical problem-solving skills are all complex cognitive activities, as a process to overcome a problem encountered and to solve it requires a number of strategies (Harahap & Surya, 2017). The skill to solve mathematical problems is one of the cognitive skills that students must have in the learning process. In addition, the overall goal in learning mathematics is problem-solving, meaning that problem-solving skill is a basic skill in learning mathematics (Sariningsih & Purwasih, 2017). The teacher plays an important role in facilitating students to actively express their ideas in the problem-solving process.

Kemendikbud (2013) suggests that learning mathematics that is expected in classroom learning practices, namely: (1) learning is centered on student activities, (2) students are given the freedom to think about understanding problems, building problem-solving strategies, submitting ideas freely and openly, (3) the teacher trains and guides students to think critically and creatively in solving problems, (4) the teacher's efforts to organize cooperation in study groups, train students to communicate using graphs, diagrams, schemes, and variables, (5) all work results are always represented in front of the class to find various concepts, problem-solving results, and mathematical rules found through the learning process. In addition, the National Council of Teachers of Mathematics or NCTM (2000) also states that mathematics standards in schools must include content and process standards. Process standards include: (1) problem-solving, (2) reasoning and proof, (3) communication (communication), (4) connection (connection); and representation. From some of the descriptions above, it can be concluded that in the process of learning mathematics in the classroom, the teacher is only a facilitator for students so they can think critically, creatively, communicate their ideas, solve a problem, and have the courage to argue.

The need for problem-solving skills is inversely proportional to the achievements achieved by Indonesian students. Based on the results of the 2018 Trends in International Mathematics and Science Study (TIMSS) study, it shows that Indonesian students are in a relatively low ranking, which ranked 72nd out of 78 countries is participating in the assessment. The results of the preliminary study conducted by the researcher yielded an mean score of the mathematical problem-solving skill of class VIII students at a junior high school in Cilegon city which was still relatively low, namely 22.3 out of a maximum value of 100. Similarly, the results of interviews with a mathematics teacher, it is known that currently class students VIII is less enthusiastic and lacks a high sense of curiosity about mathematics so that the math skills of Grade VIII students are low, especially in working on problem-solving questions.

In addition to cognitive skills, affective skills are also required for students in learning mathematics. Affective skill is one of the important skills that must be mastered by students both inside and outside of teaching and learning activities (Anas & Sartika, 2021). One of the affective skills that students must have in learning mathematics is the skill of mathematical self-efficacy (self-confidence).

In the field of mathematics study self-efficacy is needed. Oktariani (2018) suggests that students who have self-efficacy have confidence accompanied by high enthusiasm in carrying out each learning assignment so that every activity they carry out is successful, in contrast to students who have low self-efficacy who have the belief "I can't" so that he will tend to experience failure in every activity he does. Therefore, self-efficacy is very important in improving students' mathematical skills.

Self-efficacy is a self-confidence or belief that students must have in order to be successful in the learning process (Rahmi et al., 2017). Jatisunda (2017) said self-efficacy is a psychological aspect that has a significant influence on student success in solving problem-solving questions and assignments properly. Self-efficacy can be developed from students in learning mathematics through four sources, namely: (a) performance experience; (b) other people's experiences; (c) direct/social support aspect; and (d) psychological and affective aspects (Bandura, 1999).

Problem-solving skills and students' self-efficacy are two very important things in every mathematics learning process. Therefore we need a learning model that is able to make students active, creative, and innovative in improving mathematical problem-solving skills and self-efficacy. So that students have more confidence to solve math problems in everyday life if they are used to learning at school. This is in line with Permendikbud No. 65 of 2013 concerning process standards for primary and secondary education, hints at the need for a learning process that is guided by the principles of a scientific approach. One learning model that is thought to be able to improve students' problem-solving skills and self-efficacy is the Problem-Based Learning (PBL) learning model combined with the scientific approach. According to Akmalia (2016), the Problem-Based Learning (PBL) learning model can provide space for students to be able to find and construct concepts independently and be able to develop thinking skills and solve problems.

