ISSN 2502-5872 (Print)
ISSN 2622-3627 (Elektronik)

Volume 10 Number 2, May 2025, 387-400

FLIPBOOKS' SUPPORT OF PROBLEM-BASED LEARNING AND ITS IMPACT ON CRITICAL THINKING ABILITY

Dewi Vebiyanti[1*], Asih Miatun[2]
[1,2]Mathematics Education, Universitas Muhammadiyah Prof. Dr. HAMKA, Jakarta, Indonesia
*Correspondence: dewivebiyanti@gmail.com

ABSTRACT
Mathematics teaching needs to be carefully designed to promote complex cognitive skills, especially critical thinking skills, as an essential competence. However, the lecture and question-and-answer models that are still widely used are often unable to develop these skills optimally. This circumstance highlights the need for innovative learning models that actively engage students and utilize technology, in line with the Merdeka curriculum. The purpose of this study is to investigate the effectiveness of the flipbook-based model of PBL in improving students' mathematical critical thinking skills. Flipbooks in PBL provide a contextualized, visual, and student-centered approach that encourages collaboration, exploration, and reflection. The results of the Mann-Whitney hypothesis tests, as the data were not normally distributed and did not meet the requirements for a t-test, showed that students in the flipbook-based PBL group achieved a higher mean score than the lecture and question-answer model groups. The effect size (d) value of 1.01 is in the high category, indicating that this model has a positive impact on improving critical mathematical thinking skills and supports contextualized and collaborative learning.
Keywords: Mathematical Critical Thinking Ability, Problem-Based Learning, Flipbook

How to Cite: Vebiyanti, D., & Miatun, A. (2025). Flipbooks' Support Of Problem-Based Learning and Its Impact On Critical Thinking Ability. Mathline: Jurnal Matematika dan Pendidikan Matematika, *10*(2), 387-400. http://doi.org/10.31943/mathline.v10i2.953

PRELIMINARY

Mathematics helps students think logically and systematically. Knowing math improves their school performance and builds problem-solving and critical thinking skills needed for real-life situations (Kartika & Rakhmawati, 2022). It is essential to plan math lessons carefully to help students develop complex thinking skills, especially critical thinking (Ambarwati et al., 2022; Gusteti, 2022). Critical thinking is the skill of logical and deep reasoning that aids people in deciding their beliefs or actions. This competence is becoming increasingly important in various areas of life, such as education, professional life, social encounters, and everyday challenges (Naufal, 2022).

Critical thinking is essential for learning math. It means assessing and evaluating information to make logical conclusions. This skill helps to understand math concepts better (Ananda et al., 2022; Kusumawardani et al., 2022). Students with this ability are generally better prepared to understand and solve problems (Subaini et al., 2023; Syafitri et al., 2022). Permendikbudristek number 5 of 2022, which emphasizes the application of

logic and mathematical principles in everyday life, is also consistent with the importance of critical thinking (Kemdikbudristek, 2022).

The study found that secondary students still lack optimal mathematics critical thinking skills. Lukman et al. (2023) reported that secondary school students struggle to master mathematical critical thinking skills. According to Dores and Merayang (2022), 58,87% of students had limited critical thinking skills, while Az Zahra and Hakim (2022) found that 57,29% of students could be categorized as “moderate”. In addition, research by Siburian et al. (2023) found that before implementing the flipped classroom, the average low scores were 38.30 in the experimental group and 36,53 in the control group.

The PBL model is effective for teaching that encourages critical thinking. It uses real-life problems and teamwork to help students better understand and develop their thinking skills (Mulyani et al., 2024; Pramadhany et al., 2023; Subaini et al., 2023). According to Kusumawardani et al., (2022) the PBL model has a systematic syntax that promotes the development of critical thinking, namely: (1) introducing students to relevant problems; (2) planning learning activities in a structured and systematic way; (3) guiding the process of inquiry; (4) elaborating and demonstrating the results or solutions; and (5) monitoring as well as assessing the implemented problem solving. Each phase aims to strengthen critical thinking skills gradually and sustainably.

Previous research has shown that using PBL models permanently changes students' critical thinking skills. Syafitri et al. (2022) reported that critical thinking scores increased from 53,13 to 82,08 through an open PBL-based approach. Rahmawati (2022) observed an increase from 44,4% (fair category) to 81,5% (good category). Budhiyati et al. (2023) also achieved similar results: They determined that the mathematics learning model based on PBL led to an increase from 79,97% (good) to 86,13% (perfect). Mulyani dkk. (2024) also recorded a rise in the average score from 64,18 to 80,38. Rizki et al. (2024) also conducted a post-test, which showed that the PBL model with responsive learning aids positively impacted critical thinking skills.

