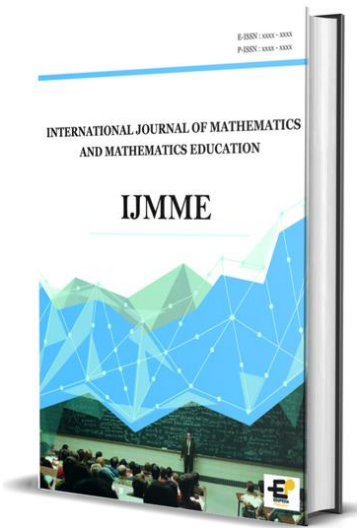

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Problem-Based Learning in Improving Problem-Solving Ability and Interest in Learning Mathematics: An Empirical Study

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To cite this article:

Nisa', et. al. (2023). Problem-Based Learning in Improving Problem-Solving Ability and Interest in Learning Mathematics: An Empirical Study. *International Journal of Mathematics and Mathematics Education (IJMME), 1*(2), 206-217 https://doi.org/10.56855/ijmme.v1i3.725

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IJMME International Journal of Mathematics and Mathematics Education

October 2023, Vol. 01, No. 03, 206-217 doi: 10.56855.ijmme.v1i3.725

Problem-Based Learning in Improving Problem-Solving Ability and Interest in Learning Mathematics: An Empirical Study

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Article Info

Article History

Received:
July 2, 2023
Accepted:
July 30, 2023

Keywords

Problem-Based Learning
Problem-Solving Ability
Interest
Learning Mathematics

Abstract

The main challenge in learning mathematics is improving students' problem-solving abilities and strengthening interest in learning. This research focuses on the Problem-Based Learning (PBL) model's influence on students' problem-solving abilities and interest in learning mathematics. This research investigates how PBL can influence the improvement of students' problem-solving abilities and interest in learning mathematics. The method used was an experimental approach with one group following PBL-based learning and a control group using conventional learning. Data was collected through problem-solving ability tests and learning interest questionnaires. The research results showed that PBL significantly improved students' problem-solving abilities and resulted in a positive increase in interest in learning mathematics. Conclusion: These findings effectively strengthen students' problem-solving abilities and awaken their interest in mathematics. The implication is the importance of implementing PBL in mathematics learning to create more competent and enthusiastic students to explore the world of mathematics.

Introduction

Mathematics education has a crucial role in students' intellectual development and their success in various fields of science (Veldhuis & Heuvel-Panhuizen, 2019). However, there are significant challenges in the world of education related to interest in learning mathematics, which often decreases students' limited problem-solving abilities (Khatimah & Sugiman, 2022). Teaching mathematics is much like building a house, and if the foundation is weak, many difficulties will appear later (Uya, 2023). This is a deep concern in efforts to improve the quality of education.

To improve students' problem-solving skills, teachers can develop students' mathematical literacy through contextual problems such as cultural, historical, or problems related to the student's

environment (Prapti, Susanto, & Sumardi, 2023). We need to address low interest in learning mathematics and limited problem-solving abilities immediately. This challenge illustrates that more than conventional approaches to teaching mathematics may be needed to meet the demands of the ever-evolving world of education. Therefore, this research will focus on the Problem-Based Learning (PBL) Learning Model as an interesting and potential alternative. PBL is known for encouraging students to take an active role in solving real-world problems, promoting collaboration, and developing critical thinking skills (Wurdinger & Qureshi, 2015). This approach aims to create a learning environment that stimulates the development of students' problem-solving abilities and fosters a more positive interest in learning mathematics.

Currently, mathematics education has become an important subject in efforts to improve students' problem-solving abilities and interest in learning. Various recent sources, such as research, highlight that the main challenge in learning mathematics is how to overcome the decline in interest in learning mathematics and strengthen students' problem-solving abilities (Novita, 2021). The state of the art in mathematics education highlights the Problem-Based Learning (PBL) learning model as the most up-to-date and promising approach. Recent research shows that PBL encourages students to play an active role in solving real-world problems, collaborating with fellow students, and developing critical thinking skills (Amin et al., 2020). The results of this research show that PBL can help significantly improve students' problem-solving abilities and stimulate their interest in mathematics. However, although several studies have confirmed the efficacy of PBL, there is still room for further research in diverse mathematics education contexts. This research will deepen our understanding of how PBL can be applied effectively in improving students' problem-solving abilities and interest in learning mathematics by considering the latest findings in this approach, as explained by various recent sources.

