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Meta Analysis: The Effect of Problem-Based Learning Model on Mathematical Critical Thinking Skills

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ABSTRACT

This study aims to determine the effect of *problem-based learning* (PBL) model on students' mathematical critical thinking skills. This research reviews the effect of *problem-based learning* (PBL) model on students' mathematical critical thinking skills as a whole and based on education level. This research is a meta-analysis research. The data sources in the study came from the analysis of 10 national articles published in the range 2020-2024. Data sources in the study were obtained from *google scholar*. The research method used in this research is meta-analysis using *OpenMEE software* with the keywords used, namely *problem-based* learning and mathematical critical thinking. Based on meta-analysis calculations, that there is a relationship between the effect of *problem-based learning* models on mathematical critical thinking skills, from this study obtained an effect size of 1.527 which is included in the high category, *p-value* <0.001 means the analysis is significant and I^2 above 80% which indicates that the heterogeneity of the effect of *problem-based learning* models on mathematical critical thinking skills is 91, 542 including very high.

Keywords: Meta analysis, Critical Thinking, *Problem Based Learning* (PBL)

INTRODUCTION

The 21st century is a century commonly known as the century of industrial revolution, globalization and knowledge based on information and communication technology. There are many changes, one of which is new demands in the world of education in order to face increasingly complex problems. (Taufik et al., 2022). In facing the 21st century era, education has a very important role, where humans are needed who have the skills to be able to face and find solutions to every problem. (Asiah et al., 2023).. Thus, through good education, the quality of human resources can be improved. Currently, 4C is a relevant competency in the world of education. The 4C competency consists of four competencies, namely *creativity, critical thinking, collaboration, and* communication. (Choifah et al., 2022).. *Critical thinking* is one part of the 4Cs. One of the *critical thinking* competencies expected in learning is the ability to think critically. Critical thinking skills are very important for various levels of education (Ferli Yanti & Wijaya, 2023).. Critical thinking is a process in forming a systematic and reliable mentality, which can be used in carrying out knowledge about life. The ability to think critically is an ability to analyze existing ideas in a more detailed direction, distinguish which is done sharply, choose, identify, conduct studies, develop towards the better and evaluate (Ruli &

Indarini, 2023). (Ruli & Indarini, 2022). Critical thinking skills are the ability to think appropriately, reflectively and purposefully in every decision that can be trusted. (Utami & Indarini, 2021).

Critical thinking is a high-level thinking ability, in learning mathematics the ability to think critically is a very important component. Critical thinking is used in formulating, identifying, interpreting and designing problem solving. Mathematical critical thinking skills are very important to apply in solving everyday problems (Susilowati et al., 2017).

There are many factors that influence the low level of critical thinking skills, one of which is the lack of enthusiasm of students in learning mathematics. In addition, the lack of presentation of a variety of problems that involve the ability to reason and analyze in solving everyday problems is also a factor that can affect the low critical thinking skills of students. (Andini & Retno Winarti, 2022). According to Pratama & Mardiani (2022) the low learning outcomes and participation of students are caused by the lack of ability to think critically in solving math problems. This is influenced by the current mathematics learning process which tends to be one-way, learning still uses conventional learning which emphasizes curriculum demands so that in its realization students tend to be passive and their mindset in solving a problem cannot develop properly. integrating critical thinking skills into the learning model is very important to do, in order to be able to solve problems systematically and effectively (Asiah et al., 2023).

The use of learning models can influence students' critical thinking to solve a problem. In improving critical thinking skills, there are several learning models including *project-based learning, discovery learning, problem solving,* and *problem-based learning*. (Asiah et al., 2023). There have been many studies that state that the *problem-based learning* model has a positive effect on critical thinking skills. Asiah (2023) argues that the *problem-based learning* model has an influence in improving students' critical thinking skills. Kamdi in (Asiah et al., 2023) stated that the *problem-based learning* model has a role in improving critical thinking skills, where in the problem-based learning process students are actively involved in solving problems through several stages of the scientific model, so that students are expected to learn knowledge related to problem-solving skills and critical thinking. brahim & Alfrits Oroh (2023) Stating that the *problem-based learning* model has a great influence, is more reasonable and superior compared to students who get direct learning seen from the results of his research where there is a significant difference between the results of the experimental and control classes. Sitompul (2021) stated that the *problem-based learning* model had an effect on critical thinking skills with an average success rate of 78.54%. The same thing, Ibrahim & Alfrits Oroh (2023) presented the results of their research on the effect of the *problem-based learning* (PBL) learning model on students' critical thinking skills. The results of the research article stated that the *problem-based learning* (PBL) learning model was able to improve students' critical thinking skills with an average success rate of 92.5%.