Interactive, contextualized, and technology-enhanced learning resources are necessary to realize an effective PBL model that aligns with the Merdeka curriculum. According to Ambarwati et al. (2022), flipbooks in problem-based learning are relevant and potential media as they can combine text, animation, video, and audio in an integrated way to increase student engagement. Heyzine allows users to create engaging and organized flipbooks that are easily accessible online. Research indicates that using PBL models with flipbooks can improve learning efficiency, help achieve learning goals, and

enhance students' analytical and critical thinking skills (Ambarwati et al., 2022; Masrifah et al., 2023; Safitri et al., 2024).

According to Rosa et al. (2024), implementing learning models aligned with the Merdeka curriculum is critical to fostering students' critical thinking skills. The curriculum focuses on contextualized and relevant learning using technology. Teachers are therefore encouraged to tailor the learning process to the characteristics and needs of students, for example, by using problem-based flipbooks in mathematics lessons. Interactive digital media, such as flipbooks, combine text, animation, video, images, music, and navigation to increase student engagement (Ambarwati et al., 2022). This study used a flipbook from the Heyzine platform, which offers a customized design, page transition effects, and online distribution and access.

Previous research has largely focused on the general application of learning models without considering the difficulty of integrating specific models with technology-enhanced digital media, especially in mathematics. This results in a research gap, especially in using interactive media such as flipbooks for students' critical thinking skills in mathematics. The researcher's study was designed to examine the effects of the flipbook-based PBL model on high school students' critical thinking skills in math-related contexts.

METHODS

A quantitative method with a quasi-experiment was used to investigate the effect of using the problem-based learning (PBL) model with the help of a flipbook on high school students' critical thinking ability in mathematics. The research design used was a non-equivalent post-test only design. The target population of this study was the students of public high schools in Jakarta, and the subjects were randomly selected from the students of class X of one of the public high schools in Central Jakarta. Class X-5 was designated as the experimental class, which was taught using the flipbook-based PBL model and consisted of 34 students. Meanwhile, class X-4 was designated as the control class that learned using the model applied by the math teacher, i.e., the lecture and question-answer model, with a total of 36 students. Az Zahra and Hakim (2022) developed a descriptive test to assess mathematical critical thinking skills, which includes four indicators, namely interpretation, analysis, evaluation, and reasoning. Before being piloted in a public high school in Jakarta, the test was validated by an experienced mathematics lecturer and a high school mathematics teacher.

Pre-research tests with ATS scores were conducted to see if the two groups had similar baseline abilities. The Mann-Whitney test was used because the normality and homogeneity tests did not meet the t-test requirements. The next step is to apply the PBL model with flipbooks to the experimental group. The application of this model includes five main syntaxes, namely problem orientation using flipbooks, organizing students into learning groups using LKPD, guiding the exploration and discussion process using visual reference flipbooks, preparation and presentation of solutions by students, and analysis and evaluation of results with feedback by the teacher. After the treatment, the students' critical mathematical thinking skills were assessed by a posttest in the form of a descriptive test. In the next step, the data on mathematical critical thinking skills were tested descriptively using the results of the post-test. The post-test results were analyzed descriptively and categorized based on Mulyani et al. (2024) in Table 1 below.

Table 1. Performance Level Of Mathematical Critical Thinking Ability

Percentage score	Categorie
$81{,}25\% < x \leq 100\%$	Very High
$71{,}5\% < x \leq 81{,}25\%$	High
$62{,}5\% < x \leq 71{,}5\%$	Medium
$43{,}75\% < x \leq 62{,}5\%$	Low
$0 < x \leq 43{,}75$	Very Low

Looking at the data description helps to organize percentages into categories for important math thinking skills. The research hypothesis was examined in the next phase using the Mann-Whitney test based on the post-test data to identify differences between the sample groups. The Mann-Whitney test was chosen because the normality and homogeneity tests did not meet the criteria for a t-test. After the Mann-Whitney test, an effect size test based on Cohen was done to see how much the treatment affected the results. Based on the criteria of Cohen et al. (2018), the results of the effect size test were divided into the following categories in Table 2.

