



## Experiments of PBL and PJBL on The Mathematical Problem-Solving Abilities of Students Junior High School

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### ABSTRACT

When designing learning plans, teachers should consider their students' mathematical problem-solving abilities. Because the purpose of this study is to determine the mathematical problem-solving abilities of junior high school students at a school mover that uses teaching modules with stages of PBL, PJBL, and conventional learning models in the Merdeka Curriculum. The research method used in this study is *Quasi-Experimental with a Pretest-Posttest Control Group Design research design*. The population in this study is all grade VII students of SMPN 1 Bantargadung, which totals 72 students, and the sample is divided into three classes. The sampling technique used in this study is *Cluster Random Sampling*. The question instruments used were in the form of three questions on mathematical problem-solving skills in social arithmetic material and observation sheets. The results of the study showed that there was a difference in the problem-solving ability of junior high school students who used the PBL learning model with the PJBL learning model, and the conventional learning model of the Merdeka Curriculum, PBL learning was better compared to the PJBL learning model on the problem-solving ability of junior high school students, the traditional learning of the Merdeka Curriculum was better than the PBL learning model on the problem-solving ability of junior high school students, and conventional learning of the Merdeka Curriculum is better than the PJBL learning model on the problem-solving ability of junior high school students.

Keywords: mathematical problem-solving ability; PBL model; PJBL model

### INTRODUCTION

The development of the curriculum in Indonesia is speedy. The Merdeka Curriculum now implemented emphasizes the ability to solve mathematical problems. This is because students' mathematical problem-solving skills are essential for providing students with application in society. The purpose of learning mathematics is to train logical and critical thinking and solve problems from learning activities that need to be improved, starting from curriculum updates, the quality of mathematics teachers, and the improvement of learning facilities (Wulansari Thania, 2019).

One of the abilities that students need to have includes problem-solving skills; problem-solving skills that students must have is how to solve problems related to the learning process, such as solving math problems through problem-solving, where students will be trained to construct knowledge and tell it to other fields of science. In addition, students can better analyze a problem presented in learning activities through problem-solving. In line with what was also given (Bernard et al., 2018; Khofifah et al., 2021) the

problem-solving ability can provide habituation to students when understanding, developing, and implementing plans, as well as re-examining the solution to the given mathematical problems. Problem-solving skills are also one of the most critical cognitive aspects of mathematics and are used in life in society. Therefore, students are required to master problem-solving skills to be trained more thoroughly, especially in solving mathematical problems related to daily life. Thus, problem-solving skills are critical in learning mathematics (Yaumil et al., 2020).

However, the fact in the field is that the mathematical problem-solving ability possessed by junior high school students still needs to improve. The low problem-solving ability can be proven from the results of *the Trends in International Mathematics and Science Study* (TIMSS) study explaining that the achievement of mathematics learning in Indonesia is in the top 6 from the bottom, namely ranked 45th out of 50 countries with a score of 397 (Diyastanti, 2018). This confirms that the mathematical problem-solving abilities of Indonesian students are not yet capable of solving non-routine questions with PISA question characteristics. Apriani & Asdar (2017) argued that problem-solving is essential in learning, but in the field, students' problem-solving skills could be higher when viewed from data at school. Seeing that problem-solving skills are mathematical skills that students must master because they are the goal of learning mathematics, an educator needs to know to what stage of understanding problems students can do. An educator also needs to know the difficulties students face in solving issues, and educators must facilitate and improve these problem-solving skills. In addition, teachers need to create a learning environment that encourages students to be active in finding solutions to math problems (Putri et al., 2021).

In line with research conducted by (Fredrik Lagadoni Meran Kraeng Retno Murniasih, 2021) at State Junior High School in Bululawang, it was found that students' problem-solving skills are still low when given story problems in statistical materials so that students have difficulty understanding problems, making solution plans, executing plans, and rechecking answers. Difficulties in understanding issues are in the form of challenges in interpreting the language of the questions, so they cannot turn the sentences into known and asked elements. Based on the results of an interview with one of the mathematics teachers at SMPN 1 Bantargadung on 28 November 2023, it was obtained that the curriculum used is the Merdeka Curriculum; even though the curriculum has been implemented, the ability of students at SMPN 1 Bantargadung is still relatively low in solving problems with problem-solving skills, this is because students are not used to solving problems that are not routine, low student confidence, lack of ability of students to convey ideas and answer questions that require reasoning. When faced with number pattern problems, most students solve problems directly using formulas without paying attention to the correct stages.

