WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Meta-Analysis: The Effect of Project Based Learning on Students' Mathematical Ability in Indonesia

Rida Adhari Yanti [1], Syamsuri [2], Yuyu Yuhana [3], Anwar Mutaqin [4]

[1,2,3,4] Department of Mathematics Education, Universitas Sultan Ageng Tirtayasa, Serang, Indonesia
DOI: https://doi.org/10.55248/gengpi.5.0224.0613

ABSTRACT:

Learning mathematics is an important lesson studyed from elementary to tertiary levels. One example of an appropriate learning model for learning mathematics is Project Based Learning (PjBL). In searching for information, the author collected 100 articles discussing the effect of implementing the PjBL learning model on mathematics learning from Indonesian jorunal sources such as Google Scholar, Garuda Portal, and Sintaristekbrin. This research uses a meta-analysis design to determine how much effect the application of the PjBL model has on mathematics learning in Indonesia. Of all the articles found, 12 met the inclusion criteria and were analyzed using the Meta-Mar website to obtain a combined effect size. From the interpretation of the combined effect size, implementing the PjBL model strongly influences mathematics learning overall. The studyes' characteristics include educational level, year of research, region, and skills developed. Based on statistics, it was found that applying the PjBL model in mathematics learning is influenced by the level of education, years of research, and skills developed.

Keywords: Meta-Analysis, Project Based Learning, Mathematical ability

Introduction:

Mathematics learning is one area of education that plays a vital role in developing logical, analytical, and problem-solving thinking skills (1). In the era of technology and information that continues to grow, traditional approaches to learning mathematics must be questioned about their effectiveness in producing a deep understanding and applying relevant concepts in real life (2).

In response to the need for more contextual and enjoyable mathematics learning for students, the project-based learning (PjBL) learning model has emerged as an attractive alternative. PjBL emphasizes applying mathematical concepts in real contexts through collaborative projects that challenge students to solve real problems using the mathematical skills they learn. The application of the Project Based Learning (PjBL) learning model in mathematics learning has several advantages, including improving students' critical mathematical thinking skills (3), improving students' mathematical representation abilities (4) increasing students' creativity and problem-solving (5) and increasing students' abilities in solving mathematical problems in everyday life.

In recent years, research on the influence of the PjBL learning model on mathematics learning has become the focus of attention of educational experts (6). Many Studyes have been conducted to investigate how PjBL can influence students' mathematical understanding, learning motivation, critical thinking skills, and cooperation. The results of this research provide a fascinating picture of the benefits and challenges of implementing PjBL in the context of mathematics learning. This article aims to conduct a meta-analysis of existing research regarding the influence of the PjBL learning model on mathematics learning. Using meta-analysis methods, researchers will compile data from various relevant Studyes to provide a comprehensive picture of the effectiveness of PjBL in improving students' mathematical understanding, problem-solving skills, and student engagement in the learning process.

This meta-analysis is hoped to provide deeper insight into the potential of PjBL as a practical learning approach to developing students' mathematical abilities. The results of this article can contribute to educators, researchers, and educational practitioners in designing innovative and meaningful mathematics learning strategies.

Methodology:

This research uses a meta-analysis method by reviewing articles in Indonesia national journals. Meta-analysis is a statistical method that systematically combines, analyzes, and synthesizes several Studyes to obtain the latest findings and conclusions with determined study effects (7).

According to (8) the meta-analysis stages include determining inclusion criteria for study analysis, empirical data collection procedures, explaining the coding of study variables, and explaining the statistical techniques used. Primary research related to the PBL model and students' logical thinking abilities is used as a primary study. Articles that meet the predetermined inclusion criteria include: the range of article publication years is from 2013 to 2023. Articles conducted on research studyes in Indonesia have been published in SINTA-indexed journals. Article with method study quasi experimentation and design randomized control group pretest-posttest design, randomized control group posttest only design, nonequivalent group pretest-posttest design, and nonequivalent group design posttest only. Article with primary study population, namely elementary, middle, and high school students in Indonesia.

