JRTP: Jurnal Riset Teknologi Pembelajaran
Volume 1(1), 2025, pp. 9-17
https://jrtp.smartedvision.com/ejournal

Combining Flipped Classroom and Project-based Learning Methods on Learning Achievement: A Meta-Analysis Study

Izza Alfina Cahyani [1, a] *, Irfan [2, b], Ade Mahniar [3, c]

[1] Program Studi Teknologi Pendidikan, Universitas Negeri Jakarta, Indonesia
[2] Program Studi Pendidikan Bahasa Arab, Universitas Negeri Makassar, Indonesia
[3] Program Studi Pendidikan Guru Sekolah Dasar, Universitas Negeri Gorontalo, Indonesia
[a] izza.alfina.cahyani@unj.ac.id; [b] irfan90@unm.ac.id; [c] ademahniar@ung.ac.id
* Corresponding Author

Receipt: 29 July 2025; Revision: 30 July 2025; Accepted: 30 July 2025

Abstract: The integration of Flipped Classroom and Project-Based Learning (FC-PjBL) has gained increasing attention as an innovative instructional model aimed at enhancing student achievement. Despite its growing application, previous empirical findings on its effectiveness remain inconsistent and fragmented. **Objective:** This study aims to provide a comprehensive evaluation of the FC-PjBL model's impact on student academic performance. **Method:** The method employed in this study is meta-analysis. Thirteen research samples (k = 13) were systematically reviewed and analyzed using a random-effects model to account for heterogeneity across studies. **Findings:** The findings reveal a statistically significant and substantial positive effect of the FC-PjBL model on student learning outcomes, with an overall effect size (g) of 1.22 ($p < 0.01$), indicating a large effect. However, a high degree of heterogeneity ($I^2 = 83.64\%$) was observed, suggesting considerable variation in the effectiveness of the model across different contexts. This variation implies the potential influence of moderating variables such as educational level, subject area, intervention duration, the quality of technology integration, and the design of project tasks. **Conclusion:** These results highlight the promise of the FC-PjBL approach in fostering academic improvement while underscoring the importance of contextual adaptation. Therefore, future research is recommended to explore these moderating factors more deeply, which will not only refine the theoretical understanding of integrated instructional models but also inform more effective implementation strategies in diverse educational settings.

Keywords: Effect Size; Flipped Learning; Meta-Analysis; Project-based Learning.

INTRODUCTION

The transformation of 21st-century education demands learning models that go beyond cognitive proficiency to include the development of critical thinking, creativity, collaboration, and communication skills. This paradigm shift necessitates a move away from conventional, teacher-centered instruction toward more active, participatory, and learner-centered approaches. In response, various pedagogical innovations have emerged, among which the integration of Flipped Classroom and Project-Based Learning (FC-PjBL) has become a prominent trend in modern instructional design.

The FC-PjBL model combines the strengths of self-directed, technology-mediated learning with collaborative, real-world problem-solving through project-based activities. Students are first exposed to instructional content independently via videos or digital materials before engaging in in-class activities centered on discussion, collaboration, and project implementation. A growing body of research has shown that this model enhances learning outcomes, promotes student engagement, and fosters higher-order thinking skills such as analysis, synthesis, and evaluation (Andrini et al., 2019; Hossein-Mohand et al., 2021; Fitrah et al., 2025). Moreover, the flexibility offered by FC-PjBL has been associated with the development of students' self-regulated learning capabilities (Zarouk et al., 2020; Pohan & Maulina, 2022).

Although numerous experimental studies have examined the effectiveness of FC-PjBL, their findings remain inconclusive and context-dependent. Many of these studies are constrained by small sample sizes and narrow educational settings, limiting the generalizability of their results. Consequently, meta-analytic approaches are essential to quantitatively synthesize existing evidence and produce more comprehensive and reliable conclusions.

