Problem Based Learning Assisted by Wordwall in Improving Students Mathematical Reflective Thinking Skills

Siti Indah Tsuray'ya[1], Sri Hastuti Noer[2*)], Mella Triana[3]
[1,2,3]Pendidikan Matematika, FKIP, Universitas Lampung
*) hastuti_noer@yahoo.com

Abstract

Mathematical reflective thinking skills is one of the higher-order thinking skills that is important to develop because it helps students understand problems, determine solution strategies, and evaluate their thinking processes. However, this ability is still not optimal because students are not yet accustomed to reflecting on the problem-solving process. This study aims to analyze the effect of the Problem Based Learning (PBL) assisted by Wordwall on students' mathematical reflective thinking skill in statistics material. This study uses a quantitative approach with a quasi-experimental method and a pretest-posttest control group design. The research population consisted of 265 eighth-grade students of SMP Negeri 9 Bandar Lampung, with the sample selected using a cluster random sampling technique. The research data were obtained through a mathematical reflective thinking skill test and analyzed using the Mann–Whitney U test. The results showed that the mathematical reflective thinking skill of students who received learning using the PBL assisted by Wordwall was higher than that of students who received direct instruction learning. Thus, the PBL assisted by Wordwall has an effect on students' mathematical reflective thinking skills and can therefore be used as an alternative approach in mathematics learning.

Keywords: mathematical reflective thinking, problem based learning, wordwall

Introduction

Education should promote the development of higher-order thinking skills, as these have been recognized as essential competencies for learners in the 21st century (Liu et al., 2024). Saely & Shaleh (2023) state that education plays a strategic role in preparing individuals who are able to face the challenges of the Industrial Revolution 4.0 through the mastery of higher-order thinking skills. In line with this perspective, Said et al. (2024) emphasize that students need to be equipped with relevant competencies to enable them to compete and contribute effectively in the future. Therefore, the implementation of education needs to prioritize a learning process that is not only oriented toward learning outcomes, but is also able to facilitate students in developing various higher-order thinking skills as a foundation for facing the challenges of life and the development of the times.

One subject that holds an important role in developing higher-order thinking skills is mathematics. Mathematics learning aims not only to equip students with the mastery of concepts and procedures, but also to develop reasoning ability, problem-solving ability, communication ability, and the ability to make logical decisions in various situations

(Hafriani, 2021). This shows that mathematical concepts and skills are needed not only in classroom learning, but also in various aspects of life, so that mathematics learning needs to develop students' way of thinking systematically (Masamah, 2017). In line with this, the mathematics learning outcomes stated in BSKAP Decree Number 46 of 2025 emphasize that students are expected to master concepts, use reasoning, solve problems, communicate mathematical ideas, and hold a positive disposition toward learning mathematics. The achievement of these competencies shows that mathematics learning is not sufficient if it develops only procedural ability, but also needs to facilitate the development of various higher-order thinking skills.

Among the various higher-order thinking skills that need to be developed through mathematics learning, mathematical reflective thinking plays an important role because it encourages students to reflect on what they do and why they do it (Umbara & Herman, 2021). Furthermore, reflective thinking is essential in mathematics learning because it supports students in solving problems and making appropriate decisions based on their understanding of mathematical situations (Fuady, 2017). This ability enables students to understand problems in depth, evaluate the solving process they carried out, and draw conclusions based on the results of their reflection on the strategies used. Noer et al. (2020) state that directed reflection can improve problem-solving ability. In addition, Hudaini & Lestari (2023) state that mathematical reflective thinking skill has a significant effect on mathematical creative thinking skill. Putri & Setiyaningsih (2024) also explain that reflective thinking is an important part of critical thinking skill because it involves the process of analyzing and evaluating a problem. These findings show that mathematical reflective thinking skill plays an important role in supporting the mastery of various other mathematical abilities.

However, the mathematical reflective thinking skill of students in Indonesia is still relatively low. The results of the 2022 Programme for International Student Assessment (PISA) show that Indonesia's mathematics score reached only 366, still below the OECD average of 472 (OECD, 2023). Most Indonesian students reach only level 2, while questions at level 5 and level 6 require higher-order thinking skills related to reasoning, problem-solving, and reflection in solving mathematical problems (Mukti & Permatasari, 2023). This condition is reinforced by the research of Ramadhani & Aini (2019), which shows that the mathematical reflective thinking skill of junior high school students is still in the low category and has not developed optimally.

