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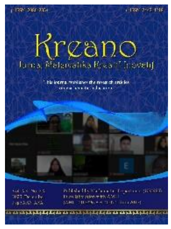

The Effect of Problem-Based Learning Model on Mathematical Problem-Solving Ability in Term of Gender Differences of Students

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Abstract

The ability to solve mathematical problems is the main objective in mathematics learning, therefore problem-solving should be taught to students as early as possible, practiced, and used not only in mathematics learning, but also in everyday life. TIMSS results indicate that Indonesian eighth-grade students' ability to solve non-routine problems (mathematical problems) is very low, but they perform relatively well in solving factual and procedural problems. This study examined the effect of Problem-Based Learning (PBL) model on mathematical problem-solving ability (MPSA) in terms of gender differences of students in class IX. This research is pseudo-experimental research with non-equivalent control group design. The population in the study were all students of class IX which amounted to 175 students, ranging from class IX.1 to IX.5. The sample in the study was taken by purposive sampling method, so that class IX.4 which amounted to 33 students as the experimental class and class IX.5 which amounted to 33 students as the control class. Data collection techniques were carried out using test techniques with MPSA test instruments in the form of pre-test and post-test. Data analysis techniques used are descriptive analysis and inferential analysis. The results showed that: a) there was a difference in the average MPSA of students in terms of the learning model used (0.000 < 0.05), b) there was a difference in the average MPSA in terms of the gender of students (0.001 < 0.05), and c) there was no interaction between the gender of students and the learning model used on the problem-solving ability used (0.899 > 0.05. It can therefore be concluded that the PBL model has an effect on MPSA when viewed from the perspective of gender differences among students.

Keywords: Problem-Based Learning; Mathematical Problem-Solving Ability; Gender.

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Abstrak

Kemampuan memecahkan masalah matematika merupakan tujuan utama dalam pembelajaran matematika, oleh karena itu pemecahan masalah harus diberikan kepada peserta didik sedini mungkin, dilatih, dan digunakan tidak hanya dalam pembelajaran matematika, tetapi juga dalam kehidupan sehari-hari. Hasil TIMSS menunjukkan bahwa kemampuan peserta didik jenjang SMP kelas dua Indonesia dalam memecahkan masalah non-rutin (masalah matematika) masih sangat rendah. Penelitian ini menguji pengaruh model Problem-Based Learning (PBL) terhadap kemampuan pemecahan masalah matematis (MPSA) ditinjau dari perbedaan jenis kelamin peserta didik kelas IX. Penelitian ini merupakan penelitian eksperimen semu dengan desain kelompok kontrol non-ekuivalen. Populasi dalam penelitian adalah seluruh peserta didik kelas IX yang berjumlah 175 peserta didik, mulai dari kelas IX.1 hingga IX.5. Sampel dalam penelitian diambil dengan metode sampling purposive, sehingga kelas IX.4 yang berjumlah 33 peserta didik sebagai kelas eksperimen dan kelas IX.5 yang berjumlah 33 peserta didik sebagai kelas kontrol. Teknik pengumpulan data dilakukan dengan teknik tes dengan instrumen tes kemampuan pemecahan masalah matematis berupa pre-test dan post-test. Teknik analisis data yang digunakan adalah analisis deskriptif dan analisis inferensial. Hasil penelitian menunjukkan bahwa: a) terdapat perbedaan rata-rata kemampuan pemecahan masalah matematis peserta didik ditinjau dari model pembelajaran yang digunakan (0,000 < 0,05), b) terdapat perbedaan rata-rata kemampuan pemecahan masalah matematis ditinjau dari gender peserta didik (0,001 < 0,05), dan c) tidak terdapat interaksi antara gender peserta didik dengan model pembelajaran yang digunakan terhadap kemampuan pemecahan masalah yang digunakan (0,899 > 0,05). Sehingga dapat disimpulkan bahwa terdapat pengaruh model PBL terhadap kemampuan pemecahan masalah matematis ditinjau dari perbedaan gender peserta didik.