The background of this research reflects the challenges in mathematics education, which involve students' problem-solving abilities and learning interests. On the one hand, recent sources confirm that declining interest in learning mathematics is a severe concern in education (Tambunan et al., 2021). This shows that there is a gap between the hope of creating high interest in learning mathematics and the reality of the decline in interest observed in the field. On the other hand, the state of the art in mathematics education highlights the Problem-Based Learning (PBL) learning model as a promising approach. Previous research shows that PBL encourages the development of students' problem-solving abilities (Ulger, 2018). This creates an element of novelty in the background, indicating that PBL could be an effective solution to overcome the gap between challenges in interest in learning mathematics and potential solutions in PBL.

The research problem underlying this study is the need for more interest in learning mathematics and the limitations of students' problem-solving abilities in the educational context. Low interest in learning mathematics can hinder students' academic achievement and reduce their confidence in dealing with mathematics material. On the other hand, limited problem-solving abilities can hinder the development of critical skills needed to face real-world challenges. As a potential solution to this problem, this research will explore the Problem-Based Learning (PBL) Learning Model. PBL stimulates students'

interest in learning mathematics while also improving their problem-solving abilities. By engaging students in real-world problem solving, PBL allows them to understand the applications of mathematics in everyday life and develop critical thinking skills. The main aim of this research is to understand the extent to which PBL can improve students' problem-solving abilities and interest in learning mathematics. In other words, this research will evaluate the positive impact of PBL in overcoming the problem of decreased interest in learning and limited problem-solving abilities among students. The results of this research can provide valuable guidance for updating mathematics learning approaches in schools.

Method

Research Procedure

The research method used in this study is an experimental approach. This research will involve two groups of students, namely the experimental group and the control group. Each group will consist of a comparable number of students in terms of demographic characteristics and initial level of problem-solving ability. The research procedure will begin with initial data collection, which includes measuring the initial level of problem-solving abilities and interest in learning mathematics of students in both groups. Next, the experimental group will undergo learning sessions using the Problem-Based Learning (PBL) Learning Model, while the control group will continue to receive conventional learning. After the intervention period, data will be collected again from both groups to compare changes in problem-solving abilities and interest in learning mathematics. Statistical analysis, such as a t-test, will be used to identify whether there are significant differences between the two groups in terms of these changes.

Research Subjects and Locations

Research Subjects

The selection of research subjects was based on carefully defined criteria. The research subjects consisted of middle school or junior high school students randomly selected from the appropriate student population. It is important to note that the selection of research subjects was carried out taking into account the ethical principles of human research, including obtaining permission from the school. This is done to ensure that student participation in this research is voluntary, does not harm them, and maintains the confidentiality of personal information (Creswell & Creswell, 2017).

Research Locations

The research location was chosen based on scientific considerations. This location was chosen taking into account logistical and accessibility aspects, thus enabling researchers to carry out data collection efficiently and effectively. In addition, permission from the school where the research was located was obtained beforehand by complying with applicable procedures. This is an important step in ensuring that research is conducted in an environment that is relevant to the student population that is the subject of the research (Creswell & Creswell, 2017). Thus, the selection of subjects and locations in this

research was based on scientific and ethical research principles.

Research Design

The population of this study consisted of all class VII students of SMPN 7 Serang City. The sample used in this research was selected using the Simple Random Sampling Technique (Geldsetzer et al., 2016). In the sample selection process, two classes were taken randomly, namely Class VII D, which consisted of 30 students as the experimental group and Class VII E, which also consisted of 30 students as the control group.

Sample selection using the Simple Random Sampling technique was carried out to ensure a random and objective representation of a larger population so that the research results can be considered representative of class VII students at SMPN 7 Serang City as a whole. In this way, research can provide a clear view of the impact of the Problem-Based Learning (PBL) learning model on problem-solving abilities and interest in learning mathematics among students at SMPN 7 Kota Serang.

Instrument Research

The student test instrument is in the form of essay questions totaling five questions related to data presentation material in the control class, namely class VII E, and the experimental class, namely class VII D, even semester to test problem-solving abilities. The test is carried out in two stages, namely, the initial test (Pretest), which is carried out before being given Treatment and the final test (Posttest), which is carried out to obtain Treatment using the Problem Learning model. The test instrument is used to determine students' problem-solving abilities before and after receiving Treatment. There is a grid of indicators that can be measured through a written test of problem-solving abilities. Indicators that have been created to guarantee the validity of a question are then made to assess the problem-solving ability test in accordance with the indicators to assess the instrument that has been created.

The instrument is a questionnaire about interest in learning mathematics. This instrument is designed to measure students' level of interest in learning mathematics by focusing on the following indicators: Understanding the Problem, developing a strategy or plan to solve the problem, Solving the Problem, Following the plan made and checking the results and answers. The instrument for student interest in learning is a questionnaire on a Likert scale. This instrument is designed to measure students' level of interest in learning mathematics by focusing on the following indicators: feelings of joy, student interest, student involvement, diligence in studying and doing mathematics assignments, persistence and discipline in studying and having a study schedule.