A similar condition was also found at one of the public junior high schools in Bandar Lampung. Based on the results of a preliminary test given to eighth-grade students, students' mathematical reflective thinking skill is still relatively low. The results of the answer analysis show that students still experience difficulty in understanding problems, determining solution strategies, and evaluating the results obtained. On one question, as many as 52% of students gave an incorrect answer, while on another question, as many as 90% of students gave no answer at all. The analysis of students' answers shows that this obstacle occurs because students have not yet been able to understand the information contained in the question or identify what is being asked, which affects the accuracy of determining the solving steps and producing the final answer. These findings show that students still experience obstacles in carrying out the reflective thinking process when solving mathematical problems.

The low mathematical reflective thinking skill of students is thought to be related, among other things, to a learning process that has not fully involved students in developing their thinking skill (Haryati et al., 2017). Based on the results of interviews with teachers, the mathematics learning applied still uses the direct instruction model because it is considered more efficient in delivering material, managing time, and achieving curriculum targets. In its implementation, the direct instruction model places the teacher as the center of learning through a more dominant delivery of material and direction, so that students tend to follow the given steps without much opportunity to explore, evaluate, and reflect on their thinking process. In addition, the learning media used have not been able to encourage students' active involvement during the learning process. This condition shows that learning is needed that is able to give students the opportunity to be actively involved in understanding problems, formulating solution strategies, and reflecting on their thinking process (Ashari et al., 2024). These learning needs are aligned with the characteristics of the Problem-Based Learning (PBL) model, which engages students in solving contextual problems and provides opportunities to construct knowledge through active investigation, thereby supporting the development of mathematical reflective thinking skills (Kartono et al., 2019). Furthermore, previous studies have consistently shown that PBL effectively improves students' mathematical reflective thinking skills compared with conventional learning (Ningrum et al., 2024).

Although the characteristics of PBL are theoretically relevant to fostering mathematical reflective thinking skills, its successful implementation depends on how learning activities are facilitated in the classroom. Ambarwati & Kurniasih (2021) state that the application of the PBL model alone has not been fully optimal in the learning process. Therefore, interactive learning media can be integrated to support the implementation of PBL and facilitate students' active involvement during learning activities. One of the interactive learning media that can be integrated with PBL is Wordwall. Wordwall provides various game- and quiz-based activities that can support students' motivation, participation, and understanding of learning materials during the learning process (Putriani & Gunawan, 2023). Thus, the integration of Wordwall into PBL is expected to strengthen learning activities by providing interactive experiences that support students in engaging with problems and reflecting on their learning process.

Various studies have shown the effect of the PBL model and of Wordwall media in mathematics learning. Dianti et al. (2018) and Gega et al. (2019) show that the application of PBL can improve students' mathematical reflective thinking skill. In addition, Bitasmi'ah et al. (2025) and Fistanti et al. (2024) show that the application of PBL assisted by Wordwall is able to improve students' critical thinking skill and learning outcomes. Research that specifically examines the effect of PBL assisted by Wordwall on students' mathematical reflective thinking skill, however, is still limited, so empirical evidence regarding the effectiveness of its implementation is needed.

Based on the description above, this study aims to analyze the effect of applying the PBL assisted by Wordwall on students' mathematical reflective thinking skill. The results of this study are expected to provide an effective alternative learning approach for improving mathematical reflective thinking skill and to serve as a reference for teachers in optimizing mathematics learning in schools.

Method

This study used a quantitative approach with a quasi-experimental method. The independent variable was the PBL assisted by *Wordwall*, while the dependent variable was students' mathematical reflective thinking skill. The research employed a Pretest–Posttest Control Group Design, as proposed by Sugiyono (2020). Through this design, both research classes were given a pretest to determine their initial ability, and then were given different treatments. The experimental class received learning using the PBL assisted by *Wordwall*, while the control class received learning using the direct instruction model. After the treatment was completed, both classes were given a posttest to obtain data on students' mathematical reflective thinking skill.

The population in this study consists of all eighth-grade students of SMP Negeri 9 Bandar Lampung in the 2025/2026 academic year, totaling 265 students spread across nine classes. The research sample was determined using a cluster random sampling technique, in which intact groups (classes) were randomly selected from the population. All eighth-grade classes had an equal opportunity to be selected as the research sample. The sampling process was carried out using a spinner, through which Class VIII C was randomly selected as the experimental class that received the PBL assisted by Wordwall, while Class VIII E was selected as the control class that received direct instruction.