INTRODUCTION

Mathematics education in schools aims to equip students with creativity, adaptability, collaboration, problem-solving ability, and innovative thinking for the future. Students are encouraged to improve their communication, critical thinking, mathematical literacy, and mathematical problem-solving skills through mathematics (MPSA) (Adlina et.al., 2024). Mathematics learning is not only required to convey and receive material, but must also have the ability and skills to achieve successful learning outcomes in mathematics. Learning mathematics helps student improve their logical, analytical, critical, and creative thought processes as well as their capacity to work together to comprehend concepts and reason about connections between them (Nurjannah et.al., 2017). On the other hand, material objectives place greater emphasis on problem-solving ability and the mathematical concept itself (Rismaini & Roza, 2019).

In mathematics learning, students must have problem-solving ability. One of the skills that students need to possess in math classes as well as other subjects is this one (Fitri & Angraini, 2023). In essence, the ability to answer mathematical problems is a prerequisite for students studying mathematics. Furthermore, a fundamental ability in mathematics education is problem-solving (Khusna et al., 2024). Focusing on problem-solving ability enables teachers to foster essential competencies in students that support their academic achievements and future career success (Adeoye & Jimoh, 2023; Shettar et al., 2020). In this context, problem-solving ability not only include solving routine problems, but also include the ability to understand new situations, formulate strategies, and evaluate the resulting solutions. Critical and logical thinking skills are necessary, as is the ability to relate mathematical ideas to practical circumstances. Therefore, in order for students to become accustomed to approaching issues methodically and creatively, the learning process for mathematics must be focused on offering relevant and difficult learning experiences. Additionally, a learning approach that prioritizes problem-solving can boost students' confidence and drive. They will feel more accomplished and become more interested in mathematics when they are able to solve challenging issues. Teachers are crucial in fostering a positive learning atmosphere, offering pertinent advice, and posing real-world situations that students can relate to. Thus, it is crucial that teachers incorporate a variety of techniques, including group discussions, open problem-solving, and technology use, into their designs of student-centered learning. These techniques not only provide students a deeper understanding of mathematical ideas but also teach them how to collaborate, communicate, and make decisions. With the right approach, mathematics learning can be a means of fostering high-level thinking skills and readiness to face future challenges (Negley, 2022).

According to Purnomo et al. (2015), mathematical problem-solving is a crucial skill and represents a core competency that students are expected to build and acquire through mathematics education. Mathematical education fundamentally aims to enhance students' problem-solving abilities, making it crucial to integrate problem-solving activities into instruction as early as possible, trained, and used not only in learning mathematics, but also in everyday life. Among cognitive tools, problem-solving stands out as the most essential in mathematics, and its development is central to educational goals (Amalina & Vidákovich, 2023).

Findings from the TIMSS (The Third International Mathematics and Science Study) indicate that Indonesian eighth-grade students perform poorly when faced with non-routine mathematical problems, while they tend to do relatively well with factual and procedural questions. This is influenced by the mathematics learning process taught by teachers which always emphasizes procedural and mechanistic exercises rather than developing students' mathematical understanding, especially in solving problems related to MPSA (Bahri, 2020). This condition is further exacerbated by teacher-centered learning approaches, where educators often fail to give sufficient attention to student engagement during lessons. Consequently, students tend to lose motivation when it comes to identifying and solving problems independently. Instead, they become more inclined to complete exercises by copying from peers. When required to work on tasks individually, their enthusiasm drops significantly due to a lack of understanding of the material being taught (Aprilia, 2022; Saputri & Febriani, 2017).