*Problem-Based Learning* (PBL) is a learning model that can be implemented in the teaching and learning sessions of the Merdeka Curriculum. In terms of improving and developing learning outcomes and mathematical problem-solving skills, *the Problem-Based Learning* (PBL) model encourages student learning motivation (Nadhifah, 2016). The *Problem-Based Learning* (PBL) learning model has a series of systematic stages that can help improve students' mathematical problem-solving ability. Many studies have concluded that the learning process of students who follow the PBL model tends to have better

mathematical problem-solving ability than conventional learning (Albab et al., 2021). Learning through problem-solving is an effective way to connect the subject matter with the real world. Thus, students can see the relevance between what they learn in school and the situations they face in their daily lives (Husadaningsih & Darajats, 2019).

In addition to *the Problem-based Learning* (PBL) learning model, the project-based learning model (PjBL) is one of the learning models teachers can use to optimize students' problem-solving skills. According to *the Buck Institute for Education* (BIE), this model involves problem-solving activities and allows learners to work independently to develop their products. This learning model also supports the implementation of the Merdeka Curriculum because the Merdeka Curriculum is all technology-based. This is in line with the study's results (Saputri et al., 2023); the TPACK-based PjBL learning model influences students' problem-solving ability, and students' cognitive style influences problem-solving ability.

Based on the problem conditions described above, researchers need to conduct further research on applying *Problem-Based Learning* (PBL) and *Project Based Learning* (PjBL) learning models to the mathematical problem-solving ability of junior high school students. This is because the Problem-Based Learning (PBL) and Project-Based Learning (PjBL) learning models, both of which are known to improve problem solving. However, most previous studies have only examined the effectiveness of each model separately, without comparing the two in the context of the same material and level of education. In fact, the differences in characteristics between Problem-based learning that emphasizes solving real problems, and Project-based learning that focuses on completing real projects, can have different impacts on students. Therefore, it is important to conduct further research to compare problem-based learning and Project-based learning on the problem-solving abilities of junior high school students. The objectives are: (1) to find out whether there is a difference in students' mathematical problem-solving abilities using the PBL learning model and the conventional learning model; (2) to find out whether there is a difference in students' mathematical problem-solving abilities using *the Project Based Learning* (PjBL) learning model and the conventional learning model.

## RESEARCH METHODS

This study uses quantitative research *using the quasi-experimental* method. The research design used is *the Pretest-Posttest Control Group Design* (Sugiyono, 2017). The population in this study is all grade VII students of SMPN 1 Bantargadung. This study uses *cluster random sampling* (Sugiyono, 2017). The sample is selected based on a predetermined area. The selected samples in this study are class VII A as experimental class I, class VII B as experimental class II, and class VII C as the control class. The number of samples in the first experimental class was 24, the second experimental class was 24, and the control class was 24.

The instrument used in this study is a problem-solving ability test instrument. The test instrument is in the form of three items with social arithmetic material in the form of a description that contains indicators of Krulik-Rudnik's problem-solving ability, namely *Read and think, Explore and plan, Select strategy, Find and answer, and Reflect and extend*. Each question item is said to be valid if it is counted  $\geq 1,721$ . All three test questions were declared

valid to be used as research instruments. Furthermore, the reliability value with *Alpha Cronbach* of  $0.820 \geq 0.433$  shows that the question instrument is *reliable* in a very high category.

Data analysis in this study was carried out by a balance test using students' pre-test scores. The balance test used was a one-way ANOVA test with the prerequisites of normality and homogeneity tests. The hypothesis test used to determine the differences in students' mathematical problem-solving abilities from the three samples, used a one-way ANOVA test. Meanwhile, to find out which learning model is better, the Scheffe test or post-ANOVA follow-up test was used.