The research procedure was carried out through three stages, namely the preparation stage, the implementation stage, and the final stage. In the preparation stage, the researcher conducted initial observations and interviews with the mathematics teacher to obtain information regarding the learning conditions and students' mathematical reflective thinking skill. Subsequently, the researcher developed learning tools and a research instrument in the form of a mathematical reflective thinking skill test on statistics material. The instrument was developed based on the indicators of mathematical reflective thinking skill proposed by Sihaloho et al. (2020) and Noer (2010), namely reacting, comparing, and contemplating. The indicators of mathematical reflective thinking skill used in this study are presented in Table 1.

Table 1. Indicators of Mathematical Reflective Thinking Skills

No	Indicator	Description
1.	*Reacting*	The ability to give an initial response to a mathematics question based on personal thinking about the condition of the given problem, particularly regarding what is being asked and the information available in the question.
2.	*Comparing*	The ability to analyze a problem being faced in order to find a solving step based on the knowledge already possessed.
3.	*Contemplating*	The ability to explain, consider, and evaluate the process and the result of solving a problem, and to draw a conclusion based on the solution obtained.

The instrument that had been developed was then content-validated by a mathematics subject teacher acting as validator to determine the suitability of the test items with the indicators of mathematical reflective thinking skill and the statistics material. After being declared suitable, the instrument was trialed on students outside the research sample to determine the quality of the items. The item analysis was conducted based on validity, reliability, discrimination index, and difficulty level. Item validity was analyzed using the item-total correlation coefficient to determine the consistency between each item score and the total test score. The reliability analysis was conducted using Cronbach's Alpha coefficient to measure the internal consistency of the instrument. Furthermore, the discrimination index was analyzed to determine the ability of each item to distinguish students with high and low abilities, while the difficulty level analysis was conducted to identify the level of difficulty of each test item. These analyses followed the criteria proposed by Arikunto (2018). The analysis results showed that all items met the eligibility criteria and could be used as a research instrument. A recapitulation of the item analysis results is presented in Table 2.

Table 2. Recapitulation of the Item Analysis Results

No.	Validity	Reliability	Discrimination Index	Difficulty Level	Conclusion
1.	Valid	Reliable (0,92)	Good (0,57)	Medium (0,58)	Suitable for use
2.			Very Good (0,81)	Medium (0,45)	
3.			Very Good (0,74)	Medium (0,39)	

The implementation stage began with the administration of a pretest to the experimental class and the control class. Subsequently, learning activities were carried out according to the predetermined treatment, namely the application of the PBL assisted by Wordwall in the experimental class and direct instruction in the control class. After all learning activities were completed, both classes were given a posttest to obtain data on students' mathematical reflective thinking skill.

The final stage of the research was carried out through the processing and analysis of the data obtained from the research results. The research data consist of quantitative data obtained through a test of students' mathematical reflective thinking skill. Data analysis was carried out using descriptive statistics and inferential statistics. Descriptive analysis was used to describe students' ability based on the pretest, posttest, and gain results in each class, while inferential analysis was used to test the improvement in mathematical reflective thinking skill between the experimental class and the control class.

Before hypothesis testing was carried out, the gain data were first tested for normality using the Chi-Square test, referring to Sudjana (2005). If the data met the parametric assumptions, hypothesis testing was carried out using an independent samples t-test. However, if the data did not meet these assumptions, the nonparametric Mann–Whitney U test was used, as proposed by Sugiyono (2020). Taraf signifikansi yang digunakan pada uji Mann–Whitney U adalah 0,05. The significance level used in the Mann–Whitney U test was 0.05, with the decision criteria that H_0 was rejected if $Z_{calculated} < Z_{critical}$.

Results and Discussion

Before the treatment was given, both classes were given a pretest to obtain a picture of the initial condition of students' mathematical reflective thinking skill. The results of the descriptive analysis of the pretest data in the experimental class and the control class are presented in Table 3.