However, previous meta-analyses also exhibit several limitations. These include a lack of focus on FC-PjBL as an integrated instructional model, insufficient attention to moderating variables such as educational level, subject domain, and intervention duration, and issues related to data duplication, selection bias, and inadequate reporting of effect sizes. Such methodological shortcomings limit the utility of earlier findings for informing educational practice and policy.

This study seeks to address these gaps by conducting a more rigorous and focused meta-analysis on the effectiveness of the FC-PjBL model in improving student learning outcomes. Using a *random-effects model*, the study not only estimates the overall effect size but also investigates the influence of relevant moderating variables. The results are expected to offer stronger empirical foundations for evidence-based decision-making in instructional design, while also contributing to the theoretical discourse on the integration of contemporary learning models in diverse educational contexts.

METHOD

Research Design

This study used a meta-analysis approach to evaluate the effectiveness of implementing the FC-PjBL learning model on student academic performance. Meta-analysis was chosen as the research design because it allows for the integration of quantitative data from various relevant studies to produce more accurate and generalizable effect size estimates. By integrating the results of various previous studies, this approach aims to gain a more comprehensive understanding of the extent to which the Flipped-PjBL model contributes to learning outcomes, while reducing potential bias from individual studies. Furthermore, meta-analysis offers the advantage of increasing statistical power through the accumulation of larger sample sizes, ultimately resulting in more stable and objective effect estimates.

Inclusion Criteria

Inclusion criteria for this meta-analysis included: (1) research articles published between 2019 and 2024; (2) using an experimental or quasi-experimental research design that clearly involved experimental and control groups; (3) The study evaluated the effectiveness of the Flipped-Project-Based Learning (Flipped-PjBL) model on

student learning outcomes at elementary, secondary, and tertiary levels; and (4) the study reported sufficient statistical data for calculating effect sizes, such as mean values, standard deviations (SD), and sample sizes for each group.

Literature Collection

Literature collection was conducted systematically through searches in the Google Scholar database and the Google search engine using combined keywords, such as ("Flipped Classroom" OR "Flipped Learning") AND ("Project-Based Learning" OR "PjBL") AND ("experimental" OR "quasi-experimental") AND ("learning outcomes" OR "student achievement"). The articles obtained were then screened using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, which include four stages: identification, screening, eligibility, and inclusion. From this selection process, nine primary studies were identified that met the criteria for further analysis. This process ensures that only relevant and high-quality studies are included in the quantitative synthesis to ensure the validity of the meta-analysis results. Figure 1 presents the data collection process using the PRISMA protocol.