From the *problem-based learning* model, there is an influence on critical thinking skills. Seeing the importance of critical thinking and the effect of *problem-based learning* on students' problem solving skills, researchers need to conduct meta-analysis research by looking at the effect *size of the problem-based learning* model on students' mathematical critical thinking skills. The purpose of this study is to investigate the effect of *problem-based learning* on students' mathematical critical thinking skills in terms of education level. The results of this meta-analysis are expected to provide a harmonized view of all as a whole.

RESEARCH METHODS

The type of research used is the meta-analysis method through a quantitative approach. Meta analysis is quantitative because it uses statistics and numerical

calculations in collecting and extracting information from large data sets that are not possible with other methods. (Putri, 2020). Meta analysis is a statistical method by combining, analyzing and synthesizing several pre-existing research results systematically in order to obtain the latest findings and conclusions with a study effect. (Rohmatulloh et al., 2022).. Meta analysis is a special research method for combining research that can be measured in *effect size*. the results of the study are in a form that can be compared, for example, correlation coefficients, means, and odds ratios. In compiling the aggregate taken from the results of the research that is made in calculating the *effect size*. Meta analysis only analyzes quantitative research, where quantitative research is research that uses quantitative measurements of a variable and reports descriptive or inferential statistics to explain the results of the research. (Rohmah et al., 2022). The meta-analysis steps in this study are (1) Determining the articles to be analyzed, (2) collecting data and coding, (3) investigating the variables of each article to calculate the *effect* size (Sofianora et al., 2020). (Sofianora et al., n.d.). In this meta-analysis study, each meta-analysis study's effec size value was measured with the help of the OPENMEE application. The criteria used in determining the effect size results use a reference from Cohen's (Widodo et al., 2021).

Table 1. Effect size interval

No.	Interval	Interpretation
1	$0{,}2 \leq d < 0{,}5$	Small effect
2	$0{,}5 \leq d < 0{,}8$	Moderate Effect
3	$d \geq 0{,}8$	Big Effect

This study is a *meta-analysis* study using the *preferred reporting item for systematic review and meta-analysis* (PRISMA) method. In choosing the PRISMA method with the consideration that the PRISMA method has structured stages and procedures according to the scientific principles of research. (Alfian Mahesa Tantra et al., n.d).. The first step in conducting this systematic review is to conduct a search source through library research by searching for articles found on *Google* scholar. (Tamur et al., 2022).. The keywords used were "mathematical critical thinking skills" and "*problem-based learning* model", then all types of research were filtered in general from academic journals to reduce the results of articles that were too excessive. (Trenggono & Bachtiar, n.d.).. Furthermore, inclusion and exclusion criteria were determined to obtain appropriate literature. The inclusion criteria applied are (1) setting keywords, namely "mathematical critical thinking ability" and "*problem-based learning* model" (2) Articles that have a writing time span of the last 4 years or those published in the period (2020-2024); (3) the type of publication is scientific articles in national journals obtained from google scholar; (4) type of quasi-experimental research design nonequivalent pre-test and post-test control group design. Exclusion criteria that are fixed include articles that are not fulltext, not a complete article, not published less than 2020. Articles that do not fulfill information and statistical data.