Table 3. Results of the Analysis of Students' Initial Mathematical Reflective Thinking skill

Class	n	Lowest Score	Highest Score	$\bar{x}$	s	Median	Ideal Maximum Score
Eksperimental	24	1	9	3,25	1,87	3	27
Control	21	0	8	2,90	2,34	2	

Based on Table 3, the average initial score of students' mathematical reflective thinking skill who received PBL assisted by Wordwall learning was descriptively 3,25, while students who received direct instruction learning obtained an average score of 2,90. The relatively small difference between the average scores shows that, descriptively, the initial mathematical reflective thinking skill of the two groups did not show a significant difference before the treatment was given. These results show that both groups held a fairly equivalent initial condition for undergoing a learning process with different treatments.

After the learning process was carried out, students' final mathematical reflective thinking skill was obtained through the administration of a posttest to both classes. The results of the analysis of students' final ability are presented in Table 4.

Table 4. Results of the Analysis of Students' Final Mathematical Reflective Thinking skill

Class	n	Lowest Score	Highest Score	$\bar{x}$	s	Median	Ideal Maximum Score
Eksperimental	24	7	22	15,92	4,95	16	27
Control	21	6	17	11,52	2,84	11	

Based on Table 4, the average final score of students' mathematical reflective thinking skill in the class that applied learning with the PBL model was higher than in the class that applied direct instruction learning. Next, to determine the improvement in students' mathematical reflective thinking skill after the treatment was given, an analysis of the gain score was carried out. The results of the descriptive analysis of the gain score for students' mathematical reflective thinking skill are presented in Table 5.

Table 5. Results of the Gain Score Analysis

Class	n	Lowest Gain	Highest Gain	$\bar{x}$	s
Eksperimental	24	0,17	0,80	0,54	0,20
Control	21	0,16	0,48	0,36	0,10

Based on Table 5, the gain score in the class that received PBL assisted by Wordwall learning was descriptively higher than in the class that received direct instruction learning.

Next, before hypothesis testing was carried out, the gain data were first tested for normality using the Chi-Square test, referring to Sudjana (2005). The results of the normality test are presented in Table 6.

Table 6. Results of the Normality Test of the Gain Data

Class	χ^2_{hitung}	χ^2_{tabel}	Test Decision
Eksperimental	13,04	5,99	Reject H_0
Control	7,03	7,81	Accept H_0

Based on Table 6, the results of the normality test show that the gain data in one of the groups were not normally distributed, so hypothesis testing was carried out using the nonparametric Mann–Whitney U test. The results of the Mann–Whitney U test show that the calculated Z value of -3.06 was smaller than the table Z value of -1.64, at a significance level of 0.05. It can therefore be concluded that the median gain in mathematical reflective thinking skill of students in the class that applied the PBL model was higher than that of students in the class that used direct instruction learning.

These results show that the PBL model improves students' mathematical reflective thinking skill. Next, to determine students' ability on each indicator of mathematical reflective thinking, an analysis was carried out based on the achievement of each indicator, namely reacting, comparing, and contemplating. This analysis aims to determine the development of students' ability on each indicator of mathematical reflective thinking after the treatment was given. The achievement results for the indicators of students' mathematical reflective thinking skill are presented in Table 7.

Table 7. Achievement of Indicators

Indicator	PBL Assisted by Wordwall		*Direct Instruction*	
	Initial	Final	Initial	Final
Reacting	19%	70%	12%	54%
Comparing	12%	61%	12%	48%
Contemplating	5%	46%	8%	26%

The improvement in students' mathematical reflective thinking skill in this study is also reflected in the achievement of each indicator. Based on the analysis results, all indicators of mathematical reflective thinking skill in the class that received PBL assisted by Wordwall learning experienced a higher improvement than in the class that applied direct instruction learning. The reacting indicator achieved the highest result compared to the other indicators, while the contemplating indicator achieved a relatively lower result. This shows that students find it easier to develop the ability to understand and give an initial response to a problem than the ability to carry out an in-depth evaluation of the thinking process they have already gone through.

The reacting indicator achieved the highest result compared to the other indicators. This finding shows that students were more able to understand problems, identify known information, and determine the initial step for solving a question. This achievement cannot be separated from the characteristics of PBL learning, which begins with the presentation of a contextual problem. Through the stage of orienting students to the problem, students are given the opportunity to observe, understand, and interpret the problem before determining a solution strategy. This process helps students build the habit of not immediately performing a calculation, but of first understanding the situation contained within the problem. The development of the reacting indicator was also supported by group discussion activities during the learning process. When solving problems in the student worksheet, students discussed in order to identify important information and to convey their initial understanding of the given problem. This activity shows that students began to be able to give a response to a problem based on their own thinking. This finding is in line with Dewey (1933) , who explains that reflective thinking begins through the process of understanding a problem and considering the condition being faced before making a decision. In addition, Noer et al. (2020) state that the reacting ability develops when students are able to understand a problem, identify the available information, and determine the initial solving step.

