The effectiveness of the problem based learning (PBL) model on student self-confidence: A meta-analysis study

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Abstract

The Problem-Based Learning (PBL) model encourages students to engage with real-world problems, fostering contextual and meaningful learning experiences that reduce the perception of abstract thinking. This approach is considered beneficial for enhancing students' self-confidence. However, previous studies examining the effectiveness of the PBL model on self-confidence have reported inconsistent findings. To address this gap, the present study conducted a meta-analysis to evaluate the overall impact of the PBL model on student self-confidence in comparison to conventional learning models. The analysis synthesized 20 effect sizes from 17 primary studies published between 2016 and 2022. Using a random effects estimation model, the findings indicate a statistically significant and moderately positive impact of PBL on students' self-confidence. These results offer a more objective understanding of the PBL model's effectiveness and highlight its potential as a pedagogical strategy for fostering confidence in learners. The study provides valuable insights for educators and policymakers in selecting instructional approaches that support student development.

Keywords: Meta-analysis; pedagogical models; problem-based learning; self-confidence; student engagement.

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1. INTRODUCTION

Self-confidence represents a crucial psychological construct that significantly contributes to enhanced academic performance and learning outcomes (Al-Hebaish, 2012; Stankov et al., 2012; Srivastava, 2013; Kukulu et al., 2013; Rezaei, 2012; Fatma, 2015; Hwang et al., 2016; Çiftçi and Yıldız, 2019; Basith et al., 2020). This attribute plays a pivotal role in shaping learners' emotions, cognition, behaviors, and motivational states (Bandura, 1977; Williams and Rhodes, 2016; Voica et al., 2020; Junli et al., 2021; Sonmez Unal et al., 2025). For instance, students exhibiting low levels of self-confidence are often reluctant to engage with complex tasks and are more likely to withdraw prematurely. Conversely, individuals who possess higher degrees of self-confidence demonstrate greater perseverance and exert more consistent effort when faced with academic challenges (Bandura, 1994; Pajares and Miller, 1994; Benabou and Tirole, 2002; Karimi, 2014; Fischer and Sliwka, 2018; Hosein and Harle, 2018). In this context, students' self-perceptions have a direct impact on their academic performance. Empirical evidence corroborates the notion that students who maintain robust self-confidence in their learning capabilities tend to achieve superior academic results (Verma and Kumari, 2016; Egorova, 2016; Honicke and Broadbent, 2016; Miscevic-Kadijevic, 2015; Muhtadi, Kaliky, et al., 2022). Moreover, well-developed self-confidence fosters efficient, assertive, and dynamic cognitive engagement in problem-solving processes (Sihotang et al., 2017). Therefore, the cultivation of self-confidence should be a central objective in instructional practices.

An effective strategy for enhancing students' self-confidence involves the implementation of appropriate instructional models (Smith et al., 2018; Hendriana et al., 2018; Ramadhani, 2018; Karatas and Baki, 2013; Montague et al., 2014; Ataman and Özsoy, 2009; Shahrill et al., 2018; Solihah et al., 2018). The selected pedagogical framework should foster student engagement, provide meaningful learning experiences, cultivate belief in personal competence, promote self-regulation, and expose students to relevant contextual challenges that support the development of self-confidence (Wijnia et al., 2024). Learning models characterized by these attributes are posited to facilitate improvements in students' confidence levels (Hendriana et al., 2018; Su et al., 2022). One such model is problem-based learning (PBL).

Problem-based learning is an instructional approach that introduces learners to authentic, real-world problems at the outset of the learning experience (Schwartz, 2013; Marra et al., 2014; Savery, 2015; Yew and Goh, 2016; Amalia et al., 2017). This method encourages students to identify gaps in their knowledge and to explore the necessary information required to solve the problem at hand (Schwartz, 2013; Jonassen and Hung, 2015). The presentation of contextualized problems serves to enhance student engagement by making learning activities more relevant and meaningful (English and Kitsantas, 2013; Sani, 2014; Zhao et al., 2023). Furthermore, the early exposure to realistic problems increases students' appreciation for the learning content, as it is perceived as more valuable and applicable (Davidson and Major, 2014; Tan, 2021).

In the application of PBL, students collaborate in groups to engage with non-routine problems facilitated through structured worksheets. The teacher assumes the role of facilitator, providing necessary scaffolding to support the learning process (Schwartz, 2013; Davidson and Major, 2014; Marra et al., 2014; Savery, 2015; Yew and Goh, 2016; Amalia et al., 2017; Tan, 2021; Mattanah et al., 2024). The standard sequence of PBL consists of the following stages: (1) orientation to authentic problems, (2) organization of student learning activities, (3) guidance of individual or collaborative exploration, (4) development and presentation of student work, and (5) evaluation and reflection on the problem-solving process. This systematic approach is anticipated to produce measurable improvements in students' self-confidence (Kirschner et al., 2006; Jonassen, 2011; Padmavathy and Mareesh, 2013).