Table 2. Criteria for Effect Size

Large Effect Size	Description
$0{,}00 \leq d \leq 0{,}20$	Very Low
$0.21 \leq d \leq 0{,}50$	Low
$0{,}51 \leq d \leq 1{,}00$	Medium
$d > 1{,}00$	High

Data analysis was conducted using SPSS version 26 to obtain objective and accurate results on the effects of the PBL model using the flipbook on students' math critical thinking skills. The preliminary hypothesis of this study is as follows.

$H_0 : \mu_1 = \mu_2$ (The experimental and control groups do not mathematically and critically differ in their thinking abilities.)

$H_0 : \mu_1 \neq \mu_2$ (The experimental and control groups differ in their ability to think mathematically and critically.)

RESULT AND DISCUSSION

Flipbooks are used in this study as learning media that are integrated into several phases of the problem-based learning (PBL) model, especially the first three phases. In the problem orientation phase, flipbooks are used to introduce students to contextualized problems that are designed to capture attention and stimulate critical thinking from the outset. In the organizing learning phase, students are divided into groups and given LKPD, using the flipbook as the main source to explore information and understand the context of the problem in depth. In the individual and group exploration phase, the flipbook is used as the main reference for students to identify key points, draft solutions, and ask critical questions, while the teacher acts as a facilitator. The use of flipbooks is maintained as a support in the solution presentation and assessment phases, although their role is no longer dominant. The integration of flipbooks in the early stages of PBL aims to strengthen students' understanding of concepts and improve their critical mathematical thinking skills.

The study started with a pre-research in which the ATS scores of the two sample groups were used. This corresponds with the study by Adi Putra et al. (2020), who used ATS scores in preliminary examinations. Sari et al. (2020) conducted another study in which the homogeneity test was also used as a pretest condition to determine whether the baseline abilities of the two sample groups were similar or different. In addition, the data from the preliminary study were analyzed with descriptive statistics, and the hypothesis analysis of the preliminary study was examined using the Mann-Whitney test. The Mann-Whitney test was selected because the results of the normality test showed that the data were not normally distributed. Descriptive data on the pre-research test are in Table 3 below.

Table 3. The description of Pre-research Data

	Descriptive Statistic					
	N	*Minimum*	*Maximum*	*Mean*	*Std. Deviation*	*Variance*
Experiment Group	34	40	93	62.79	17.139	293.744
Control Group	36	40	90	55.25	13.194	174.079

Table 3 shows that the experimental group achieved a mean of 62.79 with a standard deviation of 17.139, indicating the diversity of the data. In contrast, the control group had a mean of 55.25 and a standard deviation of 13.194, which also indicates diversity in the data. The normality and homogeneity tests performed on both groups prior to the study indicated that the data were not normally distributed. The results were significant, with values of 0.002 and 0.003 for each group below the 0.05 threshold. Based on these results, a non-parametric method of analysis was used, the Mann-Whitney test, as shown in Table 4.

Table 4. Mann-Whitney Test Results Pre-Research Data

	Value
Mann-Whitney U	459.000
Wilcoxon W	1125.000
Z	-1.814
Asymp. Sig. (2-tailed)	0.070