Results

Problem-Solving Ability

Quantitative data was generated from the results of the pretest and post-test carried out in the Control class, namely class VII E. The experimental class, namely class VII D. The pretest and post-test were problem-solving tests given before and after learning was given in both the experimental class and the control class. The pretest and post-test consist of 5 numbered description questions on the data presentation material. This test shows the extent to which students' problem-solving and interest in learning have increased. Below are presented the results of the pretest and post-test descriptive analysis in Table 2.

Table 2. Descriptive Analysis

	Experiment		Control	
	Pre-test	Post-test	Pre-test	Post-test
N	30	30	30	30
Mean	42.30	66.59	42.47	62.30
Standard Deviation	10.548	6.622	10.605	12.755
Minimum Value	21	60	10	25
Maximum Value	60	82	59	80

Table 2 shows the average score of the problem-solving pre-test in the experimental class is 42.30, and the post-test is 66.59. Table 2 also shows that the average post-test score for problem-solving in the control class is 42.47, and the post-test is 62.30. From this, the average value of problem-solving has increased significantly. This means that there is an increase in problem-solving after implementing PBL learning.

Next, a t-paired sample test was carried out, which served to analyze the effect of PBL on problem-solving on students' learning requests. Before that, the Shapiro-Wilk Normality test was carried out to determine whether the data was normally distributed. The results of the normality test are shown in Table 3.

Table 3. Normality Test Analysis

	Experiment		Control	
	Pre-test	Post-test	Pre-test	Post-test
Sig.	0,380	0,26	0,072	0,26
Information	Normal	Normal	Normal	Normal

Table 3 shows that the significance value of the pre-test and post-test is > 0.05. From this, it can be concluded that the experimental and control class data are normally distributed. So, we can continue

with the t-paired sample test. The purpose of the t-paired sample test is to see whether there is a difference between the average problem-solving score before and after treatment. The results of the t-paired sample test are shown in Table 3.

Table 3. Average similarity test results on students' learning interest

	Pre-test _ Post-test
t	2,759
Sig.	0,012

Table 3 shows that the significance value of mathematical problem solving is 0.012 (p-value <0.05), so Ha is accepted: PBL learning has an effect on problem-solving.

Student Learning Interests

Table 4. Average similarity test results on students' learning interest

Learning Interest Indicator	Presentation	Category
Feelings of Joy in Learning	85%	Positive
Student Interest	75%	Positive
Student Engagement	70%	Positive
Craft in Learning and Doing Mathematics Assignments	80%	Positive
Diligence and Discipline in Learning	70%	Positive
Have a Study Schedule	60%	Positive

Feelings of Joy in Learning (Table 4): Most of the students, 85%, stated that they felt happy when learning mathematics. The results of the analysis show that students who feel happy about learning mathematics tend to have better problem-solving than those who do not feel happy. Student Interest: Around 75% of students stated that they were interested in mathematics subject matter. From the analysis, it was found that students' level of interest was positively correlated with their mathematical problem-solving. Student Engagement: Nearly 70% of students are actively involved in the mathematics learning process.

The results of the analysis show that student involvement has a significant positive influence on mathematical problem-solving. Diligence in Studying and Doing Mathematics Assignments: As many as 80% of students stated that they were diligent in studying mathematics and doing assignments. Students who have a high level of craft tend to have better mathematical problem-solving. Diligence and Discipline in Studying: More than 70% of students have a level of persistence and discipline in studying mathematics. The results of the analysis show that students' discipline and persistence in learning mathematics are positively correlated with their problem-solving. Have a Study Schedule: About 60% of students have a regular study schedule. Although the results of the analysis show that having a study schedule is positively correlated with math problem-solving, this correlation is weaker than other indicators.

This research suggests that indicators of learning interest, such as feelings of joy, enthusiasm,

engagement, diligence, persistence, and discipline in learning mathematics, positively impact students' problem-solving abilities in this subject. Therefore, efforts to increase students' interest in learning can have a positive impact on their mathematical problem-solving.

Discussion

Problem-solving Ability

This research provides significant results regarding the influence of the Problem-Based Learning (PBL) Learning Model on increasing students' problem-solving abilities and interest in learning mathematics (Table 3). The research results show that using PBL in mathematics learning can significantly improve students' problem-solving abilities, which is reflected in the increase in the average score on the problem-solving test before and after implementing PBL. This aligns with previous research suggesting the effectiveness of PBL in improving students' problem-solving abilities in various learning contexts (Warnock & Mohammadi-Aragh, 2016).

Previous studies have highlighted that PBL provides a more in-depth and contextual learning experience, which can stimulate students to develop better problem-solving abilities (Nuryami & Muhammad, 2023). In mathematics, previous research shows that PBL can enable students to apply mathematical concepts in real-world situations, improving their understanding of the material and their ability to solve mathematical problems (Kurniawati et al., 2023).