Despite extensive research into the effectiveness of the PBL model for enhancing self-confidence, findings remain inconclusive. Some studies, such as those conducted by Hendriana et al. (2018) and Ramadhani (2018), suggest that PBL is significantly more effective than traditional pedagogical methods in bolstering student self-confidence. In contrast, research by Lesi and Nuraeni (2021) reports opposing outcomes. The presence of such conflicting evidence complicates the decision-making process for educators and stakeholders. Accordingly, it is necessary to synthesize these disparate findings through a comprehensive quantitative review, such as a meta-analysis (Muhtadi, Assagaf, et al., 2022).

Meta-analysis serves as a methodological tool to systematically aggregate findings from multiple studies to draw robust and accurate conclusions (Hunter and Schmidt, 2004; Borenstein et al., 2021). It is regarded as more objective than traditional narrative reviews due to its emphasis on effect size estimation (Cleophas and Zwinderman, 2017; Shelby and Vaske, 2008; Borenstein, 2022). By combining effect sizes from individual studies, the meta-analytic method allows researchers to determine an overall measure of effect (Borenstein, 2022; Hunter and Schmidt, 2004; Retnawati et al., 2018). This approach mitigates the risk of subjective interpretation that often arises when synthesizing research findings on a common topic (Hunter and Schmidt, 2004; Borenstein et al., 2021; Cleophas and Zwinderman, 2017; Shelby and Vaske, 2008; Borenstein, 2022; Retnawati et al., 2018).

1.1. Purpose of study

In recent years, several meta-analytic investigations have assessed the broader efficacy of PBL as a pedagogical model (Kong et al., 2014; Susanti et al., 2020; Juandi and Tamur, 2021; Suparman and Tamur, 2021; Yunita et al., 2020). However, to date, no meta-analysis has been conducted with the specific aim of evaluating the impact of PBL on students' self-confidence. The present study addresses this gap by conducting a meta-analytic review of research published between 2013 and 2022, drawn from both national and international academic journals. This investigation is essential for reconciling the inconsistent outcomes reported in the literature and for offering a more objective foundation upon which educational decisions concerning the use of PBL to enhance self-confidence can be based.

2. METHODS AND MATERIALS

2.1. Research design

This investigation employed a meta-analytic approach to evaluate the effectiveness of problem-based learning on student self-confidence. The methodological procedures encompassed several stages, including the establishment of inclusion criteria, systematic literature collection, rigorous screening of relevant studies, coding of data, and statistical analysis (Hunter and Schmidt, 2004; Borenstein et al., 2021; Retnawati et al., 2018). These steps are illustrated in Figure 1, which presents a visual representation of the procedural framework adopted in this meta-analysis.

Figure 1
Procedure meta-analysis
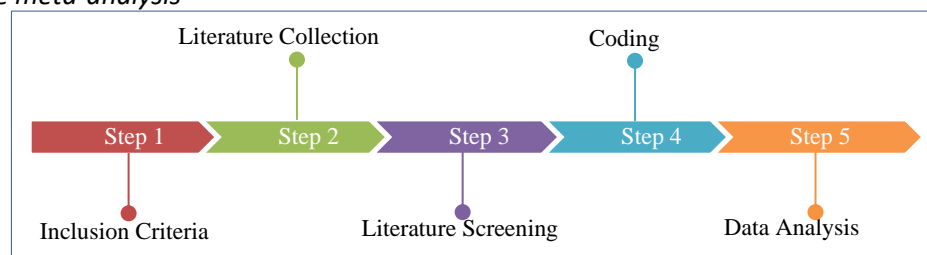
2.2. Procedure

2.2.1. Inclusion criteria

To determine the eligibility of studies for inclusion in the meta-analysis, a set of predefined inclusion criteria was applied. These criteria were as follows: (1) studies must have been published between 2016 and 2022; (2) studies must appear in either nationally or internationally recognized academic journals; (3) studies must be accessible through online platforms; (4) the research design must be experimental or quasi-experimental in nature; (5) each study must include at least one experimental group implementing problem based learning and a corresponding control group; and (6) the studies must report sufficient statistical information, including sample size, mean values, and standard deviations for both experimental and control groups.