In addition, Olpado & Heryani (2017) also stated that the Problem-Based Learning (PBL) learning model is very appropriate for use in learning mathematics because it allows students to actively participate in learning. This is also supported by the results of Sumartini's research (2016) which explains that the mathematical problem-solving skills of students who receive learning using the PBL model are better than students who receive conventional learning. The PBL learning model is learning that uses real (authentic) problems that are not structured (ill-structured) not routine questions and are open as a context for students to develop problem-solving skills and critical thinking as well as build new knowledge (Arends, 2015). Therefore learning with the PBL model is an appropriate approach by utilizing the background of actual problems so that students can learn problem-solving skills. Furthermore, according to Hosnan (2014) the PBL learning model is a learning model with a learning approach to students on authentic problems so that inquiry skills and skills can be developed to a further level, knowledge can be self-constructed, and makes students independent and improving confidence himself. So that it can provide opportunities for students to improve their self-efficacy. Therefore, this study aims to determine (1) the mathematical problem-solving skill of students who receive the PBL model compared to students who receive conventional learning, (2) improving the mathematical problem-solving skills of students who receive the PBL model with a scientific approach compared to students who receive conventional learning, (3) self-efficacy of students who receive the PBL model with a scientific approach compared to students who receive conventional learning, (4) improving the self-efficacy of students who receive the PBL model with a scientific approach compared to students who receive conventional learning.

Method

This research is a quasi-experimental study using a non-equivalent control group design, namely a research design where the research subjects are not randomly grouped because it is determined by the school. This study involved two classes, namely the experimental class and the control class. The experimental class is the class that will get the PBL learning model with a scientific approach and the control class is the class that gets conventional learning. The non-equivalent control group design research design can be seen in **Figure 1** (Ruseffendi, 2010).

0 X 0
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0 0

Figure 1. Non-Equivalent Control Group Research Design

Information:

0 = Pretest and posttest in the experimental class and control class.

X = PBL learning model with a scientific approach.

--- = Indicates the subject was not randomly selected.

The population in this study were all students of grade VIII at a junior high school in Cilegon. In this study, sampling was carried out by cluster sampling technique. The samples in this study were two classes taken from eight existing classes, then determined to be the experimental class and the control class. Class VIII B was selected as the experimental class which received the PBL model with a scientific approach and class VIII A as the control class which received conventional learning. The number of students in the two classes is different, the number of students in the experimental class is 27 students and the number of students in the control class is 26 students. This research lasted for eight meetings including pretest and posttest. The research procedure is shown in **Figure 2**.

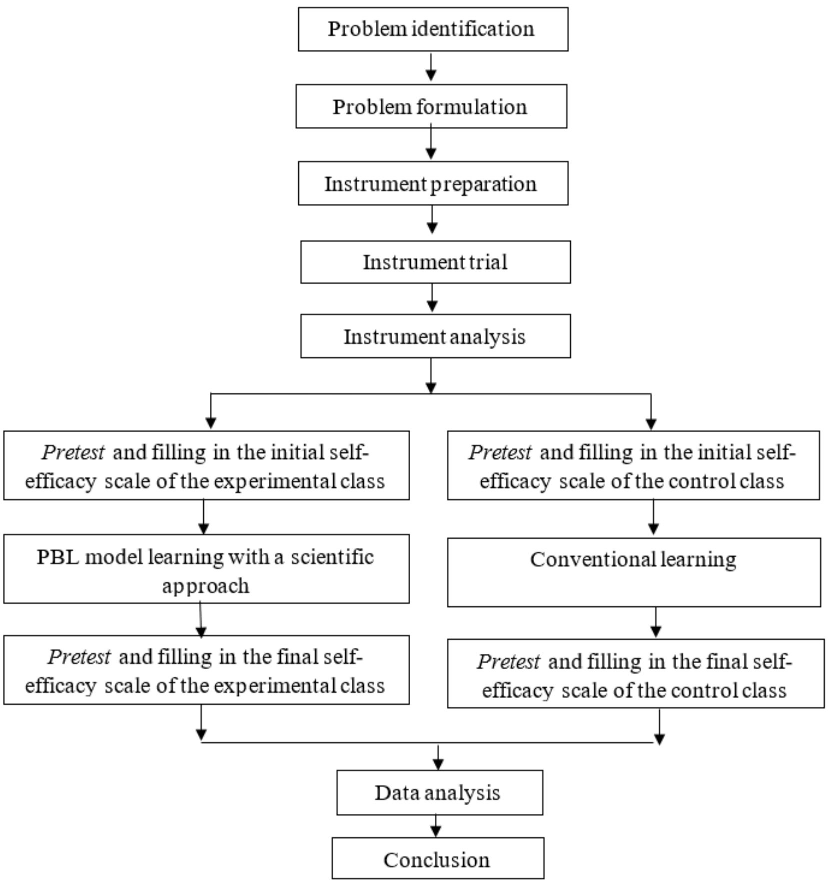

Figure 2. Research Procedure

The instruments in this study were a problem-solving skill test, a self-efficacy scale, and an observation sheet using the material for flat sides, especially prisms and pyramids. The selection of material is adjusted to the teaching and learning process that takes place at school.