Study articles with statistical data, including sample size, mean, and standard deviation. Article searches were conducted through databases such as Google Scholar, Garuda Portal, and Sinta Ristekbrin using the keywords " Project Learning, Mathematical Learning" and "PjBL, Mathematical Learning." Based on searches carried out in the publication year range 2013-2023, 100 articles were found. Of this number, selection was carried out based on inclusion criteria, and finally, 12 articles met these criteria for elementary, middle school/MTs, and high school/equivalent levels.

T were selected, and the following process was coding the study. The instruments used in this process are a coding protocol in a coding form, done manually on paper or via computer, and an instruction guide that explains how to code each item in the primary study based on data (9). Study coding includes information about the study code, author, year of publication, mean, standard deviation, sample size of the experimental and control groups, educational level, and year of research. After the coding process is complete, the effect size is calculated using the standardized mean difference or Hedges's g with the following formula:

$$Hedges'g = \frac{M_1 - M_2}{SD^*pooled}$$

Explained :

$M_1 - M_2$ = difference in means

$SD^*pooled =$ pooled and weighted standard deviation

Table 1. Interpretation of Effect Size

ES	**Interpretation ES**
$0 \leq ES \leq 0.20$	Weak Effect
$0.20 < ES \leq 0.50$	Simple Effect
$0.50 < ES \leq 1.00$	Medium Effect
$ES > 1.00$	Strong Effect

After calculating the effect size, the next step is to conduct a homogeneity test to determine the analysis model used, using the p-value in the Q-statistic (8) (10). If the p-value is <0.05, then the distribution of effect sizes from the primary Studyes in this meta-analysis is considered heterogeneous, and the analysis model used is a random effects model. Conversely, if the p-value is > 0.05, the distribution of primary study effect sizes is considered homogeneous, and the analysis model used is a fixed effects model (10).

Furthermore, to ensure that the Studyes used in this meta-analysis are representative of all Studyes that address the same research question and that there is no claim that only Studyes with significant results are published and used in this meta-analysis, authors need to detect and address bias publication (11). Several methods that can be used to detect and overcome publication bias include funnel plots and Rosenthal's Fail-Safe N (FSN) (10). The first step in detecting publication bias is to use a funnel plot. Suppose a study's distribution of effect sizes appears asymmetrical or not wholly symmetrical. In that case, it is necessary to use Rosenthal's Fail-Safe N (FSN) to help determine whether publication bias is possible (12). If The authors can continue the analysis if publication bias is detected by using a predetermined analysis model, the author can carry out a null hypothesis test. If the p-value <0.05, then the null hypothesis is accepted, which means that the application of the Project Based Learning (PjBL) Learning Model significantly influences students' mathematical learning. Suppose the analysis model used is a random effects model, which shows differences in study characteristics. In that case, the author can analyze the study's characteristics and interpret the analysis results (8).

Results

Project Based Learning (PjBL) learning model when applied in mathematics learning. The following will explain some of the Studyes found for meta-analysis material:

Table 2. Studies used in the Meta-Analysis

Study Code	Study Title	Year	Journal Name
Study 1	Peningkatan Kemampuan Representasi Matematis Dan Motivasi Belajar Siswa Melalui Model Pembelajaran Berbasis Proyek (Project Based Learning) Di Kelas VII SMP Negeri 1 Torgamba Tahun Pelajaran 2016/2017 / *Improvement of Mathematical Representation Ability and Student Motivation through Project Based Learning Model in Class VII SMP Negeri 1 Torgamba Study Year 2016/2017* (https://jurnal.ulb.ac.id/index.php/sigma/article/view/1280)	2017	Jurnal Sigma
Study 2	Kontribusi Model Pembelajaran Project Based Learning Terhadap Kemampuan Berpikir Kritis Matematis Siswa Madrasah Tsanawiyah / *Contribution of the Project-Based Learning Model to the Mathematical Critical Thinking Ability of Madrasah Tsanawiyah Students* (DOI: 10.24235/eduma.v6i1.1559)	2017	Jurnal Eduma
Study 3	Kemampuan Komunikasi Matematis Siswa SMK Ditinjau dari Self Efficacy pada Setting Pembelajaran Project Based Learning Terintegrasi STEM / *Vocational School Students' Mathematical Communication Abilities Viewed from Self-Efficacy in STEM Integrated Project Based Learning Settings* (https://journal.unnes.ac.id/sju/index.php/prisma/article/view/29049)	2019	Jurnal Prisma
Study 4	Pengaruh Model Project Based Learning (PjBL) Terhadap Hasil Belajar Keliling Dan Luas Bangun Datar Kelas IV SD / *The Influence of the Project-Based Learning (PjBL) Model on the Learning Outcomes of the Perimeter and Building Area of Class IV Elementary School* (http://dx.doi.org/10.24036/e-jipsd.v8i3.10078)	2020	Jurnal Inovasi Pembelajaran SD
Study 5	Pengaruh Model Pembelajaran Project Based Learning (PjBL) Terintegrasi Stem Terhadap Kemampuan Berpikir Kreatif Siswa Kelas 5 Di SDN Sumberpinang 02 Jember / *The Influence of the Integrated Project-Based Learning (PjBL) Learning Model on the Creative Thinking Ability of Grade 5 Students at Public Elementary School Sumberpinang 02 Jember* (https://doi.org/10.26740/eds.v4n2.p106-114)	2020	Jurnal Edustream
Study 6	Pembelajaran Project Based Learning – Literasi dalam Meningkatkan Kemampuan Penalaran Matematis Siswa di Sekolah Dasar / *Project-Based Learning - Literacy in Improving Students' Mathematical Reasoning Ability in Elementary Schools* (https://doi.org/10.31599/edukarya.v1i1.106)	2020	Jurnal Edukarya
Study 7	Pengaruh Project Based Learning Terhadap Kemampuan Berpikir Kritis Matematis Siswa / *The Influence of Project Based Learning on Students' Mathematical Critical Thinking Ability* (https://jurnal.upg.ac.id/index.php/abacus/article/download/162/118)	2021	Jurnal Abacus
Study 8	Pendampingan Peningkatan Hasil Belajar Matematika Peserta Didik Kelas XI MTs Madani Alauddin Pao-Pao Melalui Penerapan Model Project Based Learning / *Assistance in Improving Mathematics Learning Outcomes for Class XI MTs Madani Alauddin Pao-Pao Students Through the Implementation of the Project-Based Learning Model* https://doi.org/10.24252/khidmah.v1i2.21198)	2021	Jurnal Pengabdian Kepada Masyarakat
Study 9	Kemampuan Berpikir Kreatif dan Hasil Belajar Matematika Siswa Menggunakan Model Pembelajaran Project-Based Learning Berbasis Pendekatan STEM / *Creative Thinking Ability and Student Mathematics Learning Outcomes Using a Project-Based Learning Model Based on a STEM Approach* (https://doi.org/10.29408/jel.v7i1.3031)	2021	Jurnal Elemen

Study 10	Optimalisasi Kemampuan Representasi Matematis Siswa Melalui Project-Based Learning Berbantuan Software Geogebra / *Optimizing Students' Mathematical Representation Abilities Through Project-Based Learning Assisted by Geogebra Software* (https://doi.org/10.35706/judika.v9i2.5496)	2021	Jurnal Pendidikan Unsika
Study 11	Pengaruh Model Project Based Learning(PjBL) Terhadap Hasil Belajar Siswa Pada Materi Penyajian Data Di Kelas V SD Gugus 1 Kecamatan Lembah Segar Kota Sawahlunto / *The Influence of the Project-Based Learning (PjBL) Model on Student Learning Outcomes in Data Presentation Material in Class V of Gugus 1 Elementary School, Lembah Segar District, Sawahlunto City* (https://ejurnalunsam.id/index.php/jbes/article/view/6666)	2022	Journal of basic education Studyes
Study 12	Kemampuan Berpikir Kreatif Peserta Didik ditinjau dari Self-Regulated pada Model Pembelajaran Project Based Learning dengan Pendekatan Realistik / *Students' Creative Thinking Ability is viewed from Self-Regulation in the Project Based Learning Learning Model with a Realistic Approach* (https://journal.unnes.ac.id/sju/index.php/prisma/article/view/66788)	2023	Prosiding Seminar Nasional Matematika

Based on the help of meta-analysis calculations from the website https://meta-mar.com/, information was obtained for the effect size, interpretation of the effect size, Standard Error, and Confidence Interval for each study, presented in the following table.