From the results of observations conducted in grades IX.4 and IX.5 of junior high school, researchers found a lot of information that teaching and learning activities were only centered on the teacher (conventional learning) who explained in front of the class and they only listened and took notes of what the teacher wrote. Students also often only paid attention to the formula given by the teacher, so that if the teacher changed the form of the question without changing the formula, students had difficulty solving the questions. In addition, students were given more routine questions so that they did not train their reasoning ability in solving problems and their thinking ability. Information was also obtained that the teaching and learning process in the classroom tended to run as it should, but there were some students who were not focused so that they paid less attention to the explanation given by the teacher. This was because students were accustomed to working on procedural questions, so that when students were given non-routine questions, students were confused about how to answer them.

One of the factors causing students' lack of problem-solving abilities is the learning habit factor, students are only used to learning by memorizing. This learning method does not train mathematical problem-solving, and is a result of conventional learning (Vikriyah, 2015). According to Bahri (2020), conventional learning occurs when teachers start learning by explaining concepts informatively, followed by example questions, and ending with practice questions, so that students' understanding of mathematics learning is still limited. According to a different viewpoint, most teachers hardly ever provide non-routine arithmetic homework, which contributes to pupils' poor problem-solving skills.

Students' learning ability may be influenced by gender differences. Gender refers to distinguishing traits between males and females, and in mathematics problem-solving, boys and girls may utilize distinct strategies (Ajai & Imoko, 2015). This is shown in a study published in the Journal of Experimental Child Psychology by the University of Missouri, United States, which found that girls and boys have different handling of math problems in school, especially arithmetic. Girls answer questions slowly but accurately, while boys solve them quickly but make mistakes (Dorisono, 2019). This view is supported by (Hardy et al., 2015) who argue that male students generally exhibit conceptual, logical, rational, and intellectual thinking. They tend to recognize the relationships between pieces of information accurately, apply analytical methods effectively, and draw conclusions based on facts, concepts, and relevant theoretical frameworks. Meanwhile, female students tend to have a systematic and in-depth thinking style, prefer to solve problems gradually, and follow all the methods given to find new concepts in learning. According to research by Indrawati & Tasni (2016) male and female students have the same MPSA; the only difference is that male students typically solve problems quickly, failing to follow certain steps but still coming up with the right answer, whereas female students focus more on neatness and follow more structured steps (Santos et al., 2025).

The Problem-Based Learning (PBL) model is recognized as an effective strategy for enhancing students’ MPSA. As stated by Michael (Argaw et al., 2017), PBL introduces real-world problems at the beginning of instruction to contextualize learning and motivate students. This definition requires active and usually (but not always) collaborative or cooperative conditions. This method involves a significant amount of independent learning by students. PBL helps improve critical thinking ability, problem-solving ability, cognitive ability, and overall student performance compared to traditional teacher-centered approaches (Joshi et al., 2020).

PBL and problem-solving skills are related in that during stage 1, when students are oriented to the problem, they will develop their problem-solving skills in indicators 1 and 2, which are understanding the problem; during stages 2 and 3, when they are organized into study groups and given guidance both individually and in groups, which is grouping them into heterogeneous groups, they will develop their problem-solving skills in the indicator of planning and implementing solutions; and during stage 4, when they analyze and evaluate the problem-solving process, they will develop their problem-solving skills in the process of reevaluating the outcomes they have achieved (Nurjannah et al., 2017). The problem-solving indicators applied in this study are consistent with Polya's four-step model, which includes understanding the problem, formulating a solution strategy, executing the plan, and reviewing the results (Siregar et al., 2018). The initial step involves identifying known elements, the problem's requirements, and evaluating whether the available data are sufficient, then a solution is planned by applying techniques to solve mathematical problems within or outside of mathematics, implementing the plan by creating mathematical problems or gathering mathematical models and the results are explained or interpreted in light of the original problem (Simanjuntak et al., 2021). This is supported by Zetriuslita & Ariawan (2021) in their research which states that students taught through the PBL model demonstrate a more significant improvement in critical mathematical thinking ability compared to those learning through traditional methods, regardless of their initial level of curiosity.