This problem-solving skill test instrument contains five items in the form of descriptions and contains the same questions given to the research subjects. The scoring indicators used in this study are problem-solving indicators developed by Sumarmo (2010) as follows:

Table 1. Mathematical Problem-Solving Skill Scoring

Score	Understanding Problems	Create a Solution Plan	Solve the Problem	Interpret Results
0	There is no identifying information about being known and being asked	No plan, making plans irrelevant	Not doing calculations	There is no interpretation of the results
1	There is identification information about the question but it is not complete	Create a problem-solving plan that cannot be implemented / because it does not have a relationship with the necessary concepts	Carrying out the correct procedure might result in a correct answer but an incorrect calculation	There is an interpretation of the results but not complete
2	Understand and identify the complete question information	Making plans that are correct, but incomplete	Carry out correct and correct procedures in calculations	There is a complete interpretation of the results of the answers
3		Making plans that are right, but wrong in results		
4		Make plans according to procedures and lead to the correct solution		
	Max score 2	Max score 3	Max score 2	Max score 2

Adopted from Sumarmo (2010)

In this study, the attitude scale of self-efficacy in this study was measured using a questionnaire or questionnaire instrument. This scale is used to determine student self-efficacy before and after learning the PBL model with a scientific approach. This self-efficacy scale uses a Likert scale with a scale response of four answer criteria, namely Strongly Agree (SS), Agree (S), Disagree (TS), and Strongly Disagree (STS). Response options on a scale of four have better or more complete response variability and there is also no opportunity for respondents to be neutral (Widoyoko, 2013).

The third instrument is the observation sheet. The observation sheet is an instrument that is used during the learning process and is filled in directly by the observer during the learning process. Aims to guarantee the implementation of the PBL model with a scientific approach in the experimental class by researchers. After the data is collected, data processing and analysis is carried out. Data processing, namely pretest, posttest, and gain data from mathematical problem-solving skill tests and the initial scale, final scale, and gain self-efficacy which will be statistically tested include prerequisite tests for normality, homogeneity, t-test, and similarity test of two means.

Normality Test

In this study the normality test was used to determine whether the pretest, posttest and gain data in the control class and experimental class were normally distributed or not. A data forms a normal distribution if the amount of data above and below mean is the same, as well as the standard deviation (Sugiyono, 2012).

Homogeneity Test

Before testing the hypothesis, it will be tested whether the data used is homogeneous or not using the homogeneity test with the F test.

T-test

In this study the t-test aims to determine whether there is a mean difference between students in the experimental class and the control class.

Test for the Similarity of Two Means

Two-tailed t-test was used to find out whether students in the experimental class and the control class had the same mean initial conditions. The test uses pretest data on students' initial mathematical problem-solving skills and initial self-efficacy scale.

Result and Discussion

After the researchers conducted the research, data on mathematical problem-solving skills were analyzed, namely pretest scores, posttest scores, and gains, as well as self-efficacy scale data that were analyzed, namely initial scale scores, final scale scores, and self-efficacy gains. The data is used to test the hypotheses that have been formulated previously. Following are the results of data analysis of mathematical problem-solving skill and self-efficacy in this study.

Data Analysis of Mathematical Problem-Solving Skill

Descriptive Analysis

This research begins with giving a pretest. Giving pretest questions aims to determine the initial skills possessed by students in both the experimental class and the control class. An overview of the descriptive statistics regarding the pretest scores of the experimental class and the control class can be seen in **Table 2** below.

Table 2. Pretest Data Descriptive Statistics Table

Statistic	**Experiment Class**	**Control Class**
Total Students (n)	27	26
Minimum Score ($X_{\min}$)	6	5
Maximum Score ($X_{\max}$)	28	27
Mean ($\bar{X}$)	15,06	14,81
Standar Deviation (s)	6,31	6,49
Ideal Maximum Score (SMI)	50	50

(Source: Data processed by researchers)

Based on the table above, it can be seen that the pretest results for the experimental class and the control class were not much different, namely 15.06 and 14.81. This means that statistically descriptive, there was no significant difference in the initial skills of the two classes.

This research ended by giving posttest questions about mathematical problem-solving skills. Giving posttest questions aims to determine students' mathematical problem-solving skills after being given learning. An overview of the descriptive statistics regarding the posttest scores of the experimental class and the control class can be seen in **Table 3** below.