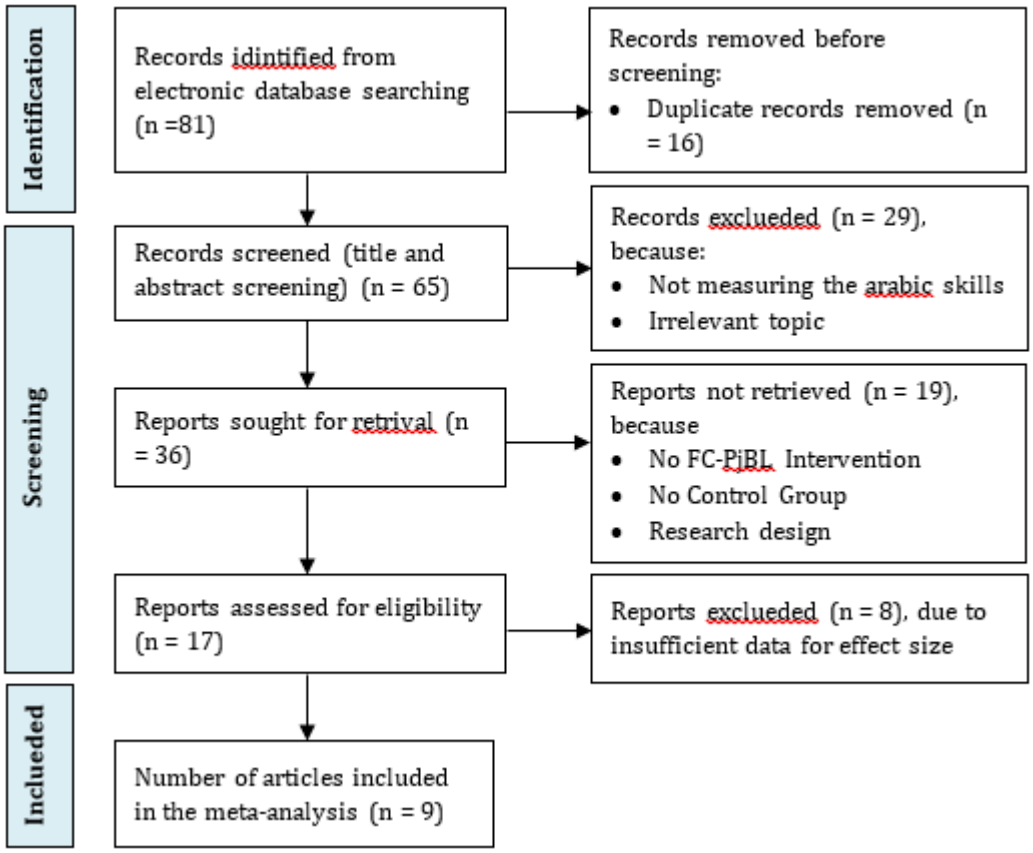

Figure 1. Literature Screening Process Using PRISMA

Data Analysis

In this study, Comprehensive Meta-Analysis (CMA) software was used as the primary tool for processing and analyzing data from the various studies collected. The data analysis process was carried out through several systematic stages. The first stage was calculating the effect size for each study using statistical data such as the mean, standard deviation, and sample size of the experimental and control groups. The second stage was conducting a heterogeneity test to determine the level of

variation between the studies analyzed. The results of this test served as the basis for determining the estimation model to be used, whether a fixed-effects or random-effects model. The third stage was calculating the overall effect size, which represents the average impact of implementing the FC-PjBL model on student academic performance. Interpretation of the effect size values was carried out using guidelines developed by Cohen (1988).

RESULTS AND DISCUSSION

Results

Table 1 presents the distribution of the effect categories of FC-PjBL meta-analysis studies on learning outcomes. The meta-analysis findings, as illustrated in the forest plot (Figure 2), synthesized data from thirteen primary studies to assess the overall effectiveness of the *Flipped Learning* integrated with *Project-Based Learning* (FC-PjBL) model in enhancing student learning outcomes. The effect sizes observed across these studies varied considerably, ranging from 0.27 to 2.32, suggesting a spectrum of impact levels depending on contextual and methodological factors. According to Cohen's (1988) benchmark for interpreting effect size magnitude, five studies demonstrated a very large effect, namely those conducted by Hujjatusnaini et al. (2022), Ramadhani and Fitri (2020)a, Sumarmi et al. (2021)a, Sumarmi et al. (2021)b, and Telaumbanua (2022). These studies signal a strong pedagogical influence of the FC-PjBL model when implemented under optimal conditions.

Meanwhile, six studies reported large effects, including Mursid et al. (2022)a, (2022)b, and (2022)c, as well as Putra et al. (2021), Silvi et al. (2019), and Sulistyowati et al. (2024), reinforcing the robustness of the model across varied educational contexts. One study by Ramadhani and Fitri (2020)b fell into the moderate category, while Mufida et al. (2020) showed a small effect size, indicating the presence of situational or design-based limitations in certain implementations. Overall, the majority of included studies exhibited large to very large effects, supporting the general conclusion that the FC-PjBL model has a substantial positive impact on student academic performance.

These findings not only affirm the instructional potential of the FC-PjBL model but also highlight the importance of examining contextual moderators that may explain variations in outcomes. A summary overview of the computed effect sizes from all thirteen studies is visually presented in Figure 3, providing a comprehensive snapshot of the model's effectiveness across the included dataset.