## RESULTS AND DISCUSSION

Based on the pretest and posttest analysis results, the study's results will provide information about students' mathematical problem-solving abilities.

### Description of Student Initial Ability Results (*Pretest*)

Data on students' initial ability to solve mathematical problems was obtained from the pretest results. After implementing the learning program, these two tests measure the difference in problem-solving skills.

Table 1. Descriptive Analysis of Pretest Results

	N	Minimum	Maximum	Mean	Std. Deviation
Pretest Experiment I	24	0	23.3	6.538	5.5944
Pretest Experiment II	24	0	36.7	5.275	7.8043
Pretest Control	24	0	56.7	14.996	15.6043

The results of the descriptive analysis show several things, namely the number of students in experimental classes 1 and 2 and control classes, which total 24 people. In contrast, the results of the pretest of experimental class 1 have the smallest value of 0, the most significant value of 2.3, the average of 6,538 with a standard deviation of 5.5944, the pretest of experimental class 2 has the smallest value of 0, the most significant value of 2.3, the average of 5,275 with a standard deviation of 7.8043. Moreover, The control class pre-test had the most miniature score of 0, the most significant value of 56.7, and an average of 14.996 with a standard deviation of 15.6043.

Table 2. Results of the Pretest Value Normality Test

	Class	Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Mr.	Statistic	df	Mr.
Pretest Results	Experiment I	0.220	24	0.004	0.847	24	0.002
	Experiment II	0.250	24	0.000	0.647	24	0.000
	Control	0.251	24	0.000	0.852	24	0.002

Based on Table 2, it was found that the significance value (Sig.) with the Kolmogorov-Smirnov normality test for all classes obtained a < value of 0.05, so it can be concluded that the research data is not normally distributed.

Table 3. Results of the Homogeneity Test of Pretest Values

		Levene	df1	df2	Mr.
		Statistic			
Pretest	Based on Mean	14.628	2	69	0.000
Results	Based on Median	6.626	2	69	0.002
	Based on the Median and with adjusted df	6.626	2	41.623	0.003
	Based on trimmed mean	12.122	2	69	0.000

Based on Table 3, it was found that the significance value (Sig.) Based on the Mean was 0.000. Because the significance value (Sig.) Based on Mean (0.000) < 0.05. Therefore, it is said that the variance of the experimental class pretest data and the control class pretest data is different (not homogeneous). Because the research data is not normally distributed or homogeneous, the Kruskal-Wallis Test was carried out to find out whether or not there is a difference between the 3 groups that are not paired.

Table 4. Kruskal-Wallis Test Results Pretest Value

Pretest Results	
Kruskal-Wallis H	6.813
df	2
Asymp. Sig.	.033

Based on Table 4, Asymp was found. Significance (Sig.) is 0.033. Because of the value of Asymp. Significance (Sig.) (0.033) < 0.05. So, there is a significant difference between the experimental class 1, the experimental class 2, and the control class.

**Description of The Final Ability of The Student (Posttest)**

Table 5. Descriptive Analysis of Posttest Results

	N	Minimum	Maximum	Mean	Std. Deviation
Posttest Experiment I	24	40.0	100.0	80.408	19.1117
Posttest Experiment II	24	26.7	100.0	79.033	25.3768
Posttest Control	24	50.0	100.0	82.783	17.0457

The results of the descriptive analysis show several things, namely the number of students in experimental classes I and II and the control class totaled 24 people. In contrast, the results of the Posttest of experimental class I had the most miniature score of 40, the most significant score of 100, the average of 80,408 with a standard deviation of 19.1117, the Posttest of experimental class II had the most miniature score of 26.7, the most significant

score of 100, the average 79.033 with a standard deviation of 25.3768, and the control class Posttest had the most miniature score of 50, the most significant value of 100, an average of 82.783 with a standard deviation of 17.0457.