Table 3. Posttest Data Descriptive Statistics Table

Statistic	Experiment Class	Control Class
Total Students (n)	27	26
Minimum Score ($X_{\min}$)	23	16
Maximum Score ($X_{\max}$)	50	40
Mean ($\bar{X}$)	34,44	29,35
Standar Deviation (s)	7,86	5,71
Ideal Maximum Score (SMI)	50	50

(Source: Data processed by researchers)

Based on the table above, it can be seen that the posttest results for the experimental class were 34.44 while those for the experimental class were 29.35. It can be seen that based on descriptive statistics, the mean experimental class students are larger than the control class.

In addition to the pretest and posttest results, there is also a gain score. The gain score is sought to determine the improve in students' mathematical problem-solving skills. Descriptive statistics regarding the gain scores of the experimental class and the control class can be seen in **Table 4** below.

Table 4. Gain Data Descriptive Statistics Table

Statistic	Experiment Class	Control Class
Total Students (n)	27	26
Minimum Score ($X_{\min}$)	0,27	0,08
Maximum Score ($X_{\max}$)	1,00	0,75
Mean ($\bar{X}$)	0,57	0,40
Standar Deviation (s)	0,21	0,17
Ideal Maximum Score (SMI)	1,00	1,00

(Source: Data processed by researchers)

Based on the table above, it can be seen that the gain of the experimental class has an mean of 0.57 with moderate classification and the control class is 0.40 with moderate classification. Based on the descriptive statistics above, it can be seen that mean gain score for the experimental class is greater than that for the control class, even though it is in the same classification, namely moderate. Mean gain score for the control class is 0.40 which, when seen in the table of the gain score criteria, is close to the maximum limit for the low classification, which is 0.30. Meanwhile, mean gain score for the experimental class was 0.57, which, when seen in the table for the gain score criteria, is close to the minimum high classification limit, namely 0.70. This means that the mathematical problem-solving skills of the experimental class students are better than those of the control class students.

Inferensial Analysis

This research begins with giving a pretest. Pretest data analysis is needed to obtain conclusions whether the experimental class and control class pretest data have the same initial skills or not. The data used are the pretest scores of students' mathematical problem-solving skills in the experimental class and the control class. The complete pretest data analysis steps are as follows.

First, there is a normality test on the pretest data using the Chi Square formula (χ^2) at a significance level of 5% (α = 0,05). After doing the calculations, it is obtained that in the experimental class $\chi^2_{count} = 4{,}05$ and the control class $\chi^2_{count} = 5{,}71$ with $\chi^2_{table} = 11{,}10$

then H_0 is accepted. This means that the pretest result data for the experimental class and the control class are normally distributed, which means that the pretest result data are taken randomly from the normal population. The results of the pretest data normality test are presented in **Table 5**.

Table 5. Pretest Data Normality Test

Data	χ^2_{count}	χ^2_{table}	Decision
Experiment	4,05	11,10	Normal
Control	5,71	11,10	Normal

(Source: Data processed by researchers)

Second, there is a homogeneity test on the pretest data using the F-test at a significance level of 5% (α = 0,05). After doing the calculations, it was obtained in the experimental class $F_{count} = 1{,}06$ with $F_{table} = 1{,}94$ because $F_{count} < F_{table}$ then H_0 was accepted. This means that the variance of the pretest data for both classes is homogeneous, which means that the population of students in the experimental and control classes is homogeneous. The results of the pretest data homogeneity test are presented in **Table 6**.

Table 6. Pretest Data Homogeneity Test Results

F_{count}	F_{table}	Decision
1,06	1,94	Homogen

(Source: Data processed by researchers)

The third is the similarity test of two means. The formulation of the hypothesis used is as follows.

H₀ : $\mu_1 = \mu_2$ (no difference in mean initial scores of the two classes)

H₁ : $\mu_1 = \mu_2$ (there is a difference in mean initial score of the two classes)

The test used is two-tailed t-test with testing criteria If $-t_{table} \leq t_{count} \leq t_{table}$ then H_o is accepted, otherwise Ho is rejected. With $\alpha = 2{,}5\%$, $dk = (n_1 + n_2 - 2)$. The results of the calculation of the similarity test for the two means can be seen in **Table 7** below.

Table 7. Results of the Two Pretest Means of the Similarity Test

Data	t_{count}	t_{table}
Pretest	0,156	2,009

(Source: Data processed by researchers)

This research ended by giving posttest. Posttest data analysis to obtain a conclusion whether the mathematical problem-solving skill of students who receive PBL learning with a scientific approach is better than students who receive conventional learning. The data used are the posttest scores of the students' mathematical problem-solving skills in the experimental class and the control class. The complete posttest data analysis steps are as follows.