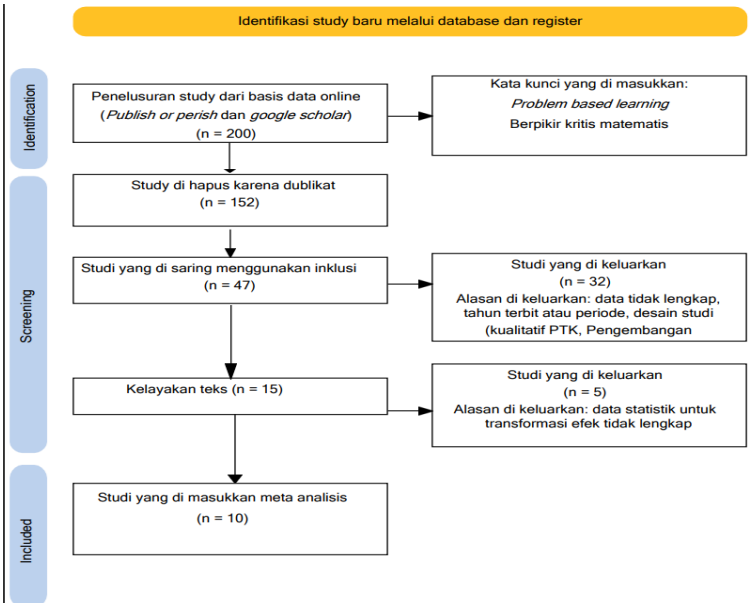

Figure 1: Stages of meta-analysis

RESULT AND DISCUSSION

In accordance with the research steps that have been determined, first select national journal scientific articles obtained from publish or perish and google scholar with the keywords mathematical critical thinking ability and problem based learning (PBL). The selected sample data is presented in the following table:

Table 2. Research sample data

No.	Code	Year	Author Name	Title	Journal
1	A.1.1	Vol. 4 No.2 Year 2020	Ni Pt Dyah Pramestika, I. Gst Ag Ayu Wulandari, I W. Sujana	Enhancement Of Mathematics *Critical Thinking Skills* Through *Problem Based Learning* Assisted With Concrete Media.	Journal Of Education Technology
2	A.1.2	Vol. 6 No. 2 Year 2022	Mitha Dwi Anggriani, Setyo Eko Atmojo	The Impact Of *Problem-Based Learning* Model Assisted By Mentimeter Media In Science Learning On Students' Critical Thinking And Collaboration Skills.	International Journal Of Elementary Education
3	A.2.1	Vol. 10 No. 1 Year 2024	Yuli Lestari, Eva Julyanti, Nurlina Ariana Harahap	The Effect of *Problem Based Learning* on Students' Mathematical Critical Thinking Skills on Number Matter.	Didactic Maths (Journal of Mathematics Education)
4	A.2.2	Vol. 7 No. 1 Year 2021	Hayatun Nufas, Herizal, Linda Dewi Hasputri	The Effect of *Problem Based Learning* (PBL) *Learning* Model on Students' Mathematical Critical Thinking Ability on Two-Variable Linear Equation System Material	JPMS (Journal of Sigma Learning and Mathematics)
5	A.2.3	Vol. 4 No. 1 Year 2021	Nova Nadila Saputri Sitompul	The Effect of *Problem Based Learning* Model on Improving Mathematical Critical Thinking Ability of Secondary School Students in Class IX	GAUSS (Journal of Mathematics Education)
6	A.2.4	Vol. 8	Eko Wahyunanto Prihono,	The Effect of *Problem Based Learning Model* on Mathematical Critical	EDU-MAT

		No. 1 Year 2020	Fitriatun Khasanah	Thinking Ability of Class VIII Junior High School Students	(Journal of Mathematics Education)
7	A.2.5	Vol. 10 No. 1 Year 2020	Dewi Retnawati, Isnaini Handayani, Windia Hadi	The Effect of PBL Learning Model Assisted by Question Card on Mathematical Critical Thinking Ability of Junior High School Students	Edumatica (Journal of Mathematics Education)
8	A.2.6	Vol. 4 No. 2 Year 2023	Hasanudin Ibrahim, Majid, Franky Alfrits Oroh	The Effect of *Problem Based Learning* Model on Students' Critical Thinking Ability in Mathematics Learning Class VIII SMP Negri 1 Bonepantai	EDUKASIA (Journal of Education and Learning)
9	A.3.1	Vol. 8 No. 1 Year 2022	Fachri Awami, Syamsuri, Yuyu Yuhana, Hepsi Nindiasari	The Effect of *Problem Based Learning (PBL)* on Critical Thinking Ability and Student Self Confidence	Educate (Journal of Education and Teaching Studies)
10	A.3.2	Vol. 8 No. 2 Year 2022	Nila Nurcahyaning Kusumawardani, Rusijono, Utari Dewi	The Effect of *Problem Based Learning* Model on Students' Mathematical Critical Thinking Ability in Solving Mathematics Problems	JIME (Mandala Education Scientific Journal)

From each research sample above, statistical data including the number of samples of each experimental and control group, the mean value (Mean), and standard deviation (SD) were recorded. Furthermore, the calculation of *effec size of* the sample components that have been obtained in accordance with the criteria and formulas that have been obtained in accordance with the criteria and formulas that have been determined. The data and results of the overall *effec size* calculation are presented in table 3 below.