Table 3. Effect size, Interpretation of Effect Size, Standard Error, and Confidence Interval of Each Study

Study Code	**Effect Size**	**Interpretation of Effect Size**	**SE**	**Confidence Interval**	
				Lower	**Upper**
Study 1	2,7824	Weak effect	0,3372	2,1215	3,4432
Study 2	2,9135	Weak effect	0,3671	2,1939	3,6331
Study 3	0,4608	Simple effect	0,2406	-0,0107	0,9323
Study 4	0,4168	Simple effect	0,2528	-0,0786	0,9122
Study 5	0,8791	Medium effect	0,3317	0,2289	9,0862
Study 6	2,6677	Weak effect	0,3999	1,8838	3,4516
Study 7	0,9273	Medium effect	0,3334	0,2737	1,5808
Study 8	0,9032	Medium effect	0,3037	0,3079	1,4985
Study 9	0,6887	Medium effect	0,2659	0,1674	1,2099
Study 10	0,5880	Medium effect	0,2661	0,0664	1,1096
Study 11	1,8885	Weak effect	0,3042	1,2923	2,4847
Study 12	1,2643	Weak effect	0,2744	0,7265	1,8021

Based on Table 3, each study has a varying effect size; the 12 existing studies have an effect size between 0.4168 and 2.9135, with an interpretation of the effect size from moderate to strong. Based on the interpretation of the effect size according to Cohen's classification, the results showed that five studies had a substantial effect size or the application of the PjBL model in these five studies had a strong influence on mathematics learning, apart from that there were five studies of medium size or the application of the PjBL model had a moderate effect on mathematics learning. There were 2 Simple sized studies, and applying the PjBL model in these two studies had a modest influence on mathematics learning abilities. To determine the combined effect size across all primary studies, the author must create an estimation model by testing all studies' homogeneity. Table 4 provides information regarding the homogeneity test of all primary studies.

Table 4. Heterogeneity of Effect Size Distributions

Heterogeneity				
Chi²	**Df**	**P-Value**	**I-squared**	**Tau²**
91,58	11	P < 0.01	88%	0.7626

Based on Table 4, t shows p-value <0.05, meaning that the distribution of effect sizes of primary studies meta-analyzed is heterogeneous. Therefore, the estimation model to determine the combined effect size is a random effects model. Then, depublication bias was identified in the funnel plot shown below.

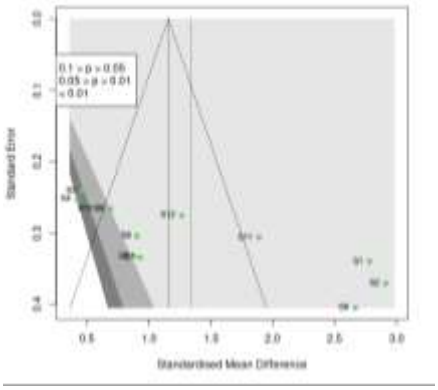

Fig 1. Funnel Plot

Based on Figure 1, the study effect size distribution is asymmetrical. So, the author detected publication bias with Fail-Safe N (FSN) in 918 of the observed studies (k), as many as 12. They are using the formula $\frac{FSN}{5k+10} = \frac{918}{5(12)+1} = \frac{918}{61} = 15{,}05 > 1$. The conclusion is that the studies in this meta-analysis have sufficient tolerance for publication bias (12).

Next, in Table 5, the results of the meta-analysis of primary studies with fixed and random effects models will be presented.

Table 5. Meta-Analysis Results Based on Estimation Models

Models	**n**	**Effect Size and Convidence Interval**				**Test of null (2-Tail)**	
		Effect Size	**SE**	**Lower**	**Upper**	**Z-Value**	**P-Value**
Fixed effect	12	1.1553	0,1682	0.9871	1.3232	13.46	< 0.0001
Random effect	12	1.3394	0,5942	0.7452	1.9336	4.96	0.0004

In previous studies, homogeneity tests were performed to identify heterogeneous effect size distributions. Therefore, the analysis was carried out using a random effects model. Table 6 shows the p-value of the Z test, which is <0.0001. Because the p-value <0.05, overall, the use of the PjBL model has a more significant influence on mathematics learning. In this study, the combined effect size was obtained at 1.3394, which, according to Cohen's classification, is categorized as a substantial effect size. Thus, the overall application of the PjBL model has a strong influence on mathematics learning. In this context, the distribution of primary study effects is known to be heterogeneous, so analysis of study characteristics is needed to understand the heterogeneity in the PjBL learning model for mathematics learning. The meta-analysis results show several characteristics, which are presented in Table 6. The meta-analysis research conducted (13)also concluded that the project-based learning model positively improved students' mathematical creative thinking abilities.