Table 1. Distribution of Effect Categories of FC-PjBL Meta-Analysis Studies on Learning Outcomes

Effect Categories (Cohen's d)	Effect Size Range	Number of Studies	Pecentage (%)	Study Name
Very Large	> 1.30	5	38.5%	Hujjatusnaini et al. (2022); Ramadhani & Fitri (2020a); Sumarmi et al. (2021a, 2021b); Telaumbanua (2022)
Large	0.80 – 1.30	6	46.2%	Mursid et al. (2022a, 2022b, 2022c); Putra et al. (2021); Silvi et al. (2019); Sulistyowati et al. (2024)

Moderate	0.50 – 0.79	1	7.7%	Ramadhani & Fitri (2020b)
Small	< 0.50	1	7.7%	Mufida et al. (2020)
Total		**13**	**100%**	

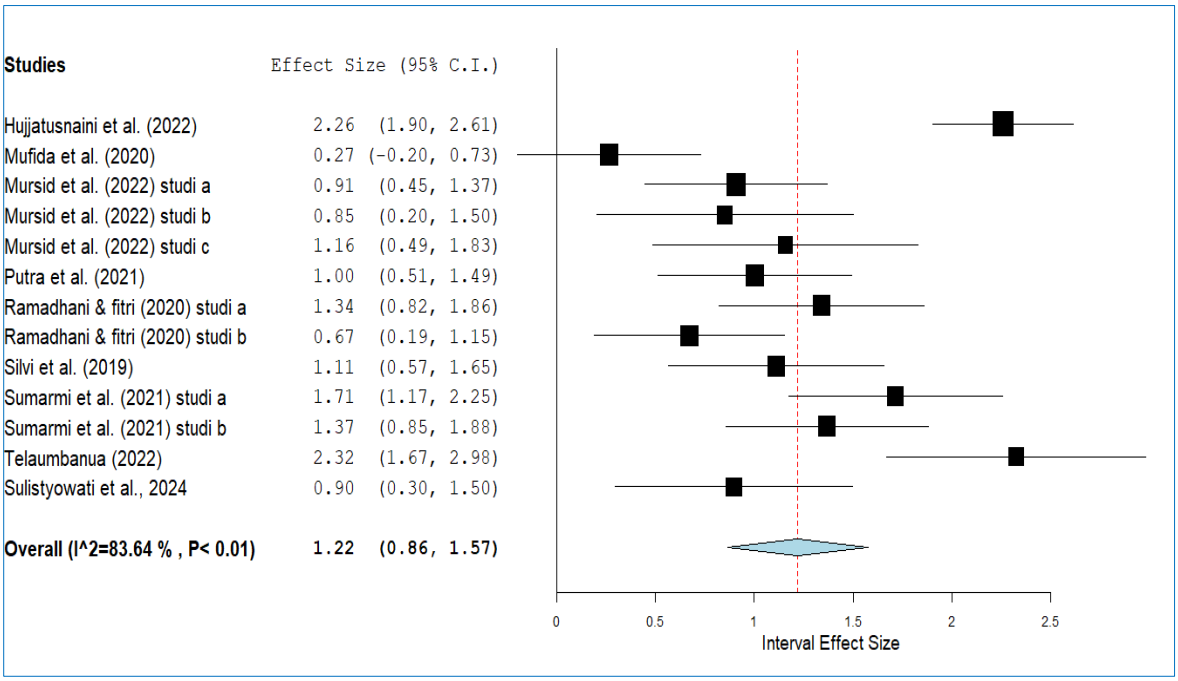

Figure 2. Forest Plot

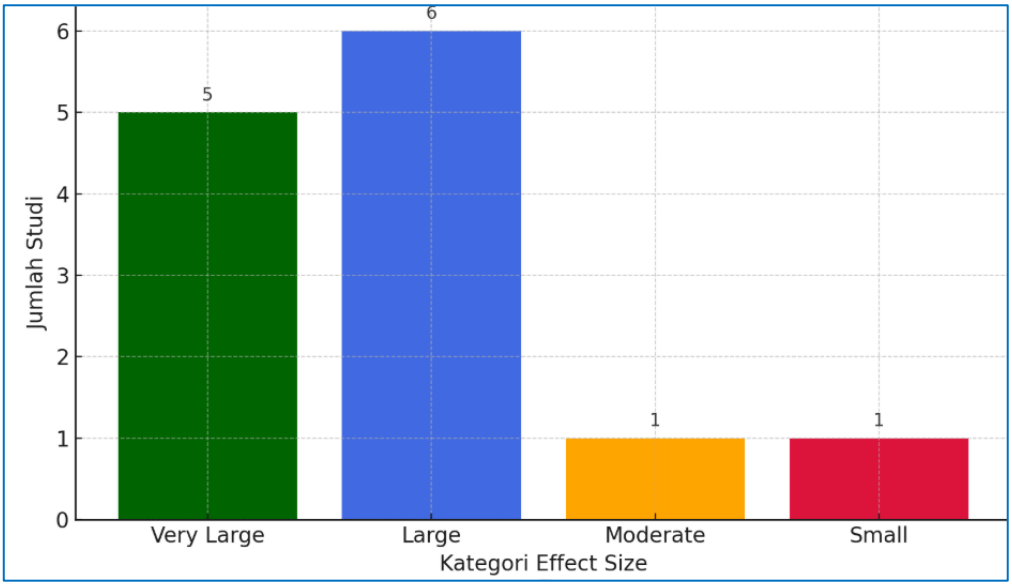

Figure 3. Distribution of Effect Size Categories Related to FC-PjBL

The heterogeneity analysis in this study revealed substantial variability across the included studies, as indicated by an I^2 value of 83.64% and a significance level of $p < 0.01$. This suggests that the distribution of effect sizes among the thirteen analyzed studies is significantly heterogeneous. Consequently, a random-effects model was employed to estimate the overall effect size in order to account for the observed

between-study differences. Based on the pooled effect size analysis (see Figure 2), the combined effect size was found to be d = 1.22, with a standard error of 0.18 and statistical significance at $p < 0.01$. According to Cohen's (1988) classification, this value falls within the large effect category. These findings indicate that, overall, the implementation of the FC-PjBL model exerts a strong and statistically significant impact on improving student learning outcomes when compared to conventional instructional approaches.

Discussion