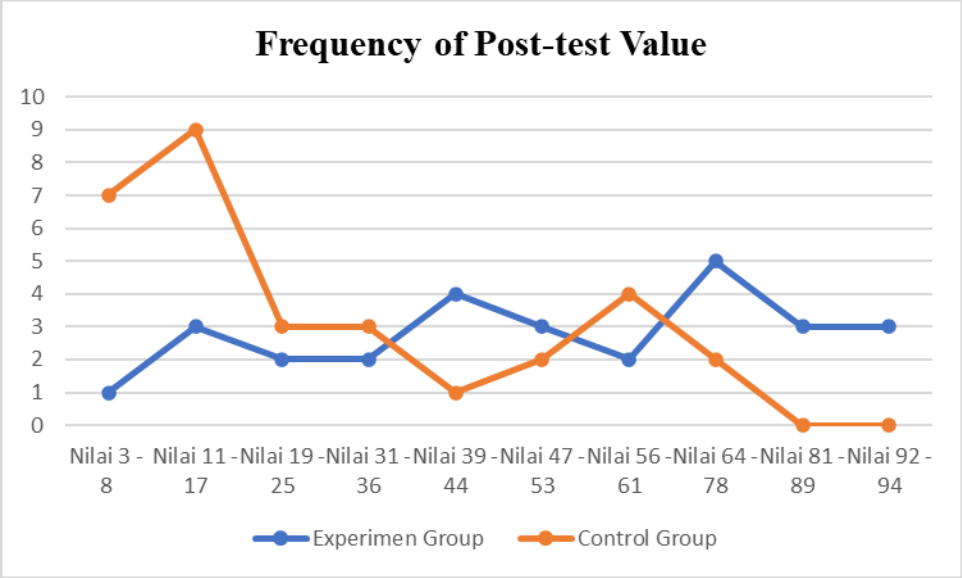
a. Grouping Variable: Class

The results of the Mann-Whitney test for the preliminary examination data are shown in Table 4. The asympt. Sig is $0.070 > 0.05$thus H_0accepted. It follows that there is no difference in the initial ability between the two samples. The results of the post-test on the mathematical critical thinking skills of the two sample groups were used to test the research hypothesis. Table 5 shows the results of the descriptive data test of the research post-test data.

Table 5. The Description of Post-Test Data

	Descriptive Statistic				
	N	*Minimum*	*Maximum*	*Std. Deviation*	*Variance*
Experiment Group	30	8	94	26.529	703.766
Control Group	31	3	78	22.020	484.899

Table 5 presents the descriptive test results of the post-test data. Accordingly, the group using the flipbook-assisted PBL model has a mean of 51.60 and a standard deviation of 26.529. This indicates a diversity of data. On the other hand, the results of the post-test in the group using the lecture and question-answer method showed an average of 26.97 and a standard deviation of 22.020, reflecting the heterogeneity of the data. The analysis of the pre-research data showed a variety of data. For the post-test, the average score of the experimental class was higher than that of the control class. Figure 1 shows a frequency diagram of the post-test results for both groups.



The distribution of the post-test results in the two sample groups is shown in Figure 1. The control group has high frequencies in the low score range, while the experimental group has a more even distribution with greater frequencies in the medium to high score range. The data suggests that the group that used the PBL model using a flipbook performed better on the post-test than the group that used the lecture and question-and-answer method.

The post-test data of the experimental group were categorized according to the level of mathematical critical thinking ability according to the guidelines of Mulyani et al (2024). Overall, 10% of the students were assigned to the medium ability range, 5% to the high ability range, and 13% to the very high ability range. The proportion of students in the higher ability range, although most are still at an intermediate level, indicates a positive impact of implementing the PBL model using flipbook media on improving critical thinking skills in mathematics. According to Fusfita et al. (2023), students who used PBL showed better critical thinking skills than those who used traditional learning methods. However, 36% of students in the study were still in the middle category. Furthermore, the solution results of students representing each category that fulfill all indicators of mathematical critical thinking ability are presented in Figure 2 below.

1. Anita, Roni, dan Fira adalah saudara kandung. Anita adalah anak pertama dan usianya 5 tahun lebih tua dari Roni. Sementara itu, Roni sebagai anak kedua memiliki selisih usia 3 tahun lebih tua dari Fira. Jika usia ketiganya dijumlahkan, hasilnya adalah 74 tahun. Tentukan usia masing-masing Anita, Roni, dan Fira dengan menggunakan metode substitusi.

Figure 1. Problem Number 1: Mathematical Critical Thinking Ability Test SPLTV Material

Figure 2 shows the first question of the mathematical critical thinking test with SPLTV material. The student solutions for the substitution method that fulfill all elements of the mathematical critical thinking indicator are also shown in Figure 3.