First, there is a normality test on the pretest data using the Chi Square formula (χ^2) at a significance level of 5% (α = 0,05). After doing the calculations, it is obtained that in the experimental class $\chi^2_{count} = 8{,}34$ and the control class $\chi^2_{count} = 10{,}31$ with $\chi^2_{count} = 11{,}10$ then H_0 is accepted. This means that the posttest result data for the experimental class and the control class are normally distributed, which means that the posttest result data are taken randomly from the normal population. The results of the posttest data normality test are presented in **Table 8**.

Table 8. Posttest Data Normality Test

Data	χ^2 count	χ^2 table	**Decision**
Experiment	8,34	11,10	Normal
Control	10,31	11,10	Normal

(Source: Data processed by researchers)

Second, there is a homogeneity test on the pretest data using the F-test at a significance level of 5% (α = 0,05). After doing the calculations, it was obtained in the experimental class $F_{count} = 1{,}91$ with $F_{table} = 1{,}95$ because $F_{count} < F_{table}$ then H_0 was accepted. This means that the variance of the posttest data for both classes is homogeneous, which means that the population of students in the experimental and control classes is homogeneous. The results of the posttest data homogeneity test are presented in **Table 9**.

Table 9. Posttest Data Homogeneity Test Results

F_{count}	F_{table}	**Decision**
1,91	1,95	Homogen

(Source: Data processed by researchers)

Third, there is a hypothesis test 1 used to find out whether the mathematical problem-solving skills of students who receive PBL learning with a scientific approach are better than students who receive conventional learning. The formulation of the hypothesis is as follows.
$H_0 : \mu_1 \leq \mu_2$ (Mean of the experimental class is not better than the control class)
$H_1 : \mu_1 > \mu_2$ (Mean of the experimental class is better than the control class)

Because the data is homogeneous, the test used is a one-sided t-test, namely the right side with the testing criteria. If $t_{count} \leq t_{table}$ then H_o is accepted, whereas if $t_{count} > t_{table}$ H_o is rejected. With α =5% and dk = $n_1 + n_2 - 2$. The results of the calculation of hypothesis test 1 can be seen in **Table 10** below.

Table 10. Hypothesis Test Results 1

Data	t_{count}	t_{table}
Posttest	2,689	1,620

(Source: Data processed by researchers)

Based on **Table 10** it can be concluded that $t_{count} > t_{table}$ then H_0 is rejected. This shows that the mathematical problem-solving skills of students who receive PBL learning with a scientific approach are better than students who receive conventional learning.

In addition to the pretest and posttest data analysis, there is also data gain analysis. Gain data analysis to obtain a conclusion whether the improve in the mathematical problem-solving skill of students who receive PBL learning with a scientific approach is better than students who receive conventional learning. The data used is the gain data of students' mathematical problem-solving skills in the experimental class and the control class. The full data gain analysis steps are as follows.

First, there is a normality test on the pretest data using the Chi Square formula (χ^2) at a significance level of 5% (α = 0,05). After doing the calculations, it is obtained that in the experimental class $\chi^2_{count} = 6{,}87$ and the control class $\chi^2_{count} = 9{,}59$ with $\chi^2_{table} = 11{,}10$

then H_0 is accepted. This means that the gain data for the experimental class and the control class are normally distributed, which means that the gain data is taken randomly from the normal population. The results of the gain data normality test are presented in **Table 11**.

Table 11. Gain Data Normality Test

Data	χ^2_{count}	χ^2_{table}	**Decision**
Experiment	6,87	11,10	Normal
Control	9,59	11,10	Normal

(Source: Data processed by researchers)

Second, there is a homogeneity test on the pretest data using the F-test at a significance level of 5% (α = 0,05). After doing the calculations, it was obtained in the experimental class $F_{count} = 1{,}45$ with $F_{table} = 1{,}95$ because $F_{count} < F_{table}$ then H_0 was accepted. This means that the variance of the gain data for both classes is homogeneous, which means that the population of students in the experimental and control classes is homogeneous. The results of the gain data homogeneity test are presented in **Table 12**.

Table 12. Data Gain Homogeneity Test Results

F_{count}	F_{table}	**Decision**
1,45	1,95	Homogen

(Source: Data processed by researchers)

Third, there is a hypothesis test 2 which is used to find out whether the improve in the mathematical problem-solving skills of students who receive PBL learning with a scientific approach is better than students who receive conventional learning. The formulation of the hypothesis is as follows.