2.2.2. Literature collection

The collection of relevant studies that satisfied the inclusion criteria was conducted using various academic databases. These included Google Scholar, the Education Resources Information Center (ERIC), the Directory of Open Access Journals (DOAJ), Springer Publishing, AIP Proceedings, IOP Sciences, and Elsevier. The search was guided by the keywords "Problem based learning" AND "self-confidence."

2.2.3. Literature screening

The screening of literature was conducted to assess the appropriateness of each study for inclusion in the meta-analysis. This process consisted of four sequential stages: identification, screening, determination of eligibility, and final inclusion. Upon completion of the screening process, a total of 17 primary studies were selected. However, some of these studies involved multiple control groups, resulting in the extraction and analysis of 20 distinct effect sizes.

2.2.4. Coding

To minimize subjectivity and potential bias, the coding process was conducted independently by three raters. The coding protocol included the documentation of the following elements: study author, sample size, mean score, and standard deviation. A summary of the coding results is provided in Table 1.

Table 1

Coding results of the primary study

Author	Nc	Xc	SDc	Ne	Xe	SDe
Hendriana et al., (2018)	33	95.3	12.57	33	102.40	12.35
Ramadhani (2018)	33	80.97	2.92	33	90.51	4.54
Rafli & Syahputra(2018)	32	68.18	6.96	31	72.24	5.78
Risnawati et al (2019) a	30	119.00	9.40	31	121.00	10.60
Risnawati et al (2019) b	41	112.00	12.0	41	113.00	11.80
Risnawati et al (2019) c	39	104.00	9.00	39	122.00	10.40
Mukaromah et al., (2018)	33	47.73	6.32	36	55.08	6.25
Dianti et al (2018)	27	74.70	9.50	29	76.17	10.30
Octaria & Sari (2018)	32	70.75	6.75	30	72.20	7.90
Rahman & Fauzia (2020)	30	73.54	9.53	30	80.07	11.07
Syafitri (2017) a	29	80.16	93.06	31	86.04	118.65
Syafitri (2017) b	29	80.16	93.06	30	96.99	112.15
Laksanawati & Rofiroh (2020)	22	40.36	2.26	22	42.00	1.25
Awami et al (2022)	31	55.79	11.03	32	52.19	7.42

Arinda (2020)	15	74.60	6.70	15	71.80	5.20
Andini et al (2024)	30	16.73	2.80	30	19.90	3.32
Dewi (2020)	35	55.47	7.21	33	57.57	5.03
Lesi & Nuraeni (2021)	29	26.28	7.75	31	26.00	13.31
Gega et al (2019)	28	55.32	6.52	28	55.54	6.58
Sukoco & Mahmudi (2016)	25	47.16	8.97	25	57.00	8.66

2.3. Data analysis

Stages of statistical analysis according to Borenstein et al., (2021) which is visualized in Figure 2 below.

Figure 2
Stages of data analysis in this meta-analysis

Step 1 • Calculate the effect size of each study

Step 2 • Testing Heterogeneity

Step 3 • Calculate the combined effect size

Step 4 • Evaluation of Publication Bias
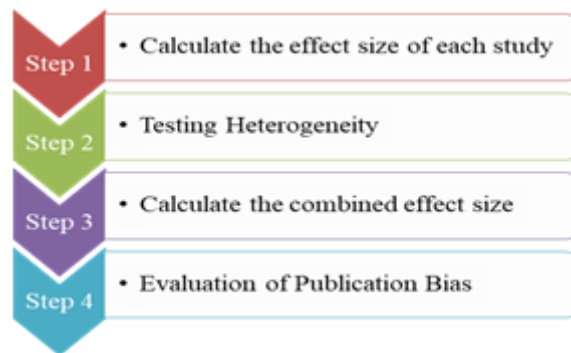
Statistical analysis was performed using the OpenMEE software. The effect size is calculated using the hedges'g equation, while the interpretation of the effect size refers to the classification of Cohen et al. (2002), which is shown in Table 2. The heterogeneity test uses the Q parameter. The heterogeneity test is carried out to select a suitable estimation model to calculate the random-effect size or fixed-effect). Evaluation of publication bias using the File-Safe N (FSN) approach.

Table 2
Categories of effect size (ES) groups using the Cohen et al. (2002) interpretation

No	Classification	Interval
1	Ignored	$0.00 < ES \leq 0.19$
2	Small Effect	$0.19 < ES \leq 0.49$
3	Moderate Effect	$0.49 < ES \leq 0.79$
4	Large Effect	$0.79 < ES \leq 1.29$
5	Very Large Effect	$ES > 1.29$

3. RESULTS

The first stage of this meta-analysis study is to calculate the effect size of each study. Based on calculations using the OpenMEE software, effect sizes and variances are presented in table 3 below.