Next, the comparing indicator shows students' ability to analyze a problem and compare the solution strategies used. On this indicator, students were trained to consider various alternative solutions through investigation activities and group discussions. In PBL learning, students do not merely receive a solving procedure from the teacher, but are given the opportunity to discover a strategy based on their own understanding. During discussions, students could compare the solving methods used among group members and determine the strategy considered most suitable for solving the problem. The activity of presenting discussion results also supported the development of the comparing indicator. At this stage, students compared their own work with the work of other groups and obtained the opportunity to give responses to the solving strategies used. In addition, the use of Wordwall provided feedback on the answers given, so that students could re-check the accuracy of their solving results. This helped students carry out an analysis of the strategies used. This finding is consistent with Upu et al. (2025) , who state that the comparing indicator relates to students' ability to analyze and evaluate solving strategies based on the knowledge they possess.

Meanwhile, the contemplating indicator achieved a relatively lower result compared to the reacting and comparing indicators. This condition shows that students' ability to carry out an in-depth evaluation of their thinking process is still a part that requires further development. Some students were already able to obtain a final answer, but still experienced difficulty in explaining the reason for using a particular strategy, re-checking the solving steps, and drawing a conclusion based on the results obtained. This shows that the activity of reflecting on the thinking process has not yet fully become a habit for students. The low achievement of the contemplating indicator is in line with the research of Noviyanti et al. (2021) who state that contemplating is an indicator of mathematical reflective thinking that is relatively difficult for students to achieve because it requires the ability to comprehensively evaluate the solving process. Nevertheless, the application of the PBL model gives students room to develop this ability through the stage of analyzing and evaluating the problem-solving process. At this stage, students together with the teacher reviewed the strategies used, checked the suitability of the answers, and corrected the errors that were found. This is in line with Noer (2010) , who explains that the contemplating indicator is shown through students' ability to reconsider the solving process and to evaluate the results obtained.

In addition to the learning model, the use of Wordwall also supported the process of developing students' mathematical reflective thinking skill. Wordwall gave students the opportunity to obtain a direct response to the answers given, which encouraged students to carry out a re-check of their work. This process helped students understand that problem-solving is oriented not only toward the final answer, but also toward the accuracy of the process carried out to obtain that answer. Thus, the integration of Wordwall into PBL learning supported the creation of more interactive learning activities and increased student involvement during the learning process. This involvement facilitated students in evaluating the problem-solving process and reflecting on the results obtained at each stage of learning. This finding is supported by Wulandari & Iskarni (2026) , who state that the use of Wordwall as an interactive learning medium is able to increase student involvement, thereby giving students a greater opportunity to participate actively at every stage of learning.

Unlike students who received PBL assisted by Wordwall learning, students who received direct instruction learning tended to follow the solving steps that had been given by the teacher. Learning took place mostly through the delivery of material, the giving of example questions, and practice based on procedures that had been taught. This condition caused students' opportunities to explore strategies, compare solutions, and re-evaluate their thinking process to become more limited. This is in line with Laili et al. (2024) , who state that conventional learning tends to make students more passive because student interaction and involvement in the learning process are not yet optimal.

The implementation of PBL assisted by Wordwall learning in this study generally ran well, although several obstacles were encountered during the learning process. At the beginning of the implementation, several students still experienced difficulty in adjusting themselves to learning that demands active involvement through discussion and problem-solving. This condition shows that the application of the PBL model requires an adaptation process, particularly for students who were previously accustomed to teacher-centered learning. This finding is in line with the research of Fitriyah & Ghofur (2021) , who state that at the early stage of implementing PBL, students still experience difficulty in understanding problems and are not yet accustomed to participating actively in group discussions, because PBL learning requires students to be more independent in finding solutions.

In addition, the use of gadgets as a means of accessing Wordwall also needed to receive supervision, because some students still used the devices beyond what was needed for learning. The research of Pérez-Juárez et al. (2023) states that the integration of technology in learning needs to be accompanied by a management strategy so that it continues to support students' academic activities. Another obstacle was that not all group members played an active role in discussion activities, so that the completion of the student worksheet was sometimes still dominated by certain students. This is in line with the research of Rahmawati et al. (2021), which states that the application of the PBL model needs to pay attention to the process of interaction and cooperation among group members, so that all students can be optimally involved in solving problems. Therefore, teachers need to give clear direction regarding the learning stages, optimize the division of roles within groups, and manage the use of technology so that it supports the active involvement of all students.