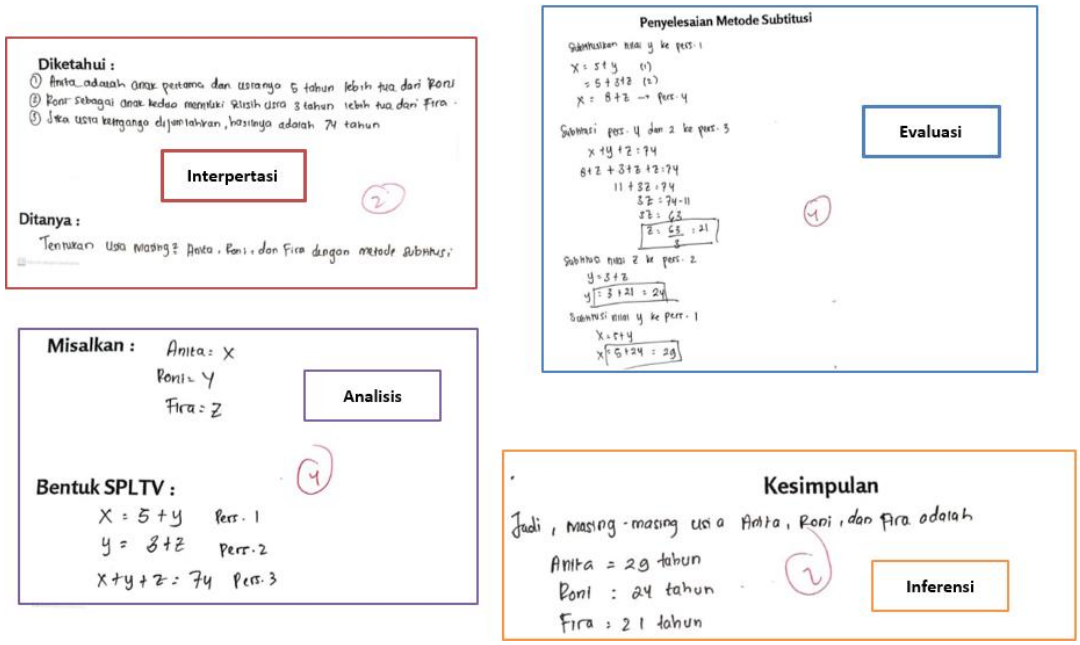


Figure 2. Results of The Graduation of Student Representatives In The "Very High" Category

Students in the very high category in Figure 3 demonstrated a good understanding of all four indicators of critical thinking skills in mathematics. In the 'interpretation' indicator, you can grasp the problem and communicate information effectively. The "Analysis" indicator shows the students' ability to identify the principles of the problem and fit them into a mathematical model. The assessment indicator indicates good planning and precision in the calculations to solve the problem. Students can draw complete and correct conclusions using the reasoning indicator. All indicators of critical mathematical thinking are therefore mastered by the students in this category. These results correlate with the studies by Zakaria et al. (2021), which show that students in the high category are able to master all facets of critical thinking. Harianja (2020) added that students with strong critical thinking skills fulfill all indicators of critical thinking.

Following the descriptive test of the data described above, the normal distribution and homogeneity of the post-test data are tested. The results of the normality test and the homogeneity test for the experimental and control groups are shown in Tables 6 and 7 below.

Table 6. Results of Post-test Data Normality Test

		Kolmogorov-Smirnov[a]		
	Class	Statistic	df	Sig.
Value	Experimen	0.077	30	0.200
	Control	0.222	31	0.000

a. Liliefors Significance Correction

Table 6 contained the results of the Lilliefors normality test, which showed that the p-value for the control group data was below 0.05 after the test, indicating that the data distribution was not normal. In addition, a test of variance homogeneity was carried out using Levene's statistic, which shows the results in Table 7.

Table 7. Results of Post-test Data Homogeneity Test

		Levene Statistic	df1	df2	Sig.
Value	Based on the Mean	1.055	1	59	0.309

The results of the homogeneity test for the post-test data are shown in Table 7 with a p-value of 0.309. As this value is less than 0.05, it can be concluded that the data are not homogeneous. The results of the condition test show that the data do not meet the criteria for normal distribution and homogeneity. For this reason, a hypothesis test according to Mann-Whitney was carried out. The results can be found in Table 8.

Table 8.Results of Post-test Data Mann-Whitney Test

	Value
Mann-Whitney U	218.000
Wilcoxon W	714.000
Z	-3.567
Asymp. Sig. (2-tailed)	0.000
Exact Sig. (1-tailed)	0.00

a. Grouping Variable: Class

The results of the Mann-Whitney test for the post-test data in Table 8 showed a significance value of $0.000 < 0.05$thusH_0 could be rejected, indicating that there was a difference in mathematical critical thinking ability between the students in the experimental and control groups, with the average test score of the students in the experimental group being better than that of the control group.