In addition, the findings of this study also support other research that highlights the positive relationship between interest in learning and mathematical problem-solving abilities. Previous research also shows that high interest in learning can increase students' motivation to overcome complex tasks, such as mathematics problems (Arthur et al., 2022). This is in line with our findings, which show that students who feel happiness and interest in mathematics learning tend to have better problem-solving abilities (Table 3). However, it is essential to note that our study also identified variations in the impact of PBL depending on the learning interest indicators used. Although having a regular study schedule also shows a positive correlation with math problem-solving, this relationship tends to be weaker than other indicators, such as student enjoyment and engagement in learning.

In order to relate these findings to previous research, our results support the idea that PBL is a practical learning approach in stimulating students' problem-solving abilities and their learning interest in mathematics subjects. Therefore, using PBL in mathematics teaching can be a valuable strategy for improving students' academic achievement and cultivating their interest in this subject. However, it is essential to remember that students' learning interests have various aspects, and it is necessary to combine various learning strategies that suit students' needs and preferences to maximize mathematics learning outcomes.

Student Learning Interests

The results of this research, as depicted in Table 4 and related descriptions, provide a robust picture of the relationship between students' learning interests and mathematical problem-solving abilities. These findings are from several previous studies highlighting the critical role of interest in learning in increasing students' academic achievement. First of all, this study's results show that most students (85%) feel happy when learning mathematics. From the analysis, students who feel happy when learning mathematics tend to have better problem-solving abilities than those who do not feel happy. This finding aligns with previous research, which shows that positive emotions such as joy can increase students' motivation and performance in solving mathematics problems (Suparman et al., 2021).

Furthermore, around 75% of students in this study expressed interest in mathematics material. The analysis found that students' level of interest was positively related to their mathematical problem-solving abilities. Previous research emphasizes that interest in learning is essential in motivating students to explore and understand lesson material better (Herpratiwi & Tohir, 2022). Apart from the interest in learning, the research results also reflect that students' active involvement in the mathematics learning process significantly positively impacts problem-solving abilities. This is in line with previous findings highlighting the importance of student involvement in active learning, especially in mathematics (Lugosi & Uribe, 2020).

Then, tenacity and discipline in studying and doing mathematics assignments have also been proven to have a strong positive correlation with problem-solving abilities. Students with a high level of tenacity tend to be more adept at solving mathematical problems. Previous research shows that the nature of persistence and effort in learning can influence student academic outcomes (Thorsen et al., 2021). However, it should be noted that although having a regular study schedule also shows a positive correlation with math problem-solving, this correlation tends to be weaker than other indicators. This may indicate that other factors, such as the level of interest and active involvement, may significantly influence students' mathematical problem-solving abilities.

Overall, the findings of this study strengthen the idea that students' interest in learning and active involvement in learning are essential aspects that need to be considered in mathematics teaching. Efforts to increase students' interest in learning mathematics can significantly impact their problem-solving abilities. Therefore, learning approaches that promote student enjoyment, interest and engagement can effectively improve mathematics learning outcomes. In the broader context of mathematics education, this research also confirms previous findings which show the importance of paying attention to students' psychological factors in designing effective learning.

The results of this study reveal a significant correlation between students' learning interests and mathematical problem-solving abilities. This finding aligns with previous research, which emphasizes the critical role of interest in learning in improving students' academic achievement. The high level of happiness and interest in mathematics encourages students to be more actively involved in learning,

which enriches their ability to solve mathematical problems. In addition, the results show that aspects of students' active involvement in learning have a strong positive impact on problem-solving abilities. This emphasizes the importance of interactive and participatory learning in the context of mathematics lessons. Overall, this research highlights the need for learning approaches that promote student interest, happiness, and participation to improve mathematics learning outcomes and encourage the development of strong problem-solving abilities.

Conclusion

This research provides strong evidence that the Problem-Based Learning (PBL) learning model positively impacts students' problem-solving abilities and learning interests in the context of mathematics learning. The results showed that using PBL significantly improved students' problem-solving abilities, reflected in an increase in the average score on the problem-solving test before and after the intervention. This confirms previous research, which suggests that PBL is a practical approach to stimulating the development of students' problem-solving abilities. In addition, this research also reveals a strong positive relationship between students' learning interests and mathematical problem-solving abilities. Students who feel happy and interested in mathematics tend to perform better in problem-solving. These findings support the idea that interest in learning is a critical factor in motivating students to tackle complex mathematical tasks. Students' active involvement in the mathematics learning process has also been proven to impact problem-solving abilities significantly. This emphasizes the importance of learning that encourages student participation and interaction in solving mathematical problems.