Overall, the research results show that the PBL assisted by Wordwall model gives a contribution to students' mathematical reflective thinking skill. Through the activities of understanding problems, determining strategies, comparing solutions, and evaluating the results obtained, students gained a learning experience that supported the development of the reacting, comparing, and contemplating indicators. Although obstacles still remained in its implementation, the results of this study show that PBL assisted by Wordwall has an effect on the improvement of mathematical reflective thinking skill.

Conclusion and Suggestion

The results of the study show that the implementation of the Wordwall-assisted Problem Based Learning (PBL) model has an effect on improving students' mathematical reflective thinking skill. The mathematical reflective thinking skill of students who received learning with the PBL assisted by Wordwall model was higher than that of students who received direct instruction learning. The application of PBL assisted by Wordwall helped students understand problems, determine solving strategies, and re-evaluate the process and results of the solutions carried out. In its implementation, obstacles still remain in the form of the limited involvement of some students in group discussions and the use of digital devices, which need to be managed more optimally. Therefore, teachers need to pay attention to group management and the use of digital media so that all students can participate actively in the learning process.

References

Ambarwati, D., & Kurniasih, M. D. (2021). Pengaruh Problem Based Learning Berbantuan Media Youtube Terhadap Kemampuan Literasi Numerasi Siswa. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *5*(3), 2857–2868. https://doi.org/10.31004/cendekia.v5i3.829.

Arikunto, S. (2018). *Dasar-Dasar Evaluasi Pendidikan (Edisi 3)*. Bumi Aksara.

Ashari, V. F., Jihad, A., & Rachmawati, T. K. (2024). Peningkatan Kemampuan Berpikir Reflektif Matematis Melalui Model Pembelajaran Connected Mathematics Project (CMP). *Jurnal Analisa*, *10*(1), 64–75. https://doi.org/10.15575/ja.v10i1.36392.

Bitasmi'ah, S. L., Isnarto, Dewi, N. R., Zaenuri, Walid, Agoestanto, A., & Sugiman. (2025). Penggunaan Wordwall Website Pada Model Pembelajaran Problem Based Learning (PBL) Terhadap Kemampuan Berpikir Kritis Matematis Siswa. *Kemungkinan Bagian Dari PRISMA, Prosiding Seminar Nasional Matematika (2025)*, *8*, 332–337. https://proceeding.unnes.ac.id/prisma/article/view/4332.

Dewey, J. (1933). *How We Think*. D.C. Heath. https://archive.org/details/dli.ernet.240488

Dianti, A., Noer, S. H., & Gunowibowo, P. (2018). Pengaruh Problem Based Learning Terhadap Kemampuan Berpikir Reflektif Matematis dan Self Confidence. *Jurnal Pendidikan Matematika Unila*, *6*(5), 332–343. http://jurnal.fkip.unila.ac.id/index.php/MTK/article/view/17675.

Fistanti, N. A. A., Kirana, A., & Indahwati, F. (2024). Penerapan Model Pembelajaran Problem Based Learning (PBL) Berbantuan Media Wordwall pada Materi Peluang untuk Meningkatkan Hasil Belajar Peserta Didik SMA Negeri 9 Surabaya. *Pentagon : Jurnal Matematika Dan Ilmu Pengetahuan Alam*, *2*(3), 54–62. https://doi.org/10.62383/pentagon.v2i3.227.

Fitriyah, I. M. N., & Ghofur, M. A. (2021). Pengembangan E-LKPD Berbasis Android dengan Model Pembelajaran Problem Based Learning (PBL) untuk Meningkatkan Berpikir Kritis Peserta Didik. *Edukatif : Jurnal Ilmu Pendidikan*, *3*(5), 1957–1970. https://jurnal.citrabakti.ac.id/index.php/jil/article/view/2147.

Fuady, A. (2017). Berfikir Reflektif Dalam Pembelajaran Matematika. *Jurnal Ilmiah Pendidikan Matematika*, *1*(2), 104–112. https://doi.org/10.26877/jipmat.v1i2.1236.