Table 3. Meta-analysis of data

Code	Sample Size		Average		Standard deviation Exsp	Control standard deviation	ESg	SEg
	Kel Exsp	Control group	Kel Exsp	Kel control				
A 1.1	32	30	81,47	64,17	17,24	16,6	1.009	0.073
A 1.2	25	25	87,36	65,32	6,37	6,91	3.264	0,129861
A 2.1	26	26	86,27	76,15	4,11	6,01	1.936	0,078472
A 2.2	18	18	15,83	12,94	1,92	2,87	1.157	0,090278
A 2.3	22	22	87,41	67,91	4,1	4,97	4.203	0,202778
A 2.4	32	32	81,25	75,26	11,2	11,04	0,36944444	0.065
A 2.5	36	36	20,88	19,02	2,47	8,02	0,21527778	0.056
A 2.6	20	20	93,5	73,83	6,47	7,76	2.699	0,132639
A 3.1	32	31	72,03	68,74	8,09	7,83	0,28333333	0.065
A 3.2	32	32	57,19	48,28	18,48	15,89	0,35486111	0.065
Average of 10 articles							1,527	

The analysis results in table 3 show that the *effect size of* each study based on data input in each study contains research results in the form of many samples, mean, and Standard Deviation.

Table 4. Effect size of all levels

Model Results

Studies	Estimate	Lower bound	Upper bound	Std. error	p-Val
Subgroup SD	2.111	−0.099	4.321	1.128	0.061
Subgroup SMP	1.739	0.754	2.725	0.503	< 0.001
Subgroup SMA	0.460	0.107	0.812	0.180	0.011
Overall	1.527	0.865	2.189	0.338	< 0.001

Based on table 4 above, the following is the overall result of the calculation, obtained the average value of the *effect size of* the elementary school level is at an average value of 2.111, the effect size value of the junior high school level with an average value of 1.739, the *effect size* value of the high school level with an average value of 0.460 and the overall average *effect size* is 1.527. The table shows all the data processed. Starting from the *lower limit*, *upper* limit and *p-value.* If the p value is not more than 5% then there is a significant difference between the control class and the experimental class. The result of the *p-value* <0.001 shows that there is a significant difference between the control class and the experimental class. In large studies the random effect will vary between other studies. In order to find out these differences, a heterogeneity test must be carried out. (Hajiriah et al., 2023).
The heterogeneity test where the I^2 value > 80% is shown in the following table:

Table 5. Heterogeneity test

Heterogeneity

tau^2	Q(df=9)	Het. p-Value	I^2
1.022	106.406	< 0.001	91.542

This study takes a *random effect* model, so the data must fulfill the assumption of heterogeneity. I^2 is used in testing heterogeneity. I^2 describes the population variation in summary effect size on a scale of 0% to 100%. Based on table 5, the *p-value* <0.001 and I^2 = 91.542% with a confidence level of 0.05, these results are above 80% so that it is said to be heterogeneous and very high and said the selection of *random effect* according to the criteria. (Azkia, 2023). Furthermore, to find out the conclusion of the overall effect can be seen in the *forest plot of* Figure 2 below:

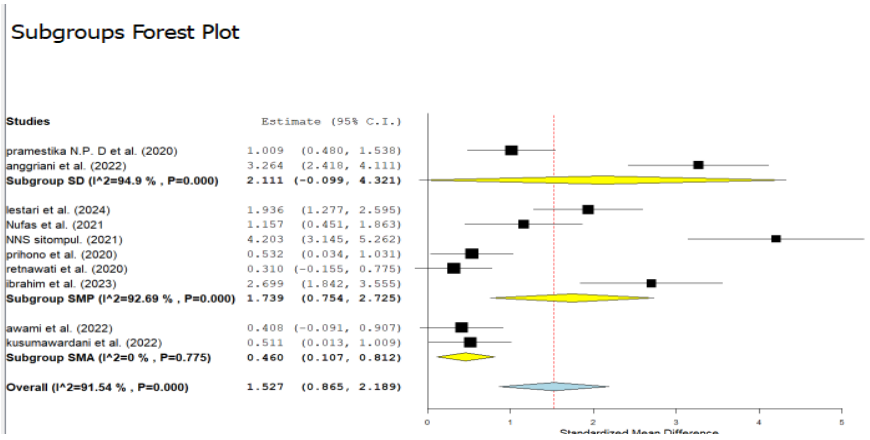

Figure 2. *forest plot*

Based on the results of the *forest plot*, it shows that the effect size is diverse as seen from the distribution of graphs that move away from the rhombus-shaped standard plot at the end of the summary effect study as a whole with a summary effect value of 1.527 which is included in the high category. In addition, with 0.95% confidence, it is known that the summary effect range is 0.865 to 2.189. This shows that there is a significant difference between the application of *problem-based learning* (PBL) and conventional learning.

In meta-analysis, bias analysis is carried out in determining the validity of a conclusion in research because meta-analysis can be considered biased if it only takes research with the desired results and does not display results that accept the null hypothesis or provide negative conclusions. In meta-analysis, publication bias is carried out with placeholder references. The following is a *funnel plot* with the help of OpenMEE software:

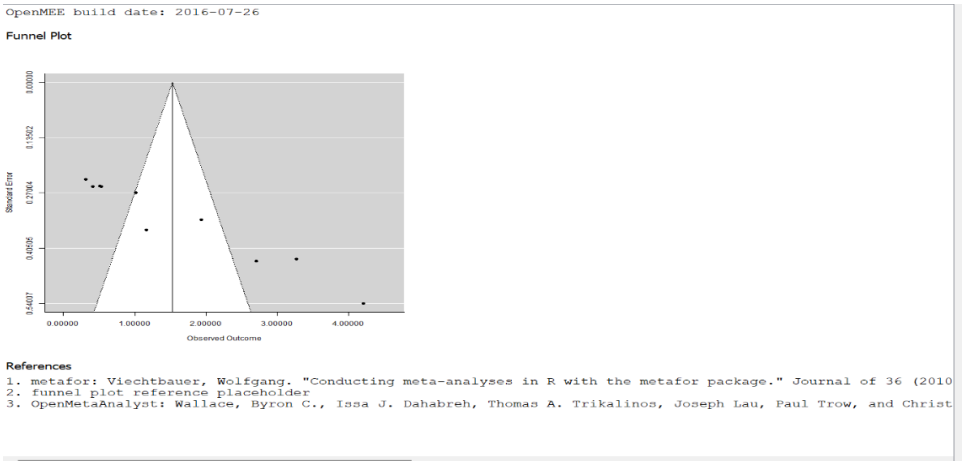

Figure 3. ***funnel plot***

Figure 3 is a *funnel plot* with a *fixed-effect model* which shows that of the 10 studies sampled in the meta-analysis, 10 studies are asymmetrically distributed, because the data distribution pattern is outside the *funnel plot.* The pattern formed is asymmetry. However, to conclude whether the funnel plot results are symmetrical or not, it can be proven with the help of another method, namely *fail-safe* N. (Azkia, 2023).

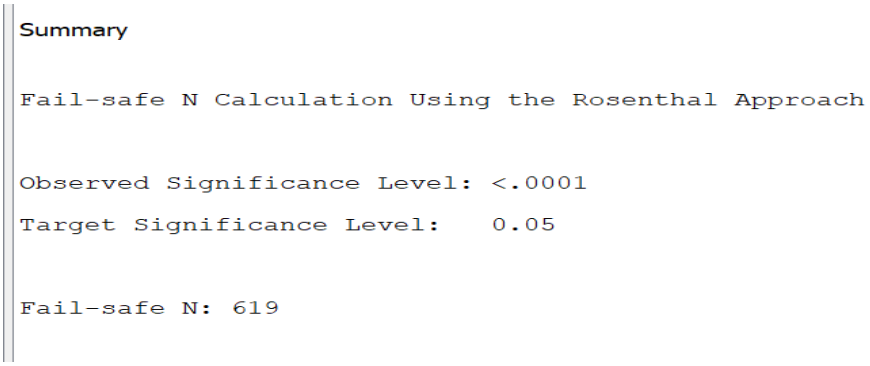

Figure 4. ***Fail-safe***

Fail-safe N is an approach used in overcoming the problem of publication bias (Hajiriah et al., 2023). The analysis results in Figure 4 show that the *Fail-safe N* value is 619, this indicates that there are 619 publications whose results are biased or can be said to be not done properly, so that the study is not published. Next, the *Fail-safe N* value is compared with the value of 5K+10 where K is the number of studies used in the

meta-analysis. K=10, so 5(10)+10=60, then the *Fail-safe N* value > 5K+10 with a significant level of 0.05 and p < 0.0001. It can be concluded that there is no publication bias problem in the meta-analysis results.