The results of the meta-analysis indicate that the integration of the Flipped Classroom and Project-Based Learning (FC-PjBL) model has a strong positive effect on improving student academic performance compared to conventional instructional methods. These findings align with previous research by Zou et al. (2021), Ramadani et al. (2023), and Hwang et al. (2020), which collectively emphasize that the combination of flipped and project-based approaches fosters more active, collaborative, and meaningful learning environments, while enhancing student engagement and deep understanding.

Referring to effect size distribution across the included studies, five studies reported a very large effect (Hujjatusnaini et al., 2022; Ramadhani & Fitri, 2020a; Sumarmi et al., 2021a; Sumarmi et al., 2021b; and Telaumbanua, 2022), while six studies demonstrated a large effect (Mursid et al., 2022a, 2022b, 2022c; Putra et al., 2021; Silvi et al., 2019; and Sulistyowati et al., 2024). Only one study reported a moderate effect (Ramadhani & Fitri, 2020b), and another showed a small effect (Mufida et al., 2020). Collectively, these findings confirm that the FC-PjBL model is generally highly effective in improving learning outcomes, with most studies showing substantial educational impact.

This significant improvement can be attributed to the synergistic nature of both instructional models. Flipped Learning empowers students to acquire foundational knowledge independently through digital resources such as videos or e-modules prior to class. This enables in-person sessions to be utilized more effectively for active learning tasks, such as collaborative problem-solving. On the other hand, Project-Based Learning immerses students in real-world, contextual projects that demand critical thinking, creativity, and application of knowledge in authentic settings. It also cultivates responsibility, metacognitive awareness, and a sense of ownership over the learning process.