Table 6. Results of the Posttest Normality Test

Class	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistic	Df	Mr.	Statistic	df	Mr.
Posttest Experiment I	0.250	24	0.000	0.875	24	0.007
Results Experiment II	0.296	24	0.000	0.751	24	0.000
Control	0.168	24	0.079	0.859	24	0.003

Based on Table 6, it was found that the significance value (Sig.) with the Kolmogorov-Smirnov normality test for experimental classes I and II obtained a value of < 0.05. While the control class got a > value of 0.05, it can be concluded that the research data is not normally distributed.

Table 7. Results of the Posttest Value Homogeneity Test

		Levene			
		Statistic	df1	df2	Mr.
Posttest	Based on Mean	3.432	2	69	0.038
Results	Based on Median	0.443	2	69	0.644
	Based on the Median and with adjusted df	0.443	2	45.23	0.645
	Based on trimmed mean	2.529	2	69	0.087

Based on Table 7, it was found that the significance value (Sig.) Based on the Mean was 0.038. Because the significance value (Sig.) Based on Mean (0.038) < 0.05. Therefore, it is said that the variance of the experimental class posttest data and the control class posttest data is different (not homogeneous). Because the research data is not normally distributed and is not homogeneous, the Kruskal-Wallis Test was carried out to find out whether or not there is a difference between the 3 groups that are not paired.

Table 9. Results of the Kruskal-Wallis Test Posttest Score

Posttest Results	
Kruskal-Wallis H	0.241
df	2
Asymp. Sig.	0.886

Based on Table 9, Asymp is found. Significance (Sig.) is 0.886. Because of the value of Asymp. Significance (Sig.) (0.886) > 0.05. So, there is no significant difference between the experimental class I, the experimental class II, and the control class.

Table 10. One-Track Anava Test Results Are Not the Same

	Sum of Squares	Df	Mean Square	F	Mr.
Between Groups	1342.267	2	671.134	5.993	0.004
Within Groups	7726.721	69	111.981		
Total	9068.989	71			

Based on Table 10, the significance value (Sig.) is 0.004. Because the significance value (Sig.) (0.004) < 0.05, it was  $H_0$  rejected. So, it can be concluded that the three learning models have different effects on the mathematical problem-solving ability of junior high school students.

The purpose of this study is to compare the mathematical problem-solving ability of junior high school students who use *the Problem-Based Learning* (PBL) learning model with the *Project Learning* (PjBL) learning model and the conventional learning model of the Merdeka Curriculum. The results of this study can be seen in table 10 that students' mathematical problem solving ability of junior high school students using *the Problem-Based Learning* (PBL) learning model is better than the *Project Learning* (PjBL) learning model on the problem-solving ability of junior high school students, the conventional learning model of the Merdeka Curriculum is better than *the Problem-Based Learning* (PBL) learning model on the problem-solving ability of junior high school students, and the conventional learning model of the Merdeka Curriculum is better than *the Project Based Learning* (PjBL) learning model on the problem-solving ability of junior high school students.

Based on the study results, *using the problem-based learning* (PBL) learning model and the conventional model of the Merdeka Curriculum shows better results in solving students' mathematical problems *than the project-based Learning* (PjBL) learning model. This is because students are not used to solving problems in the form of projects, so the most favored learning model at SMPN 1 Bantargadung is the conventional learning model using the Merdeka Curriculum teaching module. In the Merdeka Curriculum, the role of teachers must be innovative in using teaching strategies and developing learning media that can overcome difficulties and improve mathematical problem-solving skills according to the characteristics of students (Mardiah, 2018; Gumanti et al., 2022) who found that the results of *the Problem-Based Learning* (PBL) learning model were more influential in improving mathematical problem-solving skills than the *Discovery Learning* (DL) learning model. Although from some researchers, *Problem-Based Learning* (PBL) is more influential in improving mathematical problem-solving skills in research at SMPN 1 Bantargadung, the conventional learning model using the Merdeka Curriculum teaching module is the most influential in improving mathematical problem-solving skills. This is because the condition of students' cognitive abilities that still need to be guided by teachers to solve problems is not routine.