Table 3

Effect size and variance of each Study

No	Author	Effect Size	Varians	Category
1	Hendriana et al (2018)	0.56	0.06	Medium Effect
2	Ramadhani (2018)	2.47	0.11	Very Large Effect
3	Rafli et al (2018)	0.63	0.07	Medium Effect
4	Risnawati et al (2019) a	0.20	0.07	Small Effect
5	Risnawati et al (2019) b	0.08	0.05	Ignored
6	Risnawati et al (2019) c	1.83	0.07	Very Large Effect
7	Mukaromah et al (2018)	1.16	0.07	Large Effect
8	Dianti et al (2018)	0.15	0.07	Ignored
9	Octaria & Sari (2018)	0.20	0.07	Small Effect
10	Rahman & Fauzia (2020)	0.62	0.07	Medium Effect
11	Syafitri (2017) a	0.05	0.07	Ignored
12	Syafitri (2017) b	0.16	0.07	Ignored
13	Laksanawati & Rofiroh (2020)	0.88	0.10	Large Effect
14	Awami et al (2022)	-0.38	0.07	Ignored
15	Arinda (2020)	-0.45	0.14	Ignored
16	Andini et al (2018)	1.02	0.08	Large Effect
17	Dewi et al (2020)	0.33	0.06	Small Effect
18	Lesi & Nuraeni (2021)	-0.03	0.07	Ignored
19	Gega et al (2019)	0.03	0.07	Ignored
20	Sukoco & Mahmudi (2016)	1.10	0.09	Large Effect

Based on Table 3 above, the lowest effect size is -0.45 and the highest is 2.47. Meanwhile, Figure 3 shows the frequency of effect size levels based on the classification of Cohen et al. (2002).

Figure 3

Comparison of effect size classifications between studies
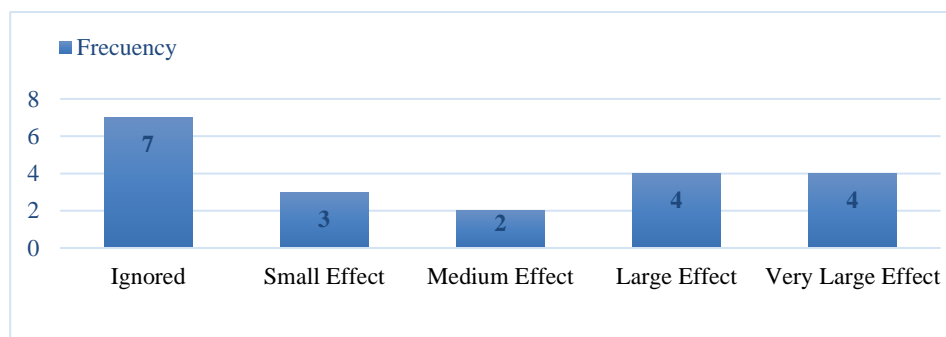

Figure 3 shows the different effect sizes of a number of studies examining the use of the PBL model in increasing students' self-confidence. Furthermore, a heterogeneity test was carried out to select an estimation model for calculating the combined effect size. Table 4 presents a summary of the heterogeneity test using the OpenMEE software.

Table 4

Heterogeneity test summary and combined effect sizes

Estimation Models	k	Effect Size (g)	[95% CI]	P	Heterogeneity	
					Q	I^2
Random-Effect	20	0.52	[0.23, 0.81]	< 0.001	115.54	83.56%
Fixed-Effect	20	0.49	[0.40, 0.60]	< 0.001		

Note. k = the number of studies; CI = Confidence Interval; Df = degree of Freedom

As presented in Table 4, the calculated Q value is 115.54, which exceeds the critical chi-square value for 19 degrees of freedom. This result indicates the presence of significant heterogeneity among the included studies. Consequently, the use of a random effects estimation model is deemed appropriate. Based on the same table, the combined effect size under the random effects model is reported as g = 0.52 with a significance level of p < 0.01. This effect size falls within the medium category, suggesting that the implementation of the problem-based learning model exerts a moderate influence on students' self-confidence. Furthermore, these findings support the assertion that the PBL model is more effective in enhancing self-confidence compared to conventional instructional methods.

To verify the objectivity of the meta-analytic findings, an assessment of potential publication bias was conducted. The results of this evaluation, which utilized the Fail-Safe N (FSN) method, are summarized in Table 5.

Table 5

File-Safe N (FSN)

	k	FSN	Target Significance	Observed Significance
Rosenthal	20	511	0.05	< 0.001

From table 5, the AND value is 511 > 5k+10 = 110. This value indicates that there is no publication bias problem, so this meta-analysis is objective and scientifically justifiable.