To assess the significance or impact of this study, the results of the post-test were analyzed using the effect size test, not taking into account the number of samples. The effect size test was calculated using Cohen's d formula. The classification is based on the criteria specified by Cohen et al. (2018) was performed in Table 2.

$$d = \frac{\mu_1 - \mu_2}{S_p} = \frac{51.60 - 26.97}{24.34} = 1.01$$

The d-value was determined to be 1.01, exceeding the threshold of 1.00 and thereby classified as high based on the effect size criteria presented in Table 2. Based on the d-value, it is clear that the flipbook-supported PBL model has an extremely high influence on the experimental group. The result suggests that the flipbook-supported PBL model influences the development of students' critical thinking skills in mathematics. These results support the hypothesis that linking problem-based learning models with interactive digital media, such as flipbooks, can lead to learning interactions that enhance knowledge. This result is consistent with the principles of the Merdeka curriculum, which emphasizes technology-integrated learning and contextual relevance within groups (Kemdikbudristek, 2022; Rosa et al., 2024). Moreover, the learning process in the flipbook-supported PBL model, whose syntax ranges from problem orientation to outcome assessment, is an efficient achievement in terms of students' critical mathematical thinking skills (Kusumawardani et al., 2022).

The application of the PBL model with flipbook support in the experimental group is consistent with the syntax of the modified PBL model with flipbook support, according to the guidelines of Kusumawardani et al. (2022) in Figure 4.

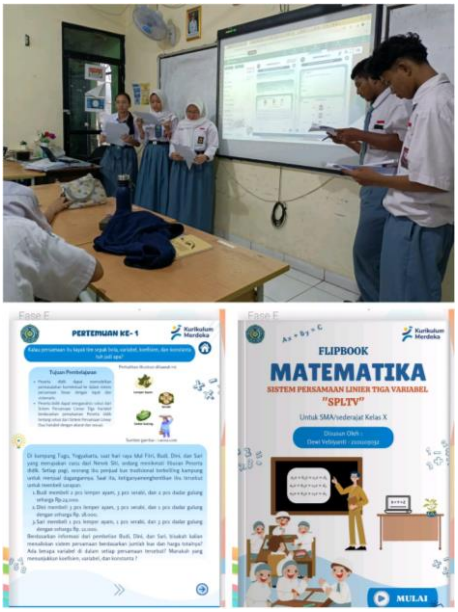


Figure 3. Learning With The Flipbook Using The PBL Model

The implementation of the flipbook-based PBL model, which demonstrates students' active participation in problem-based learning using interactive digital media, is shown in Figure 4. This activity fully applies the PBL syntax to promote contextualized and collaborative critical mathematical thinking.

According to research by Kusumawardani et al. (2022), the use of the problem-based learning (PBL) model has been shown to have a positive impact on critical thinking skills in mathematics. Another study by Afifah et al. (2023) also showed that flipbooks play a role in improving students' critical thinking skills. These findings are consistent with the results of the current study showing that critical thinking skills in mathematics can be improved by applying the PBL model with the support of flipbooks. Nevertheless, additional support is needed to optimize learning outcomes. This empirical evidence confirms that the integration of PBL and flipbook models is not only significant but also capable of optimally achieving learning goals, improving the quality of mathematics instruction, and complementing previous studies that have not simultaneously examined the relationship between model-based learning and technology.

CONCLUSION

The study results indicated that the use of PBL problem-based flipbooks had a positive effect on secondary school students' mathematical critical thinking skills. The statistical analyses showed that the experimental group using this model had higher average critical thinking skills compared to the control group, with the effect size rated as “very high”.

In addition, the results of the analysis showed that a number of students in the experimental class scored in the high and very high categories for critical thinking skills in mathematics. This illustrates that the use of flipbooks not only improved concept understanding but also stimulated active student participation in the learning process. Observations made during the learning activities also showed positive student interaction, cooperation, and engagement. This further reinforced the effectiveness of the PBL model with flipbooks as an innovative and effective learning approach.

REFERENCES

Adi Putra, I. M. D., Rati, N. W., & Jayanta, I. N. L. (2020). Implementasi Nilai-Nilai Tri Kaya Parisudha dalam pembelajaran dengan Model Pembelajaran *Numbered Head Together* Berpengaruh Terhadap Kompetensi Pengetahuan IPS. *Jurnal Pendidikan Multikultural Indonesia, 3*(2), 103–113. https://doi.org/10.23887/jpmu.v3i2.27529