Overall, this research underlines the importance of learning approaches focusing on students' psychological aspects, including learning interest and active involvement, in mathematics learning. Strategies such as PBL that stimulate students' interest, excitement, and participation can effectively improve their problem-solving abilities. These findings have important implications for developing better learning methods to improve student achievement in mathematics and provide a strong foundation for continued research in this area.

Recommendations

Recommendations based on the findings of this research are to increase students' interest in learning and mathematical problem-solving abilities. First, teachers need to design learning programs that are interesting and relevant to the real world to trigger students' feelings of enjoyment and interest in mathematics. Second, student involvement in class discussions, collaborative projects, and problem-solving assignments must be encouraged to hone their critical thinking and problem-solving skills. Furthermore, providing support to students who are less motivated or have difficulty understanding mathematics through mentoring and guidance will help them develop a more substantial interest in learning. Fourth, it is essential to teach students about diligence, persistence and discipline in studying

and help them plan and carry out an effective study schedule. Finally, ongoing measurements and assessments need to be implemented to monitor students' progress in learning interests and mathematical problem-solving abilities. These recommendations, we can help students develop a higher learning interest in mathematics and improve essential skills in mathematical problem-solving.

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IJMME International Journal of Mathematics and Mathematics Education

October 2023, Vol. 01, No. 03, 206-217 doi: 10.56855.ijmme.v1i3.725

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Article Info

Article History

Received:
July 2, 2023
Accepted:
July 30, 2023

Keywords

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Introduction

Mathematics education has a crucial role in students' intellectual development and their success in various fields of science (Veldhuis & Heuvel-Panhuizen, 2019). However, there are significant challenges in the world of education related to interest in learning mathematics, which often decreases students' limited problem-solving abilities (Khatimah & Sugiman, 2022). Teaching mathematics is much like building a house, and if the foundation is weak, many difficulties will appear later (Uya, 2023). This is a deep concern in efforts to improve the quality of education.

To improve students' problem-solving skills, teachers can develop students' mathematical literacy through contextual problems such as cultural, historical, or problems related to the student's

environment (Prapti, Susanto, & Sumardi, 2023). We need to address low interest in learning mathematics and limited problem-solving abilities immediately. This challenge illustrates that more than conventional approaches to teaching mathematics may be needed to meet the demands of the ever-evolving world of education. Therefore, this research will focus on the Problem-Based Learning (PBL) Learning Model as an interesting and potential alternative. PBL is known for encouraging students to take an active role in solving real-world problems, promoting collaboration, and developing critical thinking skills (Wurdinger & Qureshi, 2015). This approach aims to create a learning environment that stimulates the development of students' problem-solving abilities and fosters a more positive interest in learning mathematics.

Currently, mathematics education has become an important subject in efforts to improve students' problem-solving abilities and interest in learning. Various recent sources, such as research, highlight that the main challenge in learning mathematics is how to overcome the decline in interest in learning mathematics and strengthen students' problem-solving abilities (Novita, 2021). The state of the art in mathematics education highlights the Problem-Based Learning (PBL) learning model as the most up-to-date and promising approach. Recent research shows that PBL encourages students to play an active role in solving real-world problems, collaborating with fellow students, and developing critical thinking skills (Amin et al., 2020). The results of this research show that PBL can help significantly improve students' problem-solving abilities and stimulate their interest in mathematics. However, although several studies have confirmed the efficacy of PBL, there is still room for further research in diverse mathematics education contexts. This research will deepen our understanding of how PBL can be applied effectively in improving students' problem-solving abilities and interest in learning mathematics by considering the latest findings in this approach, as explained by various recent sources.

The background of this research reflects the challenges in mathematics education, which involve students' problem-solving abilities and learning interests. On the one hand, recent sources confirm that declining interest in learning mathematics is a severe concern in education (Tambunan et al., 2021). This shows that there is a gap between the hope of creating high interest in learning mathematics and the reality of the decline in interest observed in the field. On the other hand, the state of the art in mathematics education highlights the Problem-Based Learning (PBL) learning model as a promising approach. Previous research shows that PBL encourages the development of students' problem-solving abilities (Ulger, 2018). This creates an element of novelty in the background, indicating that PBL could be an effective solution to overcome the gap between challenges in interest in learning mathematics and potential solutions in PBL.

The research problem underlying this study is the need for more interest in learning mathematics and the limitations of students' problem-solving abilities in the educational context. Low interest in learning mathematics can hinder students' academic achievement and reduce their confidence in dealing with mathematics material. On the other hand, limited problem-solving abilities can hinder the development of critical skills needed to face real-world challenges. As a potential solution to this problem, this research will explore the Problem-Based Learning (PBL) Learning Model. PBL stimulates students'

interest in learning mathematics while also improving their problem-solving abilities. By engaging students in real-world problem solving, PBL allows them to understand the applications of mathematics in everyday life and develop critical thinking skills. The main aim of this research is to understand the extent to which PBL can improve students' problem-solving abilities and interest in learning mathematics. In other words, this research will evaluate the positive impact of PBL in overcoming the problem of decreased interest in learning and limited problem-solving abilities among students. The results of this research can provide valuable guidance for updating mathematics learning approaches in schools.