4. DISCUSSION

The analysis revealed that the aggregated effect size derived from 20 individual effect sizes, analyzed using a random effects estimation model, was g = 0.52 with a significance level of p < 0.001. This result indicates that the implementation of the problem-based learning model has a significantly greater positive impact on students' self-confidence compared to conventional instructional approaches. The magnitude of the effect size falls within the moderate category, suggesting that PBL produces a meaningful, though not maximal, enhancement in students' self-confidence.

These findings are consistent with earlier meta-analyses that have established the effectiveness of PBL in improving various higher-order thinking skills. For instance, previous studies have demonstrated that PBL fosters critical thinking (Kong et al., 2014; Suparman and Tamur, 2021; Suparman et al., 2021; Trisna Nugraha, 2021), creative thinking (Yunita et al., 2020), and problem-solving abilities (Juandi and Tamur, 2021; Suparman et al., 2021; Musna et al., 2021). Accordingly, the use of the PBL model is strongly recommended as a pedagogical strategy to enhance not only self-confidence but also students' critical thinking, creative capacity, and problem-solving competencies.

The application of the PBL approach enables students to engage with learning content in ways that are contextualized and relevant to their daily lives. This makes the learning process more meaningful, fosters active participation, and avoids the abstract nature often associated with traditional methods. Rezkillah and Haryanto (2020) assert that PBL encourages learners to respond to problems by drawing on real-life experiences, thereby cultivating both habitual problem-solving and self-confidence. Similarly, Lubis et al. (2022) emphasize that PBL promotes learner autonomy, which in turn contributes to the development of self-confidence. Qomariyah (2016) outlines several pedagogical advantages of PBL, including: (1) fostering students' ability to solve problems grounded in real-world contexts; (2) enhancing students' scientific communication skills during discussions and presentations; (3) promoting self-directed knowledge construction; (4) streamlining learning by focusing only on relevant content, thereby reducing the cognitive load associated with rote memorization; (5) encouraging the use of diverse information sources such as books, online platforms, interviews, and observations; (6) enabling students to evaluate their learning progress; and (7) addressing individual learning difficulties through collaborative group work.

Compared to individual primary studies, this meta-analytic investigation offers more robust and objective conclusions by integrating data across multiple studies and calculating an overall effect size. The results of the publication bias assessment indicate that this study is not affected by publication bias, thereby affirming the objectivity and scientific validity of the findings. Moreover, these outcomes are expected to serve as a foundational reference for policymakers, educators, and other stakeholders in efforts to enhance classroom learning quality and promote student development.

5. CONCLUSION

Based on a meta-analysis comprising 20 effect sizes derived from 17 primary studies, which previously presented inconsistent findings regarding the effectiveness of the problem-based learning model on students' self-confidence, the aggregated effect size was calculated as $g = 0.52$ with a significance level of $p < 0.001$. This result indicates that PBL is more effective than conventional instructional methods in enhancing student self-confidence. The effect size falls within the moderate category, suggesting that while PBL has a meaningful impact, its influence is not exceptionally large. Furthermore, the Fail-Safe N (FSN) value exceeds the threshold of $5k + 10$, demonstrating that the findings are robust and not likely to be the result of publication bias. As such, this meta-analytic study provides an objective synthesis of existing research and helps to clarify previously inconsistent results.

Nevertheless, several limitations should be acknowledged. This study included only 20 effect sizes, which may constrain the generalizability of the findings. Future meta-analyses should consider including a larger number of studies to allow for a more comprehensive and nuanced evaluation. Additionally, the current analysis was limited to estimating the overall effect size without examining potential moderating variables that might influence the strength or direction of the effect. Future research is encouraged to extend this work by exploring moderator analyses to identify contextual or methodological factors that may affect the impact of PBL on student self-confidence.

Muhtadi, A., & Hukom, J. (2025). The effectiveness of the problem-based learning (PBL) model on student self-confidence: A meta-analysis study. *International Journal of Learning and Teaching, 17*(1), 1-13. https://doi.org/10.18844/ijlt.v17i1.9704

REFERENCES

Al-Hebaish, S. M. (2012). The correlation between general self-confidence and academic achievement in the oral presentation course. *Theory & Practice in Language Studies (TPLS)*, *2*(1). http://ir.ucc.edu.gh:8080/xmlui/bitstream/handle/123456789/6414/The%20Yutong%20Bus%20Representations%20of%20a%20New.pdf?sequence=1&isAllowed=y#page=62