$H_0 : \mu_1 \leq \mu_2$ (Mean gain of the experimental class is not better than the control class)

$H_1 : \mu_1 > \mu_2$ (Mean gain of the experimental class is better than the control class)

The test used is a one-sided t-test with the testing criteria. If $t_{count} \leq t_{table}$ then H_0 is accepted, whereas if $t_{count} > t_{table}$ then H_0 is rejected. With α =5%, $dk = (n_1 + n_2 - 2)$. The results of the calculation of hypothesis test 2 can be seen in the table below.

Table 13. Hypothesis Test Results 2

Data	t_{count}	t_{table}
Gain	3,312	1,620

(Source: Data processed by researchers)

Based on Table 13 it can be concluded that $t_{count} > t_{table}$ then H_0 is rejected. This shows that to improve in the mathematical problem-solving skills of students who receive PBL learning with a scientific approach is better than students who receive conventional learning.

Self-Efficacy Data Analysis

Descriptive Analysis

First, there is the initial self-efficacy scale data analysis. In this case, the provision of an initial self-efficacy scale aims to determine the initial conditions of self-efficacy possessed by students in both the experimental class and the control class. An overview of descriptive statistics regarding the initial scale of self-efficacy for the experimental class and the control class can be seen in **Table 14** below.

Table 14. Descriptive Statistical Table of Initial Self-Efficacy Scale Data

Statistic	Experiment Class	Control Class
Total Students (n)	27	26
Minimum Score ($X_{\min}$)	36	32
Maximum Score ($X_{\max}$)	55	52
Mean ($\bar{X}$)	44,24	43,19
Standar Deviation (s)	4,84	5,79
Ideal Maximum Score (SMI)	85	85

(Source: Data processed by researchers)

Based on the table above, it can be seen that the results of the initial self-efficacy scale of students in the experimental class and control class were 44.24 and 43.19. This shows that there is no significant difference in the initial self-efficacy scale of students in the experimental class and the control class.

Second, there is an analysis of the final scale of self-efficacy data. Giving self-efficacy posttest questions aims to determine students' self-efficacy attitudes after being given learning. An overview of the descriptive statistics regarding the final scale of the experimental class and the control class can be seen in **Table 15** below.

Table 15. Descriptive Statistical Table of Final Scale Self-Efficacy Data

Statistic	Experiment Class	Control Class
Total Students (n)	27	26
Minimum Score ($X_{\min}$)	46	42
Maximum Score ($X_{\max}$)	69	64
Mean ($\bar{X}$)	58,17	53,19
Standar Deviation (s)	6,47	5,79
Ideal Maximum Score (SMI)	85	85

(Source: Data processed by researchers)

Based on the table above, it can be seen that mean final scale score of the experimental class was 58.17 and that of the control class was 53.19. It can be seen that mean final scale score of the experimental class is greater than that of the control class.

Finally, there is an analysis of the gain data on the self-efficacy scale. The gain score is sought to determine the improve in students' self-efficacy attitudes. Descriptive statistics regarding the gain scores of the experimental class and the control class can be seen in **Table 16** below.

Table 16. Table of Descriptive Statistical Data Gain Self-Efficacy Scale

Statistic	Experiment Class	Control Class
Total Students (n)	27	26
Minimum Score ($X_{\min}$)	0,22	0,08
Maximum Score ($X_{\max}$)	0,60	0,44
Mean ($\bar{X}$)	0,38	0,28
Standar Deviation (s)	0,12	0,10
Ideal Maximum Score (SMI)	1,00	1,00

(Source: Data processed by researchers)

Based on the table above, it can be seen that mean gain on the self-efficacy scale of students in the experimental class is 0.38 with medium classification and 0.28 in the control class with low classification. In this case it is also seen that mean gain of the experimental class students is greater than that of the control class students. This means that the self-efficacy of the experimental class students is better than that of the control class students.

Inferensial Analysis

Start with do an analysis of the initial scale of self-efficacy data. Initial scale data analysis serves to obtain conclusions whether the initial self-efficacy scale of the experimental class and control class has the same initial skill or not. The data used is the initial self-efficacy scale data of students in the experimental class and control class. The complete pretest data analysis steps are as follows.

First, there is a normality test on the pretest data using the Chi Square formula (χ^2) at a significance level of 5% (α = 0,05). After doing the calculations, it is obtained that in the experimental class $\chi^2_{count} = 3{,}86$ and the control class $\chi^2_{count} = 7{,}39$ with $\chi^2_{table} = 11{,}10$ then H_0 is accepted. This means that the initial scale data for the experimental class and the control class are normally distributed, which means that the initial scale data is taken randomly from the normal population. The results of the initial scale data normality test are presented in **Table 17**.