Method

Research Procedure

The research method used in this study is an experimental approach. This research will involve two groups of students, namely the experimental group and the control group. Each group will consist of a comparable number of students in terms of demographic characteristics and initial level of problem-solving ability. The research procedure will begin with initial data collection, which includes measuring the initial level of problem-solving abilities and interest in learning mathematics of students in both groups. Next, the experimental group will undergo learning sessions using the Problem-Based Learning (PBL) Learning Model, while the control group will continue to receive conventional learning. After the intervention period, data will be collected again from both groups to compare changes in problem-solving abilities and interest in learning mathematics. Statistical analysis, such as a t-test, will be used to identify whether there are significant differences between the two groups in terms of these changes.

Research Subjects and Locations

Research Subjects

The selection of research subjects was based on carefully defined criteria. The research subjects consisted of middle school or junior high school students randomly selected from the appropriate student population. It is important to note that the selection of research subjects was carried out taking into account the ethical principles of human research, including obtaining permission from the school. This is done to ensure that student participation in this research is voluntary, does not harm them, and maintains the confidentiality of personal information (Creswell & Creswell, 2017).

Research Locations

The research location was chosen based on scientific considerations. This location was chosen taking into account logistical and accessibility aspects, thus enabling researchers to carry out data collection efficiently and effectively. In addition, permission from the school where the research was located was obtained beforehand by complying with applicable procedures. This is an important step in ensuring that research is conducted in an environment that is relevant to the student population that is the subject of the research (Creswell & Creswell, 2017). Thus, the selection of subjects and locations in this

research was based on scientific and ethical research principles.

Research Design

The population of this study consisted of all class VII students of SMPN 7 Serang City. The sample used in this research was selected using the Simple Random Sampling Technique (Geldsetzer et al., 2016). In the sample selection process, two classes were taken randomly, namely Class VII D, which consisted of 30 students as the experimental group and Class VII E, which also consisted of 30 students as the control group.

Sample selection using the Simple Random Sampling technique was carried out to ensure a random and objective representation of a larger population so that the research results can be considered representative of class VII students at SMPN 7 Serang City as a whole. In this way, research can provide a clear view of the impact of the Problem-Based Learning (PBL) learning model on problem-solving abilities and interest in learning mathematics among students at SMPN 7 Kota Serang.

Instrument Research

The student test instrument is in the form of essay questions totaling five questions related to data presentation material in the control class, namely class VII E, and the experimental class, namely class VII D, even semester to test problem-solving abilities. The test is carried out in two stages, namely, the initial test (Pretest), which is carried out before being given Treatment and the final test (Posttest), which is carried out to obtain Treatment using the Problem Learning model. The test instrument is used to determine students' problem-solving abilities before and after receiving Treatment. There is a grid of indicators that can be measured through a written test of problem-solving abilities. Indicators that have been created to guarantee the validity of a question are then made to assess the problem-solving ability test in accordance with the indicators to assess the instrument that has been created.

The instrument is a questionnaire about interest in learning mathematics. This instrument is designed to measure students' level of interest in learning mathematics by focusing on the following indicators: Understanding the Problem, developing a strategy or plan to solve the problem, Solving the Problem, Following the plan made and checking the results and answers. The instrument for student interest in learning is a questionnaire on a Likert scale. This instrument is designed to measure students' level of interest in learning mathematics by focusing on the following indicators: feelings of joy, student interest, student involvement, diligence in studying and doing mathematics assignments, persistence and discipline in studying and having a study schedule.

Results

Problem-Solving Ability

Quantitative data was generated from the results of the pretest and post-test carried out in the Control class, namely class VII E. The experimental class, namely class VII D. The pretest and post-test were problem-solving tests given before and after learning was given in both the experimental class and the control class. The pretest and post-test consist of 5 numbered description questions on the data presentation material. This test shows the extent to which students' problem-solving and interest in learning have increased. Below are presented the results of the pretest and post-test descriptive analysis in Table 2.

Table 2. Descriptive Analysis

	Experiment		Control	
	Pre-test	Post-test	Pre-test	Post-test
N	30	30	30	30
Mean	42.30	66.59	42.47	62.30
Standard Deviation	10.548	6.622	10.605	12.755
Minimum Value	21	60	10	25
Maximum Value	60	82	59	80

Table 2 shows the average score of the problem-solving pre-test in the experimental class is 42.30, and the post-test is 66.59. Table 2 also shows that the average post-test score for problem-solving in the control class is 42.47, and the post-test is 62.30. From this, the average value of problem-solving has increased significantly. This means that there is an increase in problem-solving after implementing PBL learning.