CONCLUSION

The results of the analysis show that there is a significant difference between the learning outcomes of groups using *problem-based* learning (PBL) and conventional learning in mathematics. The group of students who used *problem-based* learning (PBL) had better learning outcomes than those who did not use *problem-based learning* (PBL). The *effect size* data shows that the average effect size at the elementary level is at an average value of 2.111 with a large category, the *effect size* value at the junior high school level with an average value of 1.739 with a large category, the *effect size* value at the high school level with an average value of 0.460 with a medium category and the effect size data shows that the average total effect size is 1.527 in the large category so that it can be interpreted that the learning outcomes using *problem-based* learning (PBL) have higher learning outcomes than those using conventional learning models. The *p-value* <0.001 means that the analysis is significant with sig. 0.05 and I^2 = 91.542% with a confidence level of 0.05, these results are above 80% so that it is said to be heterogeneous and very high and said the selection of *random effect* in accordance with the criteria. At the level of education, the results of the study can be concluded that the *problem-based learning* (PBL) learning model has an effect on mathematical critical thinking skills and is well applied at the elementary and junior high school levels of education because the average *effect size* is included in the high category. such as learning materials, learning media, and others.

Declaration by Authors

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REFERENCES

1. Alfian Mahesa Tantra, S., Widodo, S., Katminingsih, Y., Nusantara PGRI Kediri, U., & Ahmad Dahlan, J. K. (n.d.). Peningkatan Kemampuan Pemecahan Masalah Matematis Peserta Didik Melalui Pembelajaran Realistic Mathematics Education (RME) (Improving Students' Mathematic Problem Solving Ability Through Realistic Mathematics Education (RME)). https://magestic.unej.ac.id/
2. Andini, R., & Retno Winarti, E. (2022). Kemampuan Berpikir Kritis Siswa pada Model Problem-Based Learning Berbantuan Bahan Ajar dengan Pendekatan STEM. PRISMA. Prosiding Seminar Nasional Matematika, 5, 467–474. https://journal.unnes.ac.id/sju/index.php/prisma/
3. Asiah, S., Habibah, R., Fauzi, A., & Artikel, I. (2023). Meta-analisis pengaruh model problem based learning terhadap keterampilan abad 21 siswa. Nautical : Jurnal Ilmiah Multidisiplin, 2(9), 2023. https://jurnal.arkainstitute.co.id/index.php/nautical/index
4. Azkia, nada F. (2023). META-ANALISIS PENGARUH MEDIA PEMBELAJARAN BERBASIS DIGITAL TERHADAP HASIL BELAJAR MATEMATIKA.
5. Choifah, C., Suyitno, A., & Pujiastuti, E. (2022). Systematic Literature Review: Upaya Meningkatkan Kemampuan Berpikir Kreatif pada Pembelajaran Matematika. Jurnal Cendekia : Jurnal Pendidikan Matematika, 6(3), 3158–3166. https://doi.org/10.31004/cendekia.v6i3.1057
6. Ferli Yanti, N., & Wijaya, A. (2023). META-ANALISIS: PENGARUH PENERAPAN MODEL PEMBELAJARAN PROBLEM-BASED LEARNING TERHADAP KEMAMPUAN BERPIKIR KRITIS MATEMATIS SISWA. AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 12(1), 1213. https://doi.org/10.24127/ajpm.v12i1.6750
7. Hajiriah, T. L., Sudiatmika, A. R., Suma, I. K., & Suardana, I. N. (2023). Meta-Analisis : Studi Pentingnya Mengukur Keterampilan Metakognitif Siswa. Bioscientist : Jurnal Ilmiah Biologi, 11(2), 1697.