Amalia, E., Surya, E., & Syahputra, E. (2017). The effectiveness of using problem based learning (PBL) in mathematics problem solving ability for junior high school students. *International Journal of Advance Research and Innovative Ideas in Education*, *3*(2), 3402-3406. https://www.researchgate.net/profile/Edy-Surya-2/publication/318982082_THE_EFFECTIVENESS_OF_USING_PROBLEM-BASED_LEARNING_PBL_IN_MATHEMATICS_PROBLEM_SOLVING_ABILITY_FOR_JUNIOR_HIGH_SCHOOL_STUDENTS/links/598931e60f7e9b6c853a0048/THE-EFFECTIVENESS-OF-USING-PROBLEM-BASED-LEARNING-PBL-IN-MATHEMATICS-PROBLEM-SOLVING-ABILITY-FOR-JUNIOR-HIGH-SCHOOL-STUDENTS.pdf

Andini, R. N., Putra, A. K., An, S., & Mu'tashimbillah, M. (2024). Application of Problem Based Learning Model on the Study of Land and Sea Waters to Improve Students' Critical Thinking Skills. *Future Space: Studies in Geo-Education*, *1*(4), 422-437. http://futurespace-journal.com/index.php/js/article/view/35

Ataman, A., & Özsoy, G. (2009). The effect of metacognitive strategy training on mathematical problem solving achievement. https://earsiv.odu.edu.tr/jspui/handle/11489/1761

Awami, F., Yuhana, Y., & Nindiasari, H. (2022). Meningkatkkan kemampuan literasi numerasi dengan model problem based learning (PBL) ditinjau dari self confidence siswa SMK. *MENDIDIK: Jurnal Kajian Pendidikan dan Pengajaran*, *8*(2), 231-243. http://jm.ejournal.id/index.php/mendidik/article/view/236

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological review*, *84*(2), 191. https://psycnet.apa.org/journals/rev/84/2/191/

Bandura, A. (1994). Self-Efficacy. *Encyclopedia of Human Behavior*, 4, 71–81.

Basith, A., Syahputra, A., & Ichwanto, M. A. (2020). Academic self-efficacy as predictor of academic achievement. *JPI (Jurnal Pendidikan Indonesia)*, *9*(1), 163-170. https://ejournal.undiksha.ac.id/index.php/JPI/article/view/24403

Bénabou, R., & Tirole, J. (2002). Self-confidence and personal motivation. *The quarterly journal of economics*, *117*(3), 871-915. https://academic.oup.com/qje/article-abstract/117/3/871/1933029

Borenstein, M. (2022). Comprehensive meta-analysis software. *Systematic reviews in health research: meta-analysis in context*, 535-548. https://onlinelibrary.wiley.com/doi/abs/10.1002/9781119099369.ch27

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

Çiftçi, S. K., & Yildiz, P. (2019). The Effect of Self-Confidence on Mathematics Achievement: The Metaanalysis of Trends in International Mathematics and Science Study (TIMSS). *International Journal of instruction*, *12*(2), 683-694. https://eric.ed.gov/?id=EJ1210999

Cleophas, J. T., & Zwinderman, H. A. (2017). *Modern meta-analysis: Review and update of methodologies*. Springer International Publishing Switzerland. https://link.springer.com/content/pdf/10.1007/978-3-319-55895-0.pdf

Cohen, L., Manion, L., & Morrison, K. (2002). *Research methods in education*. routledge. https://www.taylorfrancis.com/books/mono/10.4324/9780203224342/research-methods-education-keith-morrison-louis-cohen-lawrence-manion

Davidson, N., & Major, C. H. (2014). Boundary crossings: Cooperative learning, collaborative learning, and problem-based learning. *Journal on excellence in college teaching*, *25*(3&4). https://celt.miamioh.edu/index.php/JECT/article/view/452

Dewi, D. T. (2020). Penerapan problem based learning untuk meningkatkan kemampuan berpikir kritis siswa. *Jurnal Pendidikan Ekonomi Undiksha*, *12*(1), 1-14. https://ejournal.undiksha.ac.id/index.php/JJPE/article/view/25317

Egorova, M. S. (2016). Sex differences in mathematical achievement: Grades, national test, and self-confidence. *Psychology in Russia*, *9*(3), 4. https://cyberleninka.ru/article/n/sex-differences-in-mathematical-achievement-grades-national-test-and-self-confidence

Muhtadi, A., & Hukom, J. (2025). The effectiveness of the problem-based learning (PBL) model on student self-confidence: A meta-analysis study. *International Journal of Learning and Teaching, 17*(1), 1-13. https://doi.org/10.18844/ijlt.v17i1.9704