Next, a t-paired sample test was carried out, which served to analyze the effect of PBL on problem-solving on students' learning requests. Before that, the Shapiro-Wilk Normality test was carried out to determine whether the data was normally distributed. The results of the normality test are shown in Table 3.

Table 3. Normality Test Analysis

	Experiment		Control	
	Pre-test	Post-test	Pre-test	Post-test
Sig.	0,380	0,26	0,072	0,26
Information	Normal	Normal	Normal	Normal

Table 3 shows that the significance value of the pre-test and post-test is > 0.05. From this, it can be concluded that the experimental and control class data are normally distributed. So, we can continue

with the t-paired sample test. The purpose of the t-paired sample test is to see whether there is a difference between the average problem-solving score before and after treatment. The results of the t-paired sample test are shown in Table 3.

Table 3. Average similarity test results on students' learning interest

	Pre-test _ Post-test
t	2,759
Sig.	0,012

Table 3 shows that the significance value of mathematical problem solving is 0.012 (p-value <0.05), so Ha is accepted: PBL learning has an effect on problem-solving.

Student Learning Interests

Table 4. Average similarity test results on students' learning interest

Learning Interest Indicator	Presentation	Category
Feelings of Joy in Learning	85%	Positive
Student Interest	75%	Positive
Student Engagement	70%	Positive
Craft in Learning and Doing Mathematics Assignments	80%	Positive
Diligence and Discipline in Learning	70%	Positive
Have a Study Schedule	60%	Positive

Feelings of Joy in Learning (Table 4): Most of the students, 85%, stated that they felt happy when learning mathematics. The results of the analysis show that students who feel happy about learning mathematics tend to have better problem-solving than those who do not feel happy. Student Interest: Around 75% of students stated that they were interested in mathematics subject matter. From the analysis, it was found that students' level of interest was positively correlated with their mathematical problem-solving. Student Engagement: Nearly 70% of students are actively involved in the mathematics learning process.

The results of the analysis show that student involvement has a significant positive influence on mathematical problem-solving. Diligence in Studying and Doing Mathematics Assignments: As many as 80% of students stated that they were diligent in studying mathematics and doing assignments. Students who have a high level of craft tend to have better mathematical problem-solving. Diligence and Discipline in Studying: More than 70% of students have a level of persistence and discipline in studying mathematics. The results of the analysis show that students' discipline and persistence in learning mathematics are positively correlated with their problem-solving. Have a Study Schedule: About 60% of students have a regular study schedule. Although the results of the analysis show that having a study schedule is positively correlated with math problem-solving, this correlation is weaker than other indicators.

This research suggests that indicators of learning interest, such as feelings of joy, enthusiasm,

engagement, diligence, persistence, and discipline in learning mathematics, positively impact students' problem-solving abilities in this subject. Therefore, efforts to increase students' interest in learning can have a positive impact on their mathematical problem-solving.

Discussion

Problem-solving Ability

This research provides significant results regarding the influence of the Problem-Based Learning (PBL) Learning Model on increasing students' problem-solving abilities and interest in learning mathematics (Table 3). The research results show that using PBL in mathematics learning can significantly improve students' problem-solving abilities, which is reflected in the increase in the average score on the problem-solving test before and after implementing PBL. This aligns with previous research suggesting the effectiveness of PBL in improving students' problem-solving abilities in various learning contexts (Warnock & Mohammadi-Aragh, 2016).

Previous studies have highlighted that PBL provides a more in-depth and contextual learning experience, which can stimulate students to develop better problem-solving abilities (Nuryami & Muhammad, 2023). In mathematics, previous research shows that PBL can enable students to apply mathematical concepts in real-world situations, improving their understanding of the material and their ability to solve mathematical problems (Kurniawati et al., 2023).

In addition, the findings of this study also support other research that highlights the positive relationship between interest in learning and mathematical problem-solving abilities. Previous research also shows that high interest in learning can increase students' motivation to overcome complex tasks, such as mathematics problems (Arthur et al., 2022). This is in line with our findings, which show that students who feel happiness and interest in mathematics learning tend to have better problem-solving abilities (Table 3). However, it is essential to note that our study also identified variations in the impact of PBL depending on the learning interest indicators used. Although having a regular study schedule also shows a positive correlation with math problem-solving, this relationship tends to be weaker than other indicators, such as student enjoyment and engagement in learning.

In order to relate these findings to previous research, our results support the idea that PBL is a practical learning approach in stimulating students' problem-solving abilities and their learning interest in mathematics subjects. Therefore, using PBL in mathematics teaching can be a valuable strategy for improving students' academic achievement and cultivating their interest in this subject. However, it is essential to remember that students' learning interests have various aspects, and it is necessary to combine various learning strategies that suit students' needs and preferences to maximize mathematics learning outcomes.