This study's results align with the research (Nurjanah et al., 2022). There is a difference in mathematical problem-solving ability between students who learn using *the Problem-Based Learning* (PBL) model and students who learn using the conventional learning model. *Problem-based Learning* (PBL) is designed to help students learn while solving problems. With PBL, students are trained to think critically and find solutions (Ratna

et al., 2020). In addition, the research carried out by Albab et al. (2021) proves that using the Problem-Based Learning model assisted by the Gagung Duran application can make students more independent in the learning process, and students can understand the material in depth by practicing solving problems related to students' daily lives. This is in line with the need to implement an Merdeka Curriculum because, in addition to students being active, technology must also be introduced to students. The Merdeka Curriculum is more flexible and focuses on essential things such as developing students' abilities (Sultan & Tirtayasa, 2022).

Conventional learning models are designed to maximize time efficiency during the learning process in a certain period (Arifin, 2023). When compared to the project-based learning model that emphasizes the learning process, it takes a lot of time which results in an increase in the workload of teachers and students (Dewi, 2022). Thus, mathematics learning through *problem-based learning* (PBL) and conventional learning models using the Merdeka Curriculum teaching module show positive results in improving the mathematical problem-solving ability of junior high school students, as reviewed based on students' ability to solve problems.

## CONCLUSION

Based on the results and discussions that have been explained, it can be concluded that: (1) *The Problem-Based Learning* (PBL) learning model is better than *the Project Learning* (PjBL) learning model on the problem-solving ability of junior high school students, (2) the conventional learning model of the Merdeka Curriculum is better than *the Problem-Based Learning* learning model (PBL) on the problem-solving ability of junior high school students, (3) and the conventional learning model of the Merdeka Curriculum is better than *the Project Based Learning* (PjBL) learning model on the problem-solving ability of junior high school students.

## REFERENCES

- Albab, R. U., Wanabuliandari, S., & Sumaji, S. (2021a). Pengaruh Model Problem Based Learning Berbantuan Aplikasi Gagung Duran terhadap Kemampuan Pemecahan Masalah Siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 10(3), 1767. <https://doi.org/10.24127/ajpm.v10i3.3969>
- Albab, R. U., Wanabuliandari, S., & Sumaji, S. (2021b). Pengaruh Model Problem Based Learning Berbantuan Aplikasi Gagung Duran terhadap Kemampuan Pemecahan Masalah Siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 10(3), 1767. <https://doi.org/10.24127/ajpm.v10i3.3969>
- Apriani, E., & Asdar, dan. (2017). Kemampuan Pemecahan Masalah Matematika Ditinjau dari Kemampuan Awal Matematika dan Perbedaan Gender. In *Issues in Mathematics Education* (hal (Vol. 1, Issue 1). <http://www.ojs.unm.ac.id/imed>
- Arifin, A. (2023). Implementasi Model Pembelajaran Pengajaran Langsung untuk Meningkatkan Hasil Belajar Siswa pada Pembelajaran PJOK Materi Gerak Spesifik Permainan Bola Basket di Kelas VII-G Semester 1 SMPN 1 Bolo Tahun Pelajaran 2022/2023. *Jurnal Pendidikan Dan Pembelajaran Indonesia (JPPI)*, 3(1), 69–82. <https://doi.org/10.53299/jppi.v3i1.311>
- Bernard, M., Nurmala, N., Mariam, S., & Rustyani, N. (2018). Analisis Kemampuan Pemecahan Masalah Matematis Siswa SMP Kelas IX Pada Materi Bangun Datar. *SJME*