English, M. C., & Kitsantas, A. (2013). Supporting student self-regulated learning in problem-and project-based learning. *Interdisciplinary journal of problem-based learning*, *7*(2), 6. https://docs.lib.purdue.edu/ijpbl/vol7/iss2/6/

Fatma, F. (2015). A study of self-confidence of adolescents in relation to their gender, locality and academic achievement. *IJAR*, *1*(12), 541-544. https://www.researchgate.net/profile/Zeba-Aqil/publication/383739106_A_study_of_self-confidence_of_adolescents_in_relation_to_their_gender_locality_and_academic_achievement/links/66d83a2e2390e50b2c5231ee/A-study-of-self-confidence-of-adolescents-in-relation-to-their-gender-locality-and-academic-achievement.pdf

Fischer, M., & Sliwka, D. (2018). Confidence in knowledge or confidence in the ability to learn: An experiment on the causal effects of beliefs on motivation. *Games and Economic Behavior*, *111*, 122-142. https://www.sciencedirect.com/science/article/pii/S0899825618300265

Hendriana, H., Johanto, T., & Sumarmo, U. (2018). The Role of Problem-Based Learning to Improve Students' Mathematical Problem-Solving Ability and Self Confidence. *Journal on Mathematics Education*, *9*(2), 291-300. https://eric.ed.gov/?id=EJ1194294

Honicke, T., & Broadbent, J. (2016). The influence of academic self-efficacy on academic performance: A systematic review. *Educational research review*, *17*, 63-84. https://www.sciencedirect.com/science/article/pii/S1747938X15000639

Hosein, A., & Harle, J. (2018). The relationship between students' prior mathematical attainment, knowledge and confidence on their self-assessment accuracy. *Studies in Educational Evaluation*, *56*, 32-41. https://www.sciencedirect.com/science/article/pii/S0191491X16301651

Hunter, J. E., & Schmidt, F. L. (2004). *Methods of meta-analysis: Correcting error and bias in research findings*. Sage. https://books.google.com/books?hl=en&lr=&id=IHSBTHEmYNgC&oi=fnd&pg=PA308&dq=Schmidt,+F.+L.,+%26+Hunter,+J.+E.+(2014).+Methods+of+meta-analysis:+Correcting+error+and+bias+in+research+findings.+Sage+publications.&ots=4a4seY4LRO&sig=RFSdJdT6Wfy8x_jWKEiiZIyeW6Q

Hwang, M. H., Choi, H. C., Lee, A., Culver, J. D., & Hutchison, B. (2016). The relationship between self-efficacy and academic achievement: A 5-year panel analysis. *The Asia-Pacific Education Researcher*, *25*, 89-98. https://link.springer.com/article/10.1007/s40299-015-0236-3

Jonassen, D. (2011). Supporting problem solving in PBL. *Interdisciplinary Journal of Problem-Based Learning*, *5*(2), 95-119. https://scholarworks.iu.edu/journals/index.php/ijpbl/article/view/28258

Jonassen, D. H., & Hung, W. (2015). All problems are not equal: Implications for problem-based learning. *Essential readings in problem-based learning: Exploring and extending the legacy of Howard S. Barrows*, *1741*. https://books.google.com/books?hl=en&lr=&id=fF7yDwAAQBAJ&oi=fnd&pg=PA17&dq=Jonassen,+D.+H.,+%26+Hung,+W.+(2015).+All+problems+are+not+equal:+Implications+for+problem-based+learning.+Essential+readings+in+problem-based+learning,+2(2),+17-42.+https://doi.org/10.7771/1541-5015.1080&ots=5xG8E7vJ4c&sig=tN9uKpT7H-xuLiRJmzZjBgYXbKg

Juandi, D., & Tamur, M. (2021). Review of problem-based learning trends in 2010-2020: A meta-analysis study of the effect of problem-based learning in enhancing mathematical problem-solving skills of Indonesian students. In *Journal of Physics: Conference Series, 1722*(1), 012103. https://iopscience.iop.org/article/10.1088/1742-6596/1722/1/012103/meta

Junli, L. I. U., Tianyuan, L. I. U., & Jinglan, S. U. N. (2021). The Impact of Self-confidence, Self-motivation and Competitive State Anxiety on attentional control in athletes in China. *Journal of Sport Psychology*, *30*(1), 31-48. https://rpd-online.com/manuscript/index.php/rpd/article/view/287

Karatas, I., & Baki, A. (2013). The effect of learning environments based on problem solving on students' achievements of problem solving. *International Electronic Journal of Elementary Education*, *5*(3), 249-268 https://iejee.com/index.php/IEJEE/article/view/25

Karimi, A. (2014). The relationship between self-confidence with achievement based on academic motivation. *Kuwait Chapter of the Arabian Journal of Business and Management Review*, *4*(1), 210.