According to the above-described introduction, the purpose of this study is to determine if the PBL paradigm has an effect on students' MPSA with regard to gender disparities

Mathematical Problem-Solving Ability (MPSA)

Problem-solving ability is a frequently occurring goal and is a basic goal of mathematics education. Problem-solving ability prioritizes the methods and strategies used by students to solve problems, while the final result is usually prioritized. As a result, students' ability to understand problems and solve them becomes a fundamental ability developed through mathematics education (Anshori et al., 2020).

Problem-solving is a strategy used in education and teaching to achieve instructional goals by preparing students to find solutions to a problem, from the easiest to the most complex to solve on their own. Developing problem-solving competence remains a central focus of mathematics instruction across all educational stages, from primary to tertiary levels. As a result, students will develop thought patterns, persistence and inquiry habits, and a sense of confidence in a variety of unconventional scenarios that they may encounter outside of the mathematics classroom (Cuong et al., 2025 ;Gilbert & Gyöngyvér, 2025).

According to Polya (Ansori & Aulia, 2015) there are four main steps in problem-solving, namely: 1) Understanding the problem (identifying and determining the elements known, asked, and the adequacy of the elements needed), 2) Making a plan (formulating a mathematical problem or compiling a mathematical model), 3) Implementing the plan (choosing and implementing the right strategy to compile a mathematical model and writing a conclusion at the end of the solution), and 4) Rechecking (explaining or interpreting the findings in light of the original problem). In the study (Gilbert & Gyöngyvér, 2025), if Polya's MPSA steps are implemented collaboratively, then they are in accordance with the PBL steps taken.

Problem-Based Learning (PBL)

PBL, or problem-based learning, is a learning model that uses real-world situations as the basis for learning activities. This allows students to gain information about the subject and hone their scientific problem-solving ability. Jacobson (Zetriuslita & Ariawan, 2017) stated that the main objectives of implementing the PBL model are: (1)

developing students' ability to provide systematic and critical thinking on a question or problem regularly, (2) developing independent learning, and (3) gaining mastery of content.

The steps or syntax used in implementing the PBL model are as follows (Nurdyansyah & Fahyuni, 2016): (1) directing students' attention to the problem; (2) facilitating their learning process; (3) supporting individual and group investigations; (4) producing and sharing solutions; and (5) examining and reflecting on the problem-solving outcomes.

METHOD

Population and Sample

The population of this study consisted of all 175 ninth-grade students (from classes IX.1 to IX.5). The sample was selected randomly through purposive sampling, resulting in class IX.4 being assigned as the experimental group and class IX.5 as the control group. The experimental class was taught using the PBL model, while the control class received instruction through conventional methods. The research design applied in this study follows the framework described by (Sugiyono, 2019).

Table 1. Non-Equivalent Control Group Design

O_1	X	O_2
O_3		O_4

Where:
X : The treatment given (PBL model)
$\mathbf{O_1}$: Pre-test results of the experimental class
$\mathbf{O_2}$: Post-test results of the experimental class
$\mathbf{O_3}$: Pre-test results of the control class
$\mathbf{O_4}$: Post-test results of the control class

Table 2. Distribution of Research Samples Based on Gender

Class	N	Gender	
		Male	Female
Experiment (PBL Model)	33	16	17
Control (Conventional Learning)	33	16	17

Data Collection Instrument

The data were collected using a test instrument composed of questions related to the topic of similarity and congruency, which were developed based on indicators of mathematical problem-solving ability (MPSA). The indicator of problem-solving ability is to develop the problem-solving indicator from Polya, namely:

1. Understand the problem by identifying the known elements, the questions asked, and the adequacy of the required elements.
2. Plan the solution by applying strategies to solve mathematical problems in or outside mathematics.
3. Implement the plan by through the construction of mathematical models or by clearly formulating the mathematical problems.
4. Review the solution by interpreting or explaining the results in alignment with the original problem.