- (*Supremum Journal of Mathematics Education*), 2(2), 77–83. <https://doi.org/10.5281/zenodo.1405906>
- Dewi, M. R. (2022). Kelebihan dan kekurangan Project-based Learning untuk penguatan Profil Pelajar Pancasila Kurikulum Merdeka. *Inovasi Kurikulum*, 19(2), 213–226. <https://doi.org/10.17509/jik.v19i2.44226>
- Diyastanti, A. (2018). *Meningkatkan Kemampuan pemecahan masalah dan Self esteem Matematis Siswa Kelas VII Dengan Model Eliciting Activities*.
- Fredrik Lagadoni Meran Kraeng, Y., & Retno Murniasih, T. (2021). Analisis Kesulitan Siswa dalam Menyelesaikan Soal Cerita Pada Materi Statistika. *Jurnal Ilmiah Pendidikan Matematika AL-QALASADI*, 5(1), 72–80.
- Gumanti, G., Maimunah, M., & Roza, Y. (2022). Kemampuan Pemecahan Masalah Matematis Siswa SMP Kecamatan Bantan. *PRISMA*, 11(2), 310. <https://doi.org/10.35194/jp.v11i2.2301>
- Husadaningsih, T., & Darajats, P. P. (2019). *Penerapan Metode Pembelajaran Problem Based Learning Dengan Menggunakan Pendekatan Sainifik Kurikulum 2013 Pada Mata* (Vol. 10, Issue 2).
- Khofifah, L., Supriadi, N., & Syazali, M. (2021). Model Flipped Classroom dan Discovery Learning terhadap Kemampuan Pemahaman Konsep dan Pemecahan Masalah Matematis. *PRISMA*, 10(1), 17-29. <https://doi.org/10.35194/jp.v10i1.1098>
- Mardiah, W. (2018). Pengaruh Model Pembelajaran Dan Sikap Sosial Siswa Terhadap Kemampuan Pemecahan Masalah Matematis ( Eksperimen Pada Siswa Smp Negeri Kecamatan Ciracas Jakarta Timur ). *Jurnal Pendidikan MIPA*, 1(1), 122–134.
- Nadhifah, G. (2016). *Peningkatan Kemampuan Pemecahan Masalah Matematis Siswa dengan Menerapkan Model Pembelajaran Problem Based Learning dan Inquiry* (Vol. 5, Issue 1).
- Nurjanah, A., Nurcahyono, N. A., & Imswatama, A. (2022). Penerapan Model Problem Based Learning terhadap Kemampuan Pemecahan Masalah Matematis Ditinjau dari Gaya Belajar Siswa SMP. *PRISMA*, 11(2), 406-414. <https://doi.org/10.35194/jp.v11i2.2420>
- Putri, R. K., Inggit, D., & Roichan, P. (2021). Pengaruh Model Pembelajaran Problem Based Learning terhadap Kemampuan Pemecahan Masalah Matematika Siswa Kelas XI SMA Negeri 15 Surabaya.
- Soleh, E. R. A., Setiawan, W., & Haqi, R. (2020). Upaya Meningkatkan Kemampuan Komunikasi Matematis dan Aktivitas Belajar Siswa Menggunakan Model Problem Based Learning. *Prisma*, 9(1), 1-9. <https://doi.org/10.35194/jp.v9i1.798>
- Saputri, T. R., Kamid, K., & Mujahidawati, M. (2023). Pengaruh Model PjBL Berbasis TPACK dan Gaya Kognitif terhadap Kemampuan Pemecahan Masalah Matematis Siswa. *PRISMA*, 12(2), 551-559. <https://doi.org/10.35194/jp.v12i2.3387>
- Sugiyono. (2017). *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D*. Alfabeta.
- Sultan, U., & Tirtayasa, A. (2022). *Implementasi kurikulum merdeka ditinjau dari pembelajaran matematika dan pelaksanaan P5 (studi di SMA Negeri 12 Kabupaten Tangerang) 1 Awaliyah Septiani, 2 Novaliyosi, 3 Hepsi Nindiasari* (Vol. 13, Issue 3).
- Wulansari Thania, P. A. R. N. H. M. (2019). Pengaruh Model Pembelajaran Berbasis Masalah Pada Materi Statistika Terhadap Kemampuan Penalaran Statistis Siswa. *AKSIOMA: Jurnal Matematika Dan Pendidikan Matematika*, 10(1), 35–47.
- Yaumil, S. S., Yuhana, Y., & Rafianti, I. (2020). Post Solution Posing dengan Cooperative Tipe Berkirim Salam dan Soal terhadap Kemampuan Pemecahan Masalah Matematis. *Prisma*, 9(1), 77-86. <https://doi.org/10.35194/jp.v9i1.922>