Nonetheless, the effectiveness of the FC-PjBL model is not uniform across all contexts. Studies that reported lower effect sizes often implemented shorter interventions, employed lower-quality flipped content, or lacked authentic project design. These findings suggest that successful implementation of the FC-PjBL model is contingent upon well-structured instructional design, adequate technological support, and the active facilitation role of the teacher throughout the learning process.

The high heterogeneity identified in this meta-analysis ($I^2 = 79.61\%$, $p < 0.01$) reflects significant variation among the included studies. Therefore, further moderator analyses are necessary to examine the influence of variables such as educational level (e.g., secondary vs. tertiary), subject domain (e.g., mathematics, language, science), intervention duration, and the quality of digital tools used in flipped instruction. Socio-cultural backgrounds and technological readiness in each study's context may also play a crucial role in shaping the success of the FC-PjBL integration.

From a pedagogical perspective, these findings reinforce the relevance of the FC-PjBL model as a transformative instructional strategy aligned with 21st-century skill

development, particularly the 4Cs: critical thinking, communication, collaboration, and creativity. Beyond conceptual understanding, the model enhances self-regulated learning and promotes both individual and group accountability. Therefore, it is recommended that the FC-PjBL model be incorporated into curriculum reform strategies, teacher training programs, and education policy initiatives aimed at fostering active, student-centered, and project-based learning environments.

CONCLUSION

This meta-analysis demonstrates that the integration of *Flipped Classroom and Project-Based Learning* (FC-PjBL) is highly effective in enhancing student learning outcomes. The pooled effect size of 1.22 (classified as a *large effect*) confirms that this instructional model fosters an active, meaningful, and collaborative learning environment, while simultaneously promoting 21st-century skills such as critical thinking, communication, collaboration, and creativity. The majority of the analyzed studies reported large to very large effects, indicating consistent positive impacts of FC-PjBL implementation across diverse educational settings.

Nevertheless, this study has several limitations. The high level of heterogeneity among the studies suggests substantial variation in implementation contexts, intervention duration, educational levels, and instructional quality. Additionally, most of the included studies were conducted in specific subject areas (e.g., science and mathematics), which limits the generalizability of the findings across different disciplines and educational levels. Other limitations include a lack of detailed reporting in some primary studies, particularly regarding technological integration, teacher involvement, and the authenticity of project design.

Given these findings and limitations, future research is encouraged to conduct more comprehensive moderator analyses to explore the influence of factors such as educational level, subject area, intervention duration, and students' socio-cultural backgrounds on the effectiveness of the FC-PjBL model. Further studies should also consider adopting *mixed-methods* approaches to gain deeper insights into students' and teachers' experiences during the implementation process. From a practical perspective, professional development programs for teachers, improved digital infrastructure, and the incorporation of project-based elements into the curriculum should be prioritized to ensure the successful and sustainable adoption of the FC-PjBL model across various educational contexts.

REFERENCE

Andrini, V. S., Pratama, H., & Maduretno, T. W. (2019). The effect of flipped classroom and project based learning model on student's critical thinking ability. In *Journal of Physics: Conference Series* (Vol. 1171, No. 1, p. 012010). IOP Publishing.

Borenstein, M., Hedges, L. V., Higgins, J. P., & Rothstein, H. R. (2021). *Introduction to meta-analysis*. John wiley & sons.