Table 17. Initial Self-Efficacy Scale Data Normality Test

Data	χ^2_{count}	χ^2_{table}	Decision
Experiment	3,86	11,10	Normal
Control	7,39	11,10	Normal

(Source: Data processed by researchers)

Second, there is a homogeneity test on the pretest data using the F-test at a significance level of 5% (α = 0,05). After doing the calculations, it was obtained in the experimental class $F_{count} = 1{,}43$ with $F_{table} = 1{,}94$ because $F_{count} < F_{table}$ then H_0 was accepted. This means that the initial scale data variance of the two classes is homogeneous, which means that the population of students in the experimental and control classes is homogeneous. The results of the initial scale data homogeneity test are presented in **Table 18**.

Table 18. Initial Scale Homogeneity Test Results Self-Efficacy

F_{count}	F_{table}	Decision
1,43	1,94	Homogen

(Source: Data processed by researchers)

The third is the similarity test of two means. The formulation of the hypothesis used is as follows.

H_0 : $\mu_1 = \mu_2$ (No difference in mean initial scores of the two classes)

H_1 : $\mu_1 = \mu_2$ (There is a difference in mean initial score of the two classes)

The test used is two-tailed t-test with testing criteria. If $-t_{table} \leq t_{count} \leq t_{table}$ then H_o is accepted, otherwise H_o is rejected. With $\alpha = 2{,}5\%$, $dk = (n_1 + n_2 - 2)$. The results of the calculation of the similarity test for the two means can be seen in **Table 19** below.

Table 19. Results of the Two Pretest Means of the Similarity Test

Data	t_{count}	t_{table}
Initial scale	0,717	2,009

(Source: Data processed by researchers)

Based on **Table 19** it can be concluded that $-t_{table} \leq t_{count} \leq t_{table}$ then H_0 is accepted. This shows that there is no difference in the initial self-efficacy scale between students in the experimental class and the control class.

Next, there is an analysis of the final scale of self-efficacy data. Analysis of the final scale data to obtain a conclusion whether the self-efficacy of students who receive PBL learning with a scientific approach is better than students who receive conventional learning. The data used is the final scale data of students' self-efficacy in the experimental class and the control class. The complete pretest data analysis steps are as follows.

First, there is a normality test on the final scale data using the Chi Square formula (χ^2) at a significance level of 5% (α = 0,05). After doing the calculations, it is obtained that in the experimental class $\chi^2_{count} = 6{,}94$ and the control class $\chi^2_{count} = 5{,}19$ with $\chi^2_{table} = 11{,}10$ then H_0 is accepted. This means that the final scale data for the experimental class and the control class are normally distributed, which means that the final scale data are taken randomly from the normal population. The results of the final scale data normality test are presented in **Table 20**.

Table 20. Final Scale Normality Test of Self-Efficacy

Data	χ^2_{count}	χ^2_{table}	Decision
Experiment	6,94	11,10	Normal
Control	5,19	11,10	Normal

(Source: Data processed by researchers)

Second, there is a homogeneity test on the final scale data using the F-test at a significance level of 5% (α = 0,05). After doing the calculations, it was obtained in the experimental class $F_{count} = 1{,}25$ with $F_{table} = 1{,}95$ because $F_{count} < F_{table}$ then H_0 was accepted. This means that the variance of the final scale data for both classes is homogeneous, which means that the population of students in the experimental and control classes is homogeneous. The results of the final scale data homogeneity test are presented in **Table 21**.

Table 21. Final Scale Homogeneity Test Results Self-Efficacy

F_{count}	F_{table}	Decision
1,25	1,95	Homogen

(Source: Data processed by researchers)

Then the third is hypothesis test 3. The formulation of the hypothesis is as follows.
$H_0 : \mu_1 \leq \mu_2$ (Mean of the experimental class is not better than the control class)
$H_1 : \mu_1 > \mu_2$ (Mean of the experimental class is better than the control class)
The test used is the one-sided t-test, namely the right side with the testing criteria. If $t_{count} \leq t_{table}$ then H_0 is accepted, whereas if $t_{count} > t_{table}$ H_0 is rejected. With α =5% and dk = $n_1 + n_2 - 2$. The results of the calculation of hypothesis test 3 can be seen in the table below.

Table 22. Hypothesis Test Results 3

Data	t_{count}	t_{table}
Posttest	2,95	1,62

(Source: Data processed by researchers)

Based on **Table 22** it can be concluded that $t_{count} > t_{table}$ then H_0 is rejected. This shows that the self-efficacy of students who receive PBL learning with a scientific approach is better than students who receive conventional learning.