Afifah, R. N., Sa’adah, S., & Maryanti, S. (2023). Pengaruh Pembelajaran Sistem Imunitas Melalui Model *Discovery Based Unity of Science* (DBUS) Berbantu Media E-Flipbook Terhadap Kemampuan Berpikir Kritis Siswa. *Jurnal Inovasi Pendidikan, 1*(2), 82–100. https://doi.org/10.60132/jip.v1i2.31

Ambarwati, Y. E., Darminto, P. B., & Nugraheni, P. (2022). Pengembangan Media Pembelajaran *Flipbook* Berbasis Masalah untuk Meningkatkan Hasil Belajar Matematika Siswa. *Jurnal Inovasi pendidikan Matematika*, *4*(2), 33–43. http://jurnal.umpwr.ac.id/index.php/jipm

Ananda, S. R., Murni, A., & Maimunah, M. (2022). Pengembangan Perangkat Pembelajaran Berbasis Masalah *Open-Ended* Untuk Memfasilitasi Kemampuan Berpikir Kritis Siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(1), 342. https://doi.org/10.24127/ajpm.v11i1.4537

Az Zahra, F., & Hakim, D. L. (2022). Kemampuan Berpikir Kritis Matematis Siswa Sma Pada Materi Bangun Ruang Sisi Datar Pasca Pembelajaran Jarak Jauh.*Teorema: Teori dan Riset Matematika*, *7*(2), 425–438. https://doi.org/10.25157/teorema.v7i2.7221

Budhiyati, S. Y., Rasiman, & Sulianto, J. (2023). Pengembangan Perangkat Pembelajaran Berbasis PBL Untuk Meningkatkan Kemampuan Berpikir Kritis Penjumlahan Dan Pengurangan Bilangan Bulat Bagi Siswa Kelas VI SDN Kambangan 01. *Didaktik : Jurnal Ilmiah PGSD STKIP Subang*, *9*(2), 2261–2271. https://doi.org/10.36989/didaktik.v9i2.929

Cohen, L., Manion, L., & Morrison, K. (2018). *Research Methods in Education*.

Dores, O. J., & Merayang, R. V. S. M. V. (2022). Analisis Kemampuan Berfikir Kritis Matematis Siswa Sma Immanuel Sintang. *Kadikma*, *13*(1), 67–72.

Fusfita, F., Cahyani, R., Usep Kosasih, Anisa Umi Kulsum, Fahya Annisatun, Marsela Devanka, & Cahyani, R. (2023). Kemampuan Berpikir Kritis Matematis Dan Self Efficacy Siswa Melalui Model Pembelajaran *Problem-Based Learning* (PBL). *PERISAI: Jurnal Pendidikan dan Riset Ilmu Sains*, *2*(2), 291–300. https://doi.org/10.32672/perisai.v2i2.283

Gusteti, M. U. (2022). Pembelajaran Matematika yang Menyenangkan Dengan Metode Mathemagics. *Jurnal Lebesgue : Jurnal Ilmiah Pendidikan Matematika, Matematika dan Statistika*, *3*(3), 552–559. https://doi.org/10.46306/lb.v3i3.166

Harianja, J. K. (2020). Implementasi Rally Coach Untuk Mengembangkan Keterampilan Berpikir Kritis Pada Pelajaran Matematika. *Scholaria: Jurnal Pendidikan dan Kebudayaan*, *10*(2), 162–170. https://doi.org/10.24246/j.js.2020.v10.i2.p162-170

Kartika, Y. K., & Rakhmawati, F. (2022). Peningkatan Kemampuan Berpikir Kritis Matematis Siswa Menggunakan Model Inquiry Learning. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *6*(3), 2515–2525. https://doi.org/10.31004/cendekia.v6i3.1627

Kemdikbudristek. (2022). SKL Permendikbud 5 tahun 2022. *Gastronomía ecuatoriana y turismo local.*, *1*(69), 5–24.

Kusumawardani, N. N., Rusijono, R., & Dewi, U. (2022). Pengaruh Model Problem Based Learning Terhadap Kemampuan Berpikir Kritis Matematis Siswa Dalam Memecahkan Masalah Matematika. *Jurnal Ilmiah Mandala Education*, *8*(2), 1416–1427. https://doi.org/10.58258/jime.v8i2.3217

Lukman, H. S., Setiani, A., & Agustiani, N. (2023). Validitas instrumen tes kemampuan berpikir kritis matematis berdasarkan teori FRISCO. *SJME (Supremum Journal of Mathematics Education)*, *7*(1), 55–67. https://doi.org/10.35706/sjme.v7i1.6960

Masrifah, S., Taufik, M., & Kusumawardana, A. S. (2023). Development of Flip book-Based Interactive Learning Media to Improving Understanding of Statistical Material Concepts. *Mathematics Education Journal*, *7*(2), 239–247. https://doi.org/10.22219/mej.v7i2.28313

Mulyani, R. E., Masfingatin, T., & Suparwati, A. (2024). Problem Based Learning Terintegrasi Pendekatan Teaching at the Right Level untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *EDUKASIA: Jurnal Pendidikan dan Pembelajaran*, *5*, 1589–1604.