Gega, M., Noer, S. H., & Gunowibowo, P. (2019). Pengaruh Model Problem Based Learning Terhadap Kemampuan Berpikir Reflektif dan Self Efficacy Siswa. *Jurnal Pendidikan Matematika Unila*, *7*(1), 117–131. https://jurnal.fkip.unila.ac.id/index.php/MTK/article/view/17675.

Hafriani. (2021). Mengembangkan Kemampuan Dasar Matematika Siswa Berdasarkan NCTM Melalui Tugas Terstruktur Dengan Menggunakan ICT (Developing The Basic Abilities Of Mathematics Students Based On NCTM Through Structured Tasks Using ICT). *Jurnal Ilmiah Didaktika*, *22*(1), 63–80. https://doi.org/10.22373/jid.v22i1.7974.

Haryati, T., Nindiasari, H., & Sudiana, R. (2017). Analisis Kemampuan Dan Disposisi Berpikir Reflektif Matematis Siswa Ditinjau Dari Gaya Belajar. *Jurnal Penelitian Dan Pembelajaran Matematika*, *10*(2), 146–158. https://doi.org/10.30870/jppm.v10i2.2039

Hudaini, N., & Lestari, K. E. (2023). Pengaruh Kemampuan Berpikir Reflektif Matematis Terhadap Kemampuan Berpikir Kreatif Matematis Siswa. *Jurnal Didactical Mathematics*, *5*(2), 413–421. https://ejournal.unma.ac.id/index.php/dm/article/view/6365/3514.

Kartono, Arumsasi, P. D., & Mariani, S. (2019). Analysis of Students' Mathematical Reflective Thinking on Problem-Based Learning (PBL) Based From Learning Styles. *Unnes Journal of Mathematics Education*, *8*(1), 34–41. https://doi.org/10.15294/ujme.v8i1.24239.

Laili, A., Lestari, N. A. P., & Sudewiputri, M. P. (2024). Pengaruh Model Pembelajaran Discovery Learning Terhadap Hasil Belajar IPA Siswa SD. *Jurnal Ilmiah Pendidikan Citra Bakti*, *11*(1), 1–10. https://jurnal.citrabakti.ac.id/index.php/jil/article/view/2147.

Liu, J., Liu, Z., Wang, C., Xu, Y., Chen, J., & Cheng, Y. (2024). No Title. *K-12 Students' Higher-Order Thinking Skills: Conceptualization, Components, and Evaluation Indicators*, *52*. https://doi.org/https://doi.org/10.1016/j.tsc.2024.101551.

Masamah, U. (2017). Peningkatan Kemampuan Berpikir Reflektif Matematis Siswa SMA Melalui Pembelajaran Berbasis Masalah Ditinjau Dari Kemampuan Awal Matematika. *Jurnal Penelitian Pendidikan Matematika*, *1*(1), 1–18. https://www.academia.edu/86132776.

Mukti, Z. F., & Permatasari, D. (2023). Kemampuan Berpikir Reflektif dalam Menyelesaikan Soal PISA-Like ditinjau dari Disposisi Matematis Siswa SMP. *Jurnal Tadris Matematika (JTMT)*, *4*(1), 10–22. https://doi.org/10.47435/jtmt.v4i1.1670

Ningrum, A. K. P., Novaliyosi, & Nindiasari, H. (2024). Systematic Literature Review: Model Problem Based Learning terhadap Kemampuan Berpikir Reflektif Matematis Siswa. *Jurnal Educatio FKIP UNMA*, *10*(3), 873–880. https://doi.org/10.31949/educatio.v10i3.9325.

Noer, S. H. (2010). *Peningkatan kemampuan berpikir kritis, kreatif, dan reflektif (K2R) matematis siswa SMP melalui pembelajaran berbasis masalah* [Unpublished doctoral dissertation]. Universitas Pendidikan Indonesia.

Noer, S. H., Gunowibowo, P., & Triana, M. (2020). Improving Students' Reflective Thinking Skills and Self-efficacy Through Scientific Learning. *Journal of Physics: Conference Series*, *1581*(1), 1–9. https://doi.org/10.1088/1742-6596/1581/1/012036

Noer, S. H., Gunowibowo, P., & Triana, M. (2020). Improving Students' Reflective Thinking Skills and Self-efficacy Through Scientific Learning. *Journal of Physics: Conference Series*, *1581*(1), 1–9. https://doi.org/10.1088/1742-6596/1581/1/012036.