Table 6. Meta Analysis Results for Each Character Study

Characteristics Study	**Category**	**N**	**Hedges'g**	**P-value**	**95% CI**	
					Lower	**Upper**
Educational level	Elementary	4	1.28	< 0.01	-0.24	2.80
	Midle School	5	1.82	< 0.01	0.54	3.10
	High School	3	0.61	0.52	0.06	1.15
Year of Research	2017-2019	3	2.03	< 0.01	-1.41	5.48
	2020-2021	7	0.97	< 0.01	0.30	1.63

	2022-2023	2	1.56	0.13	-2.40	5.52
Region	Java Island	7	1.36	< 0.01	0.75	1.93
	Outside of Java Island	5	1.32	< 0.01	0.11	2.53
Skill	Creative Thinking	3	0.95	0.31	0.18	1.71
	Critical thinking	2	1.91	< 0.01	-10.57	14.53
	Learning outcomes	3	1.06	< 0.01	-0.81	2.92
	Representation	2	1.68	< 0.01	-12.27	15.52
	Reasoning	1	2.67	0.000	1.87	3.46
	Communication	1	0.46	0.000	-0.01	0.93

Based on the results of grouping based on study characteristics of the use of the PjBL learning model for mathematics learning, as presented in Table 6 above, the following information was obtained:

Characteristics based on education level

Based on the results of the characteristics of educational levels, information is obtained in Table 6; of the 12 existing studies, four studies discuss the application of PjBL in elementary school level mathematics learning, five studies discuss the application of PjBL in junior high school level mathematics learning, and three studies that discuss the application of PjBL in high school level mathematics learning. The P-value value at the elementary and middle school levels is < 0.05, meaning that the two categories are heterogeneous. Meanwhile, for the effect size, you can see the picture in the following boxplot:

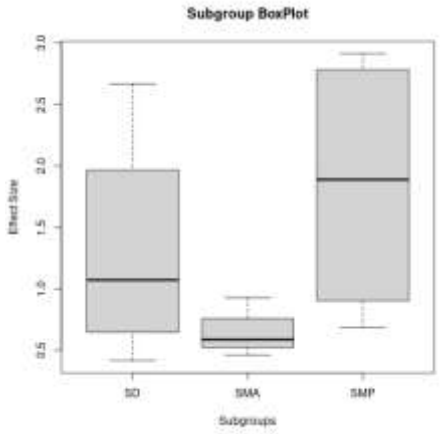

Fig 2. Boxplot based on educational level characteristics

The boxplot image above shows that the application of the Project Learning (PjBL) learning model, which is influenced by educational level, is suitable for use at elementary and middle school levels because it has a strong influence, as seen based on the interpretation of the effect size which is within the muscular effect size.

Characteristics by year of study

Based on the results of the characteristics based on the research year, information is obtained in Table 6. Of the 12 existing studies, three studies discuss the application of PjBL in mathematics learning in the 2017-2019 research year, seven studies discuss the application of PjBL in mathematics learning in the 2020 research year -2021, and 2 studies discuss the application of PjBL in mathematics learning in the 2022-2023 research year. The P-value value in the 2017-2019 research year and the 2020-2021 research year is P-value < 0.05, meaning the two categories are heterogeneous. Meanwhile, for the effect size, you can see the picture in the following boxplot:

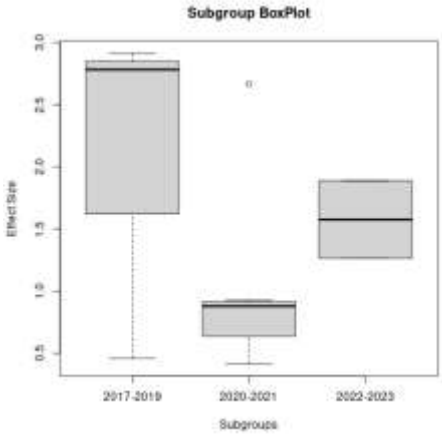

Fig 3. Boxplot based on study year characteristics

The boxplot image above shows that the implementation of the Project Learning (PjBL) model, which is influenced by educational level, is suitable for use in 2017-2019 and in 2022-2023 because it has a strong influence as seen based on the interpretation of the effect size in the effect size. Strong. However, in the 2020-2021 research year, an effect size was obtained in the medium effect category.

Characteristics by region

Based on the results of the characteristics based on the year of research, information is obtained in Table 6; of the 12 existing studies, seven studies discuss the application of PjBL in mathematics learning in the Java Island region, and five studies discuss the application of PjBL in mathematics learning in the Outer Island region. Java. The P-value value based on each region, both Java Island and Outside Java Island, is P-value < 0.05, meaning the two categories are heterogeneous. Meanwhile, for the effect size, you can see the picture in the following boxplot:

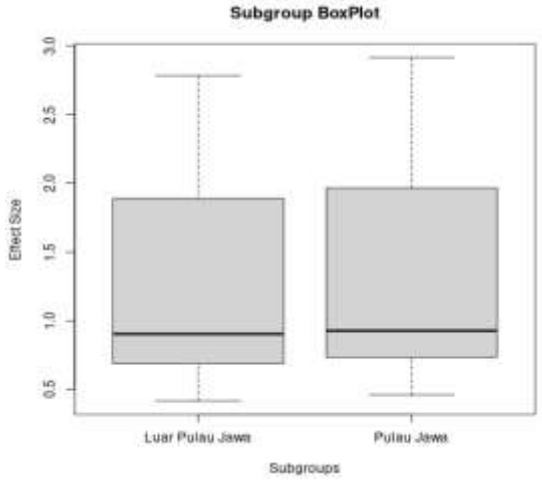

Fig 4. Boxplot based on regional characteristics

The boxplot image above shows that the application of the project-based Learning (PjBL) learning model, which is influenced by regions in the Java Island region and areas outside Java Island, does not show significant differences. This means that both have a good influence when viewed from the effect size, which contains the interpretation of the effect size in terms of a substantial effect size.

Characteristics based on the skills tested

As a result of the characteristics based on the skills tested, information is obtained in Table 6; of the 12 existing studies, three studies discuss the application of PjBL in mathematics learning on creative thinking abilities; two studies discuss the application of PjBL in mathematics learning on critical thinking abilities, three studies discussing the application of PjBL in mathematics learning on student learning outcomes, two studies discussing the application of PjBL in mathematics learning on mathematical representation abilities, 1 study discussing the application of PjBL in mathematics learning on reasoning abilities, and 1 study discussing regarding the application of PjBL in mathematics learning towards mathematical communication skills. The P-value value based on each skill tested is < 0.05, meaning the two categories are heterogeneous. Except for creative thinking skills, the P-value value is > 0.05, which means the sample is homogeneous. Based on the effect size criteria, measures in critical thinking skills, learning outcomes, representation, and

reasoning have effect sizes in the strong effect category; the creative thinking category has a medium effect size. In contrast, communication skills have a modest effect size. This means applying the PjBL learning model is recommended to measure critical thinking skills, learning outcomes, representation, and reasoning in mathematics learning.

This aligns with research (8) results conducted on third-grade elementary school students showing that applying the PjBL learning model can improve students' critical thinking abilities. Other research has argued (14) that the PJBL learning model can improve junior high school students' learning outcomes. B, in its research, results based on the research results show that the application of the PjBL learning model can help improve students' mathematical representation abilities (4). Other research states (15) that the PjBL model can improve mathematical reasoning abilities because learning that uses the context of everyday life can foster students' literacy understanding so that their reasoning also improves.