https://doi.org/10.33394/bioscientist.v11i2.9567
8. Ibrahim, H., & Alfrits Oroh, F. (2023). Pengaruh Model Problem Based Learning terhadap Kemampuan Berpikir Kritis Siswa pada Pembelajaran Matematika di Kelas VIII SMP Negeri 1 Bonepantai. 4, 1657–1668. http://jurnaledukasia.org
9. Pratama, B. A., & Mardiani, D. (2022). Kemampuan berpikir kritis matematis antara siswa yang mendapat model problem-based learning dan discovery learning.
10. Putri, K. E. (2020). Meta Analisis: Pendekatan Saintifik Terhadap Hasil Belajar Siswa. JURNAL PENDIDIKAN DASAR NUSANTARA, 6(1), 127–135. https://doi.org/10.29407/jpdn.v6i1.14559
11. Rohmah, N., Widodo, S., Katminingsih, Y., Studi Pendidikan Matematika, P., Ilmu Kesehatan dan Sains, F., & Nusantara PGRI Kediri Jl Ahmad Dahlan No, U. K. (2022). Meta Analisis: Model Pembelajaran PBL Terhadap Kemampuan Berpikir Kritis Matematis Siswa. 06(01), 945–953.
12. Rohmatulloh, Nindiasari, H., & Fatah, A. (2022). Analisis Meta: Pengaruh Model Pembelajaran Problem Based Learning. 06(02), 1558–1567.
13. Ruli, E., & Indarini, E. (2022). Meta Analisis Pengaruh Model Pembelajaran Problem Based Learning Terhadap Kemampuan Berpikir Kritis Dalam Pembelajaran Matematika Di Sekolah Dasar. Jurnal Pendidikan Dan Konseling, 4(4), 221–228.
14. Sitompul, N. N. S. (2021). Pengaruh Model Pembelajaran Problem Based Learning terhadap Peningkatan Kemampuan Berpikir Kritis Matematis Siswa SMP Kelas IX. GAUSS: Jurnal Pendidikan Matematika, 4(1), 45–54. https://doi.org/10.30656/gauss.v4i1.3129
15. Sofianora, A., Suharyat, Y., Apra Santosa, T., & Supriyadi, A. (n.d.). PENGARUH PROFESIONALITAS GURU MATEMATIKA DALAM MENINGKATKAN KOMPETENSI SISWA ERA REVOLUSI INDUSTRI 5.0 DI INDONESIA: SEBUAH META-ANALISIS. In Jurnal MATH-UMB.EDU (Vol. 10, Issue 2).
16. Susilowati, sajidan, & Ramli, M. (2017). Analisis Keterampilan Berpikir Kritis Siswa Madrasah Aliyah Negeri di Kabupaten Magetan. SEMINAR NASIONAL PENDIDIKAN SAINS, 223–231.
17. Tamur, M., Men, F. E., Ermi, K. E., Muhut, A. M., Nunang, R., & Lay, O. A. (2022). Penggunaan ICT dan Pengaruhnya terhadap Kemampuan Penalaran Matematis Siswa: Sebuah Analisis Bibliometrik. Juring (Journal for Research in Mathematics Learning), 5(4), 261. https://doi.org/10.24014/juring.v5i4.19991
18. Taufik, W., Arsih, F., Studi Pendidikan Biologi, P., Negeri Padang, U., Kunci, K., & Kritis, B. (2022). META ANALISIS PENGARUH MODEL PEMBELAJARAN PROBLEM BASED LEARNING TERHADAP KEMAMPUAN BERPIKIR KRITIS. Bioilmi: Jurnal Pendidikan, VIII(I). http://jurnal.radenfatah.ac.id/index.php/bioilmi
19. Trenggono, P. H., & Bachtiar, A. (n.d.). PERAN ARTIFICIAL INTELLIGENCE DALAM PELAYANAN KESEHATAN : A SYSTEMATIC REVIEW. http://journal.universitaspahlawan.ac.id/index.php/ners
20. Utami, F. N., & Indarini, E. (2021). Meta Analisis Pengaruh Pendekatan Matematika Realistik Terhadap Kemampuan Berpikir Kritis Pada Matematika Siswa di Sekolah Dasar. Jurnal Basicedu, 5(2), 887–894. https://doi.org/10.31004/basicedu.v5i2.852
21. Widodo, S., Katminingsih, Y., & Nirwono, B. (2021). META ANALISIS: PENGARUH MODEL PEMBELAJARAN BERDASARKAN MASALAH TERHADAP KEMAMPUAN BERPIKIR KREATIF. Indonesian Journal of Educational Development, 1(4). https://doi.org/10.5281/zenodo.4559716

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