Noviyanti, E. D., Purnomo, D., & Kusumaningsih, W. (2021). Analisis Kemampuan Berpikir Reflektif dalam Pemecahan Masalah Matematika Ditinjau dari Gaya Kognitif. *Imajiner: Jurnal Matematika Dan Pendidikan Matematika*, *3*(1), 57–68. https://journal.upgris.ac.id/index.php/imajiner/article/download/7097/3873.

Pérez-Juárez, M. Á., González-Ortega, D., & Aguiar-Pérez, J. M. (2023). Digital Distractions from the Point of View of Higher Education Students. *Sustainability*, *15*(7), 1–22. https://doi.org/10.3390/su15076044.

Putriani, N., & Gunawan, R. (2023). Media Games Interaktif Wordwall untuk Meningkatkan Keaktifan Belajar Peserta Didik Kelas IV Sekolah Dasar pada Muatan IPAS. *Journal of Education Action Research*, *7*(3), 409–415. https://doi.org/10.23887/jear.v7i3.66527.

Putri, K. R., & Setiyaningsih, D. (2024). Tercermin pada Kemampuan Literasi Matematika kelas V Sekolah Dasar. *Seminar Nasional Dan Publikasi Ilmiah*, 997–1002. https://jurnal.umj.ac.id/index.php/SEMNASFIP/article/view/23669.

Rahmawati, D. U., Jumadi, & Ramadan, E. M. (2021). Problem-Based Blended Learning : The Impacts on Students ' Collaborative Skills. *Proceedings of the 7th International Conference on Research, Implementation, and Education of Mathematics and Sciences (ICRIEMS 2020)*, *528*(Icriems), 492–499. https://doi.org/10.2991/assehr.k.210305.072.

Ramadhani, N. F., & Aini, I. N. (2019). Kemampuan Berpikir Reflektif Matematis Siswa dalam Menyelesaikan Masalah yang Berkaitan dengan Bangun Ruang Sisi Datar. *Prosiding Seminar Nasional Matematika Dan Pendidikan Matematika Sesiomadika 2019*, *2*(1), 754–761. https://journal.unsika.ac.id/index.php/sesiomadika/article/view%0A/2835.

Saely, E., & Shaleh. (2023). Strategi Pengembangan Sumber Daya Manusia dalam Menghadapi Era Industri 4.0. *Edudikara: Jurnal Pendidikan Dan Pembelajaran*, *8*(1), 1–10. https://www.researchgate.net/publication/383436133.

Said, M., Alaidrus, A. J., & Badrun. (2024). Pengembangan Sumber Daya Manusia : Meningkatkan Soft Skill Siswa Untuk Kesiapan Dunia Kerja. *Jurnal Ilmiah Profesi Pendidikan*, *9*(3), 1923–1929. https://doi.org/10.29303/jipp.v9i3.2466.

Sihaloho, R., Zulkarnaen, R., & Haerudin. (2020). *Analisis Kemampuan Berpikir Reflektif Matematis Siswa Dalam Menyelesaikan Soal Cerita*. *4*(2), 271–281. https://doi.org/10.36526/tr.v4i2.928.

Sudjana. (2005). *Metode Statistika*. Tarsito.

Sugiyono. (2020). *Metode Penelitian Kuantitatif Kualitatif dan R&D*. Alfabeta.

Umbara, F. D. A. D. U., & Herman, T. (2021). *Kemampuan Berpikir Reflektif Matematis Siswa Dalam Menyelesaikan Masalah Matematis Terbuka Ditinjau Dari Gaya Belajar*. *12*(1), 167–186. https://doi.org/https://doi.org/10.24127/ajpm.v12i1.6807.

Upu, E. E., Ere, D. A., & Rena, P. (2025). Inovasi Dalam Pengembangan Kurikulum. *ARINI: Jurnal Ilmiah Dan Karya Inovasi Guru*, *2*(1), 65–76. https://www.scribd.com/document/90663290%0A1/5-Erwin-E-Upu-Dkk-Inovasi-Dalam-Pengembangan-Kurikulum.

Wulandari, F. I., & Iskarni, P. (2026). Enhancing Student Engagement and Learning Outcomes in Social Studies Through Wordwall : A Quasi-Experimental Study in A Junior High School Context. *IRJE: Indonesian Research Journal in Education*, *10*(1), 416–431. https://online-journal.unja.ac.id/irje/article/download/47898/23815/174504.