Student Learning Interests

The results of this research, as depicted in Table 4 and related descriptions, provide a robust picture of the relationship between students' learning interests and mathematical problem-solving abilities. These findings are from several previous studies highlighting the critical role of interest in learning in increasing students' academic achievement. First of all, this study's results show that most students (85%) feel happy when learning mathematics. From the analysis, students who feel happy when learning mathematics tend to have better problem-solving abilities than those who do not feel happy. This finding aligns with previous research, which shows that positive emotions such as joy can increase students' motivation and performance in solving mathematics problems (Suparman et al., 2021).

Furthermore, around 75% of students in this study expressed interest in mathematics material. The analysis found that students' level of interest was positively related to their mathematical problem-solving abilities. Previous research emphasizes that interest in learning is essential in motivating students to explore and understand lesson material better (Herpratiwi & Tohir, 2022). Apart from the interest in learning, the research results also reflect that students' active involvement in the mathematics learning process significantly positively impacts problem-solving abilities. This is in line with previous findings highlighting the importance of student involvement in active learning, especially in mathematics (Lugosi & Uribe, 2020).

Then, tenacity and discipline in studying and doing mathematics assignments have also been proven to have a strong positive correlation with problem-solving abilities. Students with a high level of tenacity tend to be more adept at solving mathematical problems. Previous research shows that the nature of persistence and effort in learning can influence student academic outcomes (Thorsen et al., 2021). However, it should be noted that although having a regular study schedule also shows a positive correlation with math problem-solving, this correlation tends to be weaker than other indicators. This may indicate that other factors, such as the level of interest and active involvement, may significantly influence students' mathematical problem-solving abilities.

Overall, the findings of this study strengthen the idea that students' interest in learning and active involvement in learning are essential aspects that need to be considered in mathematics teaching. Efforts to increase students' interest in learning mathematics can significantly impact their problem-solving abilities. Therefore, learning approaches that promote student enjoyment, interest and engagement can effectively improve mathematics learning outcomes. In the broader context of mathematics education, this research also confirms previous findings which show the importance of paying attention to students' psychological factors in designing effective learning.

The results of this study reveal a significant correlation between students' learning interests and mathematical problem-solving abilities. This finding aligns with previous research, which emphasizes the critical role of interest in learning in improving students' academic achievement. The high level of happiness and interest in mathematics encourages students to be more actively involved in learning,

which enriches their ability to solve mathematical problems. In addition, the results show that aspects of students' active involvement in learning have a strong positive impact on problem-solving abilities. This emphasizes the importance of interactive and participatory learning in the context of mathematics lessons. Overall, this research highlights the need for learning approaches that promote student interest, happiness, and participation to improve mathematics learning outcomes and encourage the development of strong problem-solving abilities.

Conclusion

This research provides strong evidence that the Problem-Based Learning (PBL) learning model positively impacts students' problem-solving abilities and learning interests in the context of mathematics learning. The results showed that using PBL significantly improved students' problem-solving abilities, reflected in an increase in the average score on the problem-solving test before and after the intervention. This confirms previous research, which suggests that PBL is a practical approach to stimulating the development of students' problem-solving abilities. In addition, this research also reveals a strong positive relationship between students' learning interests and mathematical problem-solving abilities. Students who feel happy and interested in mathematics tend to perform better in problem-solving. These findings support the idea that interest in learning is a critical factor in motivating students to tackle complex mathematical tasks. Students' active involvement in the mathematics learning process has also been proven to impact problem-solving abilities significantly. This emphasizes the importance of learning that encourages student participation and interaction in solving mathematical problems.

Overall, this research underlines the importance of learning approaches focusing on students' psychological aspects, including learning interest and active involvement, in mathematics learning. Strategies such as PBL that stimulate students' interest, excitement, and participation can effectively improve their problem-solving abilities. These findings have important implications for developing better learning methods to improve student achievement in mathematics and provide a strong foundation for continued research in this area.

Recommendations

Recommendations based on the findings of this research are to increase students' interest in learning and mathematical problem-solving abilities. First, teachers need to design learning programs that are interesting and relevant to the real world to trigger students' feelings of enjoyment and interest in mathematics. Second, student involvement in class discussions, collaborative projects, and problem-solving assignments must be encouraged to hone their critical thinking and problem-solving skills. Furthermore, providing support to students who are less motivated or have difficulty understanding mathematics through mentoring and guidance will help them develop a more substantial interest in learning. Fourth, it is essential to teach students about diligence, persistence and discipline in studying

and help them plan and carry out an effective study schedule. Finally, ongoing measurements and assessments need to be implemented to monitor students' progress in learning interests and mathematical problem-solving abilities. These recommendations, we can help students develop a higher learning interest in mathematics and improve essential skills in mathematical problem-solving.

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