Data Collection Technique

The data collection technique is by giving tests to both classes, namely an initial test (pre-test) obtained before treatment is given to both classes and a final test (post-test) obtained after treatment is given to both classes. The pre-test and post-test each comprised four descriptive questions covering the same content on similarity and congruency.

Data Analysis Technique

The pre-test and post-test data from both the experimental and control groups were analyzed using a variance homogeneity test and a two-way ANOVA, conducted through the SPSS 23 software. Based on the results of the two-way ANOVA, and in line with the stated hypotheses, the following conclusions were drawn:

1. If the significance value (Sig.) is less than 0.05, it indicates a significant difference in the average MPSA between the experimental group (using the PBL model) and the control group (using conventional instruction), when viewed based on student gender.
2. If the significance value (Sig.) is greater than 0.05, it suggests that there is no significant difference in the average MPSA between the experimental and control groups with respect to gender differences among students

RESULT AND DISCUSSION

Results

The MPSA of students was tested using a test instrument consisting of 4 descriptive questions. It is known that there are two classes used to assess the MPSA of students consisting of 33 students in the experimental class and 33 students in the control class. Based on the calculation results using the SPSS application, the descriptive analysis of the variables is obtained as follows.

Table 3. Descriptive Analysis of MPSA

		Pretest MPSA	Posttest MPSA	Gender	Class
N	Valid	66	66	66	66
	Missing	0	0	0	0
Mean		22.58	67.36	1.52	1.50
Std. Deviation		8.231	21.868	.504	.504
Minimum		10	23	1	1
Maximum		40	100	2	2
Sum		1490	4446	100	99

Table 3 shows that the MPSA pre-test results had an average of 22.58, with a minimum value of 10 and a maximum value of 40. With an average score of 67.36, the MPSA post-test results range from a low of 23 to a maximum of 100. Therefore, based on the pre-test and post-test findings, there is an improvement in the capacity to solve mathematical problems.

Table 4. Tests of Between-Subjects Effects

Dependent Variable: Hasil MPSA

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	19454.115[a]	3	6484.705	34.573	.000
Intercept	297636.554	1	297636.554	1586.827	.000
Gender	2298.069	1	2298.069	12.252	.001
Model	17151.137	1	17151.137	91.440	.000
Gender * Model	3.076	1	3.076	.016	.899
Error	11629.158	62	187.567		
Total	330582.000	66			
Corrected Total	31083.273	65			

a. R Squared = .626 (Adjusted R Squared = .608)

According to Table 4, the gender Sig. value is 0.001 < 0.05, indicating that Ho is rejected and H1 is approved. As a result of H1's acceptance, the hypothesis that "There is a difference in the average MPSA between the experimental class (PBL Model) and the control class (conventional learning) in terms of differences in student gender" is also accepted. This suggests that gender influences the average MPSA.

There is no interaction effect between the experimental class using the PBL model and the control class using conventional learning on the MPSA of students, according to Table 4, which shows the interaction between the gender of students and the learning model used on the MPSA of class IX students of SMP Negeri 35 Pekanbaru. The Sig. value is 0.899 > 0.05.

Table 5. Gender Analysis

Dependent Variable: Results of MPSA

Gender	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Male	61.281	2.421	56.442	66.121
Female	73.088	2.349	68.393	77.783

Table 5 indicates that the average MPSA score of male students is 61.281, which is 17.807 points lower than the average score of female students, recorded at 73.088. This suggests that female students outperformed male students in terms of mathematical problem-solving ability. Additionally, Table 5 also shows a significance value (Sig.) of 0.001 for gender, which is below the 0.05 threshold. Therefore, it can be concluded that there is a statistically significant difference in the average MPSA between male and female ninth-grade students at SMP Negeri 32 Pekanbaru.

Figures 1 and 2 below show the disparities in the ways that male and female students solved the test, which consisted of four descriptive questions with four MPSA indications.