Conclusion

Based on the results of the meta-analysis of 12 studies conducted, it was found that the combined effect size of primary (16) studies was 1.3394, which is included in the strong effect category according to Cohen's classification. In conclusion, using the PjBL model substantially impacts mathematics learning more than the traditional model, which generally places the teacher as the center of learning and students as objects in the learning process. Apart from that, the application of the PjBL model in mathematics learning in Indonesia is effected by educational level, year of research, and research area. These findings will help educators in Indonesia use the PjBL Model, which also strongly influences student skills, including critical thinking skills, learning outcomes, representation, and reasoning in mathematics learning.

References:

Research Papers:

1. Nurulaeni F, Rahma A. Analisis Problematika Pelaksanaan Merdeka Belajar Matematika. 2022;2(1):2807–1107. Available from: https://unu-ntb.e-journal.id/pacu

2. Wijaya S. Kampus Merdeka dan Inovasi Pendidikan Peluang dan Tantangan di Era 4.0. Rozi A, editor. Serang: Desanta Muliavisitama; 2021.

3. Anwar S. Pengaruh Project Based Learning Terhadap Kemampuan Berpikir Kritis Matematis Siswa. Journal Abacus. 2021;2(1):61.

4. Harahap NA. Peningkatan Kemampuan Representasi Matematis Dan Motivasi Belajar Siswa Melalui Model Pembelajaran Berbasis Proyek (Project Based Learning) Di Kelas VII SMP Negeri 1 Torgamba Tahun Pelajaran 2016/2017. SIGMA. 2017;3(1):38–48.

5. Mustika J. Pengembangan E-Modul Matematika Berbasis Project Based Learning (PJBL) Ditinjau Dari Kemampuan Berpikir Kreatif. AKSIOMA: Jurnal Program Studi Pendidikan Matematika. 2022;11(4):3573.

6. Ariyana Y, Pudjiastuti A, Bestary R, Zamroni. Buku Pegangan Pembelajaran Berorientasi Pada Keterampilan Berpikir Tingkat Tinggi. Direktorat Jenderal Guru dan Tenaga Kependidikan Kementrian Pendidikan dan Kebudayaan; 2018. 1–86 p.

7. Shah A, Hunter E, Cooper H, Olkin I, Raju NS, Cohen J, et al. Basics of meta-analysis. 2020.

8. Borenstein M, Hedges L V, Higgins JP, Rothstein H. Introduction to Introduction. In An Introduction to Information Processing. A John Wiley and Sons; 2009.

9. Wilson DB. The handbook of research synthesis and meta-analysis. Russell Sage Foundation; 2009. 159–176 p.

10. Retnawati H, Apino E, Kartianom DH, Anazifa RD. Pengantar Meta Analisis. 2018. 208 p.

11. Greenhouse JB, Iyengar S. Sensitivity Analisis and Diagnostics The Handbook of Research Synthesis and Meta-Analisis 2nd . Cooper VL, Hedges, J. C. Valentine, editors. 2009.

12. Tamur M, Juandi D, Kusumah YS. The effectiveness of the application of mathematical software in indonesia; a meta-analysis study. International Journal of Instruction. 2020;13(4):867–84.

13. Yunita Y, Juandi D, Hasanah A, Tamur M. Studi Meta-Analisis: Efektivitas Model Project-Based Learning Terhadap Kemampuan Berpikir Kreatif Matematis Siswa. AKSIOMA: Jurnal Program Studi Pendidikan Matematika. 2021;10(3):1382.

14. Arafyana AA, Sugita G, Murdiana IN. Penerapan Model Pembelajaran Project Based Learning (PJBL) untuk Meningkatkan Hasil Belajar Siswa pada Materi Aritmatika Sosial di Kelas VII E SMP Negeri 2 SIGI. Jurnal Elektronik Pendidikan Matematika Tadulako. 2018;5(3):278–91.

15. Abidin Z, Utomo AC, Pratiwi V, Farokhah L. Pembelajaran Project Based Learning – Literasi Dalam Meningkatkan Kemampuan Penalaran Matematis Siswa Di Sekolah Dasar. Educational Journal of Bhayangkara. 2020;1(1):30–6.

16. Nida Winarti, Maula LH, Amalia AR, Pratiwi NLA, Nandang. Penerapan Model Pembelajaran Project Based Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Kelas Iii Sekolah Dasar. Jurnal Cakrawala Pendas. 2022;8(3):552–63.