In addition to the analysis of the initial and final scale of self-efficacy data, there is also an analysis of the gain data of the self-efficacy scale. Gain data analysis to obtain a conclusion whether the improve in self-efficacy of students who receive PBL learning with a scientific approach is better than students who receive conventional learning. The data used are data gain self-efficacy of students in the experimental class and control class. The full data gain analysis steps are as follows.

First, there is a normality test on the final scale data using the Chi Square formula (χ^2) at a significance level of 5% (α = 0,05). After doing the calculations, it is obtained that in the experimental class $\chi^2_{count} = 9{,}84$ and the control class $\chi^2_{count} = 2{,}78$ with $\chi^2_{table} = 11{,}10$ then H_0 is accepted. This means that the self-efficacy gain data for the experimental class and the control class are normally distributed, which means that the self-efficacy gain data is taken randomly from the normal population. The results of the final scale data normality test are presented in **Table 23**.

Table 23. Final Scale Normality Test of Self-Efficacy

Data	χ^2 count	χ^2 table	Decision
Experiment	9,84	11,10	Normal
Control	2,78	11,10	Normal

(Source: Data processed by researchers)

Second, there is a homogeneity test on the final scale data using the F-test at a significance level of 5% (α = 0,05). After doing the calculations, it was obtained in the experimental class $F_{count} = 1{,}35$ with $F_{table} = 1{,}95$ because $F_{count} < F_{table}$ then H_0 was accepted. This means that the variance of the gain self-efficacy data for the two classes is homogeneous, which means that the population of students in the experimental and control classes is homogeneous. The results of the homogeneity test of the gain self-efficacy data are presented in **Table 24**.

Table 24. Final Scale Homogeneity Test Results Self-Efficacy

F_{count}	F_{table}	Decision
1,35	1,95	Homogen

(Source: Data processed by researchers)

Then the third is hypothesis test 4. The formulation of the hypothesis is as follows.

H_0 : $\mu_1 \leq \mu_2$ (Mean gain of the experimental class is not better than the control class)

H_1 : $\mu_1 > \mu_2$ (Mean gain of the experimental class is better than the control class)

The test used is the one-sided t-test, namely the right side with the testing criteria. If $t_{count} \leq t_{table}$ then H_0 is accepted, whereas if $t_{count} > t_{table}$ H_0 is rejected. With α =5% and dk = $n_1 + n_2 - 2$. The results of the calculation of hypothesis test 4 can be seen in the table below.

Table 25. Hypothesis Test Results 4

Data	t_{count}	t_{table}
Gain	3,19	1,62

(Source: Data processed by researchers)

Based on **Table 25** it can be concluded that $t_{count} > t_{table}$ then H_0 is rejected. This shows that the increase in self-efficacy of students who receive PBL learning with a scientific approach is better than students who receive conventional learning. In line with the research results of Hursen (2021) that the Self-Efficacy of students who received the Problem Based Learning model assisted by Quizizz was better than students who received the conventional learning model. Apart from that, according to Purnomo (2015) said that the problem solving abilities of students whose learning uses a scientific approach to problem posing model is better than students who use conventional learning. Based on the description above, the use of the Problem Based Learning (PBL) learning model with a scientific approach can improve problem-solving abilities and self-efficacy and improve it better than learning with conventional models.

Conclusion

Based on the results and discussion of the research that has been described previously, the researcher has the following suggestions: (1) mathematics teachers can apply the Problem Based Learning model with a scientific approach to improve students' mathematical problem-solving skills and self-efficacy, especially in conveying material on flat sided shapes on the subject of prisms and pyramids, (2) the success of the problem-based learning model with a student-centered scientific approach, namely that students can be active in each phase of learning, so that the role of the teacher is suggested to be able to create a comfortable learning atmosphere and attract students to participate in each phase, (3) this research is only limited to mathematical problem-solving skills and self-efficacy. It is suggested for future researchers to be able to further develop the PBL model with this scientific approach on other skills such as mathematical communication, mathematical connections, understanding of other concepts and attitudes such as habits of mind, self-regulated, and self-esteem, and (4) based on the results of the posttest, the mathematical problem-solving skills of students who received the PBL model with a scientific approach for each indicator were understanding the problem 78.89%, planning problem-solving 72.41%, solving problems 64%, interpreting answers 56.63%. In order to provide effective results, learning should prioritize the process of solving problems for each face of mathematical problems, especially indicators of solving problems and interpretation of answers.

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