Naufal, A. L. A. (2022). Pengembangan *E-Book* Matematika Untuk Meningkatkan Keterampilan Berpikir Kritis Siswa Pada Materi Persamaan Garis Lurus. *MATHEdunesa*, *11*(2), 378–389. https://doi.org/10.26740/mathedunesa.v11n2.p378-389

Pramadhany, A., Mardiyah, A., & Suryan, M. (2023). Pengaruh Penerapan Model Pembelajaran Problem Based Learning (Pbl) Terhadap Hasil Belajar. *TEACHING : Jurnal Inovasi Keguruan dan Ilmu Pendidikan*, *3*(1), 49–56. https://doi.org/10.51878/teaching.v3i1.2163

Rahmawati, I. (2022). Model PBL untuk Meningkatkan Keterampilan Berpikir Kritis dalam Materi Bentuk Pecahan. *Journal of Education Research*, *3*(2), 62–70. https://doi.org/10.37985/jer.v3i2.77

Rizki, B. F. S., Harjono, A., Rahmatih, A. N., & Fauzi, A. (2024). Kemampuan Berpikir Kritis Matematika Peserta Didik Kelas IV dengan Model Problem Based Learning (PBL). *Journal of Classroom Action Research*, *6*(4), 800–806.

Rosa, E., Destian, R., Agustian, A., & Wahyudin, W. (2024). Inovasi Model dan Strategi Pembelajaran dalam Implementasi Kurikulum Merdeka. *Journal of Education Research*, *5*(3), 2608–2617. https://doi.org/10.37985/jer.v5i3.1153

Safitri, N., Nuriman, & Alfarisi, R. (2024). Model *Problem Based Learning* Berbantuan Media Powerpoint untuk Meningkatkan Hasil Belajar Matematika Siswa SD. *Jurnal Review Pendidikan urnal Kajian Pendidikan dan Hasil Penelitianhttp*, *4*(3), 248–254. https://doi.org/10.23887/jippg.v4i3.36096

Sari, P. M. N., Parmiti, D. P., & Sukmana, A. I. W. I. Y. (2020). Efektivitas Hasil Belajar Matematika Melalui Model CTL Berbasis Masalah Terbuka Siswa Kelas IV SD. *Jurnal Ilmiah Sekolah Dasar*, *4*(2), 248–256.

Siburian, J., Sinaga, E., & Murni, P. (2023). Kemampuan Berpikir Kritis Melalui Implementasi *Flipped Classroom* Pada Siswa Sma. *Jurnal Pendidikan IPA*, *12*(1), 71–80. https://doi.org/10.20961/inkuiri.v12i1.68213

Subaini, Irvan, & Nasution, M. D. (2023). Pengaruh Pembelajaran Berbasis Masalah Terhadap Kemampuan Berpikir Kritis Matematis Siswa Smp. *Jurnal Riset Rumpun Matematika Dan Ilmu Pengetahuan Alam*, *2*(1), 113–123. https://doi.org/10.55606/jurrimipa.v2i1.742

Syafitri, O. V., Astuti, R., & Firdaus, M. (2022). Penerapan Model Pembelajaran Problem Basesd Learning Dengan Pendekatan Open Ended Terhadap Kemampuan Berpikir Kritis Siswa Pada Kelas Ix Smp. *Journal of Innovation Research and Knowledge*, *1*(8), 683–688. https://bajangjournal.com/index.php/JIRK/article/view/1117

Zakaria, P., Nurwan, N., & Silalahi, F. D. (2021). Deskripsi Kemampuan Berpikir Kritis Siswa Melalui Pembelajaran Daring Pada Materi Segi Empat. *Euler : Jurnal Ilmiah Matematika, Sains dan Teknologi*, *9*(1), 32–39. https://doi.org/10.34312/euler.v9i1.10539