Cahyani, I. A., Sujarwo, S., Imaroh, Y. R., Hukom, J., Yanuar, F. S., Martaputri, N. A., & Nisrina, N. (2024). Effectiveness of Geogebra Integration into Flipped Classroom (GFC) on Students Mathematics Skills: A Meta-Analysis Study. *Jurnal Pendidikan Progresif*, *14*(3), 1754-1769. http://dx.doi.org/10.23960/jpp.v14.i3.2024119

Chua, K. J., & Islam, M. R. (2021). The hybrid Project-Based Learning–Flipped Classroom: A design project module redesigned to foster learning and engagement. *International Journal of Mechanical Engineering Education*, *49*(4), 289-315.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences, 2nd ed*. Routledge

Fitrah, M., Sofroniou, A., Setiawan, C., Widihastuti, W., Yarmanetti, N., Jaya, M. P. S., ... & Susianti, I. (2025). The Impact of Integrated Project-Based Learning and Flipped Classroom on Students' Computational Thinking Skills: Embedded Mixed Methods. *Education Sciences*, *15*(4), 448.

Fitriawan, D., Sulistyowati, E., & Siregar, N. (2024). Penerapan Metode Project Based Learning dikombinasikan Flipped Classroom Terhadap Kemampuan Berpikir Kritis. *Jurnal Padegogik*, *7*(1), 35-42. https://doi.org/10.35974/jpd.v7i1.3253

Hossein-Mohand, H., Trujillo-Torres, J. M., Gómez-García, M., Hossein-Mohand, H., & Campos-Soto, A. (2021). Analysis of the use and integration of the flipped learning model, project-based learning, and gamification methodologies by secondary school mathematics teachers. *Sustainability*, *13*(5), 2606.

Hujjatusnaini, N., Corebima, A. D., Prawiro, S. R., & Gofur, A. (2022). The Effect of Blended Project-based Learning Integrated with 21st-Century Skills on Pre-Service Biology Teachers' Higher-order Thinking Skills. *Jurnal Pendidikan IPA Indonesia, 11*(1), 104-118. https://doi.org/10.15294/jpii.v11i1.27148

Hukom, J., Prihatmojo, A., Manaf, A., Suciati, I., & Ratau, A. (2023). Integration of Blended Learning and Project-Based Learning (BPjBL) on Achievement of Students' Learning Goals: A Meta-Analysis Study. *Pegem Journal of Education and Instruction*, *13*(4), 274-281. https://doi.org/10.47750/pegegog.13.04.32

Kamsurya, M. A., Wijaya, A., Ramadhani, R., & Hukom, J. (2022). The Effect of Self-Efficacy on Students' Mathematical Abilities: A Meta-Analysis Study. *Jurnal Pendidikan Progresif*, 12(2), 451-463. http://dx.doi.org/10.23960/jpp.v12.i2.202205

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. SAGE publications, Inc.

Martaputri, N. A., Muhtadi, A., Hukom, J., & Samal, D. (2021). The Correlation between Emotional Intelligence and Academic Achievement: A Meta Analysis Study. *Jurnal Pendidikan Progresif*, 11(3), 511-523. http://dx.doi.org/10.23960/jpp.v11.i3.202102

Mawardi, D. N., Sulistyowati, E., & Hukom, J. (2024). Meta-Analisis investigasi model kelas terbalik pada keterampilan berpikir tingkat tinggi (HOTS) siswa matematika: Analisis efek gabungan dan heterogenitas. *Jurnal Math Educator Nusantara: Wahana Publikasi Karya Tulis Ilmiah di Bidang Pendidikan Matematika*, *10*(1), 154-166. https://doi.org/10.29407/jmen.v10i1.22296

Mufida, S. N., Sigit, D. V., & Ristanto, R. H. (2020). Integrated project-based e-learning with science, technology, engineering, arts, and mathematics (PjBeL-STEAM): its effect on science process skills. Biosfer: *Jurnal Pendidikan Biologi, 13*(2), 183-200. https://doi.org/10.21009/biosferjpb.v13n2.183-200

Muhtadi, A., Assagaf, G & Hukom, J. (2022). Self-efficacy and students' mathematics learning ability in Indonesia: A meta analysis study. *International Journal of Instruction*, 15(3), 1131- 1146. https://doi.org/10.29333/iji.2022.15360a