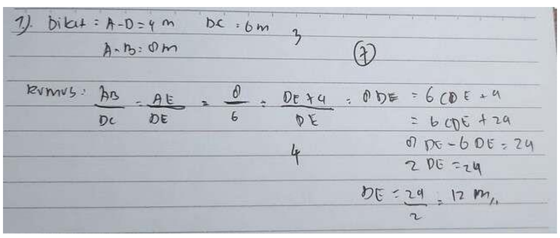

Figure 1a. Answer from One of the Male Student

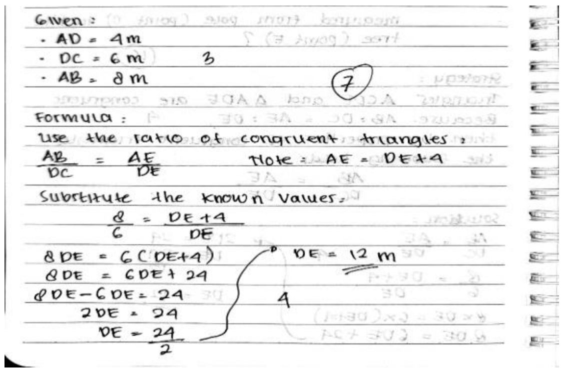

Figure 1b. Answer from One of the Male Student (English Version)

According to the MPSA indications, Figure 1 demonstrates that male students can follow the solution technique, although mistakes still occur. While male pupils can write down the aspects they know, they are unable to put down the elements that are asked. Then, male students also do not write down the mathematical model according to the problem even though the solution to the answer is correct. Furthermore, the male students are unable to deduce a conclusion from the response.

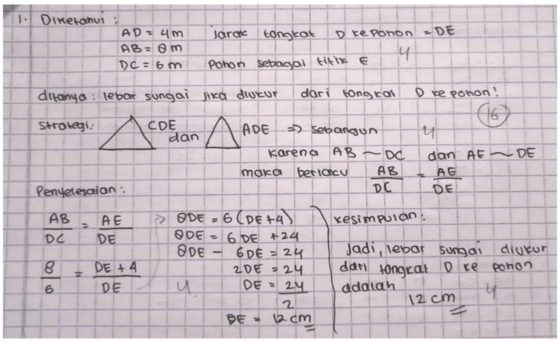

Figure 2a. Answer from One of the Female Student

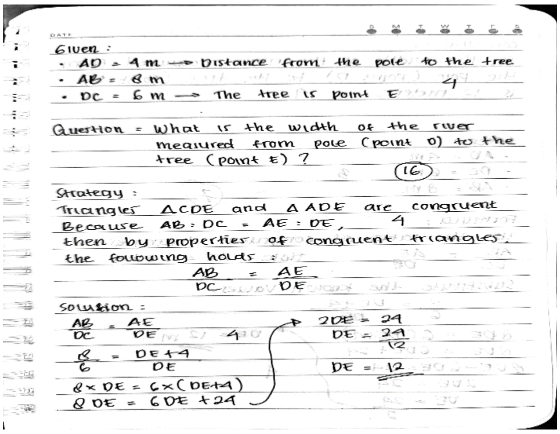

Figure 2b. Answer from One of the Female Student (English Version)

According to the MPSA indications, Figure 2 demonstrates that female students can follow the solution technique and provide correct answer. Female students are capable of writing down the known and requested elements fully and accurately, are able to write down the mathematical model that matches the problem completely and correctly, are able to write down the solution to the answer completely and correctly, and are able to interpret the answer into the correct conclusion according to the initial problem.

Table 6. Learning Model Analysis

Dependent Variable: Results of MPSA

Learning Model	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
PBL Model	83.313	2.385	78.545	88.080
Conventional learning	51.057	2.385	46.289	55.825

According to Table 6, there is a very significant difference (32.286) between the average MPSA value of students utilizing the PBL approach and the average MPSA value of students using traditional learning. The average MPSA of students using the PBL model is 83.313 while the average MPSA of students using conventional learning is 51.057. Then based on table 4, the significance value (Sig.) for the learning model on MPSA is 0.000 < 0.05. So it can be concluded that there is a difference in the average MPSA of students between those using the PBL model and those using conventional learning in class IX of SMP Negeri 35 Pekanbaru.

Table 7. Interaction of Student Gender and Learning Models Used

Dependent Variable: Results of MPSA

Gender	Learning Model	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Male	PBL Model	77.625	3.424	70.781	84.469
	Conventional Learning	44.938	3.424	38.093	51.782

Female	PBL Model	89.000	3.322	82.360	95.640
	Conventional Learning	57.176	3.322	50.537	63.816

According to Table 7, students that use the PBL methodology have an average MPSA of 77.625. This value is lower than the average value of MPSA of female students using the same learning model, which is 89 with a difference of 11.375. The average value of MPSA of male students using conventional learning is 44.938, which is lower than the average value of MPSA of female students using the same learning model, which is 57.176 with a difference of 12.238.

Overall, the study's findings suggest that the PBL model has an impact on MPSA in relation to gender disparities among SMP Negeri 35 Pekanbaru's grade IX students.

Discussion

This research found disparities in MPSA scores between male and female students in the PBL class. Specifically, male students had an average score of 77.625, while female students achieved a higher mean score of 89 under the same model. When both students participated in PBL-based learning, the 11.273-point difference indicates that female students did better in MPSA than their male counterparts. This is corroborated by the findings of earlier study, which indicates that students' average problem-solving skills vary depending on their gender (Dorisno, 2019). According to the study's findings, male and female students differ in their capacity to answer mathematical problems. This is evident from the F test calculation, which shows that Fcount > Ftable, with the Fcount value being 4.704 and the Ftable being 3.99.

According to Table 7, male students' average problem-solving skills are inferior to those of female students, because as stated (Dorisno, 2019), male students tend not to write down problem-solving indicators such as what is known, what is asked, immediately carrying out the solution, even though in each indicator there is a score given as explained in the question grid.

The results of the test of the interaction between the learning model and the students' gender are displayed in Table 4 and have a Sig. value of 0.899, which is higher than the significance threshold of 0.05. It may be said that there is no relationship between the learning paradigm and the students' gender. Therefore, both male and female students' MPSAs are influenced by the PBL approach in a fairly balanced way. This is consistent with study by Dorisno (2019), which indicates that students of either gender may use the PBL paradigm to increase their MPSA. In other words, this PBL model is suitable for teaching male and female students. So the PBL model does not consider the gender of students in influencing the MPSA of students.

In theory, the PBL learning model has advantages in classroom implementation. Therefore, if these advantages can be optimized in learning activities, learning will be better. The following are some benefits of the PBL model: (D. I. Amaliyah et al., 2023) (Amaliyah dkk., 2019): 1) Students are inspired to apply their problem-solving ability to real-life contexts; 2) Students actively participate in the construction of their own understanding; 3) Group collaboration promotes scientific inquiry; and 4) Students enhance their ability to communicate academically and present their findings. These four things can help students in mathematical communication to provide information, such as conveying ideas, providing questions and responses. In the PBL, the teacher functions as a facilitator who monitors students' learning progress, provides encouragement, and offers guidance to help them reach their learning objectives. This approach encourages students to take a more active role in the learning process and to collaborate and support one another.

In theory, the PBL learning model has advantages in its implementation in the classroom, so that if these advantages can be optimized in learning activities, learning will be better. In the PBL model, there are the following advantages (D. I. Amaliyah et al., 2023; Amaliyah dkk., 2019): 1) students are encouraged to have the ability to solve mathematical problems in real situations; 2) students have the ability to build their own knowledge through learning activities; 3) scientific activities occur in students through group work; and 4) students have the ability to carry out scientific communication and discussion activities and present the results of their work. These four things can help students in communicating mathematically to provide information, such as conveying ideas, asking questions and responses. In PBL learning, the role of the teacher as a facilitator can monitor the development of student learning activities and encourage and guide them to achieve their goals. So that students are expected to be more active in learning and helping each other.