Muhtadi, A., Pujiriyanto., Syafruddin, K., Hukom, J., & Samal, D. (2022). A meta-analysis: Emotional intelligence and its effect on mathematics achievement. *International Journal of Instruction*, 15(4), 745-762. https://doi.org/10.29333/iji.2022.15440a

Mursid, R., Saragih, A. H., & Hartono, R. (2022). The Effect of the Blended Project-Based Learning Model and Creative Thinking Ability on Engineering Students' Learning Outcomes. *International Journal of Education in Mathematics, Science and Technology, 10*(1), 218-235. https://doi.org/10.46328/ijemst.2244

Pohan, L., & Maulina, J. (2022). Blended Learning Integrated with Project-Based Learning: Its Effect on Learning Outcomes, Perception, and Self-Regulated Learning. *Jurnal Pendidikan Kimia Indonesia*, *6*(2), 97-106.

Purnomo, B., Muhtadi, A., Ramadhani, R., Manaf, A., & Hukom, J. (2022). The effect of flipped classroom model on mathematical ability: A meta analysis study. *Jurnal Pendidikan Progresif*, 12(3), 1201-1217. http://dx.doi.org/10.23960/jpp.v12.i3.202216

Putra, A. K., Sumarmi., Deffinika, I., & Islam, M. N. (2021). The effect of blended projectbased learning with stem approach to spatial thinking ability and geographic skill. International Journal of Instruction, 14(3), 685-704. https://doi.org/10.29333/iji.2021.14340a

Ramadhani, R., & Fitri, Y. (2020). A Project-based learning into flipped classroom for ePUB3 electronic mathematics learning module (eMLM)-based on course design and implementation. *Universal Journal of Educational Research, 8*(7), 3119-3135.

Samritin, S., Susanto, A., Manaf, A., & Hukom, J. (2023). A meta-analysis study of the effect of the blended learning model on students' mathematics learning achievement. *Jurnal Elemen*, 9(1), 15-30. https://doi.org/10.29408/jel.v9i1.6141

Setiawan, A. A., Muhtadi, A., & Hukom, J. (2022). Blended learning and student mathematics ability in Indonesia: A meta-analysis study. *International Journal of Instruction*, 15(2), 905-916. https://doi.org/10.29333/iji.2022.15249a

Silvi, F., & Maryono, D. (2020, May). The Influence of Project-Based Blended Learning Toward Outcomes Student Learning. In *International Conference on Online and Blended Learning 2019 (ICOBL 2019)* (pp. 63-65). Atlantis Press.

Sulistyowati, E., Hukom, J., & Muhtadi, A. (2023). Meta-Analysis of Flipped Classroom on Students' Mathematics Abilities: Effectiveness and Heterogeneity Analysis. *JTP - Jurnal Teknologi Pendidikan*, *25*(2), 140–159. https://doi.org/10.21009/jtp.v25i2.27433

Sumarmi, S., Bachri, S., Irawan, L., Aliman, M., & Ahmad, W. W. (2021). Project-Based Research Learning (PBRL) Integrated With E-Learning in Projects Completion. *International Journal of Emerging Technologies in Learning (iJET)*, 16(7), 16-31.

Telaumbanua, S. (2022). The Effect of Project Based Blended Learning Towards Negotiation Text Writing Ability Moderated by Learning Motivation. *AL-ISHLAH: Jurnal Pendidikan, 14*(2), 2327-2334. https://doi.org/10.35445/alishlah.v14i2.1159

Zarouk, M., Olivera, E., Peres, P., & Khaldi, M. (2020). The impact of flipped project-based learning on self-regulation in higher education. *International Journal of Emerging Technologies in Learning (iJET)*, *15*(17), 127-147.

Zuliana, E., Dwiningrum, S. I. A., Wijaya, A., & Hukom, J. (2025). The effect of culture-based mathematics learning instruction on mathematical skills: a meta-analytic study. *Journal of Education and Learning (EduLearn)*, *19*(1), 191-201. https://doi.org/10.11591/edulearn.v19i1.21172

.