The previous discussion highlights that students engaged with the PBL approach exhibit stronger MPSA indicators than those taught using traditional methods. This is consistent with findings from (Joshi et al., 2020) which show that PBL enhances critical thinking, problem-solving, cognition, and overall academic outcomes relative to teacher-centered instruction. Nurrohma & Adistana (2021) also stated that PBL is viewed as an effective instructional model since it empowers learners to independently seek solutions, thereby deepening their conceptual understanding and advancing their cognitive development toward high-level problem-solving. Wahyuni (2021) further notes that students taught through PBL demonstrate superior MPSA compared to those in conventional classrooms. When viewed from the gender differences of students, research conducted by Yusuf (2023) shows that female students get higher average scores in MPSA than male students. PBL has been extensively explored in Indonesian research for its potential to foster students' MPSA. Studies consistently affirm its beneficial influence on MPSA development. (Suparman et al., 2021).

Furthermore, Liu & Pásztor (2022) stated that PBL is a learner-focused strategy emphasizing problem-solving as a primary mode of learning, and it has been implemented in higher education to cultivate undergraduates' critical thinking. PBL fosters a more supportive classroom climate that encourages greater student engagement in tackling problems (Firdaus et al., 2015). Learning with the PBL model which is rich in problem posing and problem-solving can realize students' abilities in identifying known elements, being asked, and the adequacy of elements, the ability to formulate mathematical models, the ability to apply strategies to solve various problems, and the ability to interpret results according to the original problem. The problems given during the learning process provide opportunities for students to explore their abilities so that they can solve problems in more than one way. The use of the PBL model in learning can build a culture of working together, respecting different opinions, and trying to find other solutions. Some of this research supports research results related to gender differences (Ajai & Imoko, 2015; Amalina & Vidákovich, 2023; Argaw et al., 2017; Beroíza-Valenzuela & Salas-Guzmán, 2024; Chukwuyenum, 2013; Cuong et al., 2025; Gilbert & Gyöngyvér, 2025; Liu & Pásztor, 2022; Masek & Yamin, 2011; Saad et al., 2024; Safri et al., 2018; Santos et al., 2025.; Ulum, 2022;.Norhaslina et al., 2025; Zetriuslita et al., 2016).

Implication of Research

The implications of the results of this study are expected for further researchers to pay attention to the readiness of students with the model that will be applied, both in terms of their academic level and the time used, so that the results will be maximized. Also, the information given before learning must be clear so that students are not confused about what they have to do with the LKPD given in each group, where students with high abilities provide direction to students with medium and low abilities so that all students in the group understand the tasks in the LKPD.

Limitation

The limitation of this study is that students are still adapting to the PBL learning model, because so far students have not been accustomed to learning by implementing a student-centered learning model (SCL), which in its implementation lacks time in organizing students in groups. When instructed to sit in groups, there were several students who objected to the predetermined group members so that the class became unconducive and the learning process time was reduced

CONCLUSION

Based on the findings and analysis conducted on ninth-grade students at SMP Negeri 35 Pekanbaru, the following conclusions can be drawn: a) The significance value for gender is 0.001, which is less than 0.05, indicating a significant difference in students' mathematical problem-solving ability (MPSA) based on gender; b) The significance value for the learning model is 0.000, also below 0.05, suggesting that the type of learning model used significantly affects students' MPSA; c) The significance value for the interaction between gender and the learning model is 0.899, which exceeds 0.05, indicating that there is no significant interaction between gender and the learning model in relation to MPSA. Therefore, it can be concluded that the PBL model has a significant effect on students' MPSA when viewed from the perspective of gender differences among grade IX students at SMP Negeri 35 Pekanbaru.

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