Muhtadi, A., & Hukom, J. (2025). The effectiveness of the problem-based learning (PBL) model on student self-confidence: A meta-analysis study. *International Journal of Learning and Teaching, 17*(1), 1-13. https://doi.org/10.18844/ijlt.v17i1.9704

https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=0d0c85f628b7cffee329e2891242aace6d610c26

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational psychologist*, *41*(2), 75-86. https://www.tandfonline.com/doi/abs/10.1207/s15326985ep4102_1

Kong, L. N., Qin, B., Zhou, Y. Q., Mou, S. Y., & Gao, H. M. (2014). The effectiveness of problem-based learning on development of nursing students' critical thinking: A systematic review and meta-analysis. *International journal of nursing studies*, *51*(3), 458-469. https://www.sciencedirect.com/science/article/pii/S0020748913001910

Kukulu, K. A. M. I. L. E., Korukcu, O., Ozdemir, Y., Bezci, A., & Calik, C. (2013). Self-confidence, gender and academic achievement of undergraduate nursing students. *Journal of psychiatric and mental health nursing*, *20*(4), 330-335. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2850.2012.01924.x

Laksanawati, E. K., & Rofiroh, R. (2020). Perbandingan Metode Problem Based Learning dengan Metode Konvensional terhadap Kemampuan Pemecahan Masalah dan Self Efficacy Matematis Mahasiswa pada Mata Kuliah Matematika Teknik. *Jurnal Pendidikan Matematika (JUPITEK)*, *3*(2), 81-87. https://ojs3.unpatti.ac.id/index.php/jupitek/article/view/2703

Lesi, A. N., & Nuraeni, R. (2021). Perbedaan Kemampuan Pemecahan Masalah Matematis dan Self-Confidence Siswa antara Model TPS dan PBL. *Plusminus: Jurnal Pendidikan Matematika*, *1*(2), 249-262. https://journal.institutpendidikan.ac.id/index.php/plusminus/article/view/899

Lubis, D. F., Mashudi, M., & Khosmas, K. (2022). Efektivitas model PBL dalam meningkatkan kepercayaan diri dan hasil belajar di SMA Negeri 4 Pontianak. *Jurnal Pendidikan dan Pembelajaran Khatulistiwa (JPPK)*, *8*(10).

Marra, R. M., Jonassen, D. H., Palmer, B., & Luft, S. (2014). Why problem-based learning works: Theoretical foundation. *Journal on Excellence in College Teaching*, *25*(3&4). https://celt.miamioh.edu/index.php/JECT/article/view/461

Mattanah, J., Holt, L., Feinn, R., Bowley, O., Marszalek, K., Albert, E., ... & Katzenberg, C. (2024). Faculty-student rapport, student engagement, and approaches to collegiate learning: exploring a mediational model. *Current Psychology*, *43*(28), 23505-23516. https://link.springer.com/article/10.1007/s12144-024-06096-0

Miscevic-Kadijevic, G. (2015). TIMSS 2011: Relationship between self-confidence and cognitive achievement for Serbia and Slovenia. *Revista electrónica de investigación educativa*, *17*(3), 109-115. https://www.scielo.org.mx/scielo.php?pid=S1607-40412015000300008&script=sci_arttext&tlng=en

Montague, M., Krawec, J., Enders, C., & Dietz, S. (2014). The effects of cognitive strategy instruction on math problem solving of middle-school students of varying ability. *Journal of Educational Psychology*, *106*(2), 469. https://psycnet.apa.org/record/2013-42327-001

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://e-iji.net/ats/index.php/pub/article/view/367

Muhtadi, A., Kaliky, S., 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://e-iji.net/ats/index.php/pub/article/view/285

Mukaromah, D., Sugiyo, S., & Mulawarman, M. (2018). Keterlibatan siswa dalam pembelajaran ditinjau dari efikasi diri dan self regulated learning. *Indonesian Journal of Guidance and Counseling: Theory and Application*, *7*(2), 14-19. https://journal.unnes.ac.id/sju/jbk/article/view/17949

Musna, R. R., Juandi, D., & Jupri, A. (2021). A meta-analysis study of the effect of Problem-Based Learning model on students' mathematical problem solving skills. In *Journal of Physics: Conference Series,* 1882(1), 012090. https://iopscience.iop.org/article/10.1088/1742-6596/1882/1/012090/meta

Octaria, D., & Sari, E. F. P. (2018). Peningkatan self-efficacy mahasiswa melalui Problem Based Learning (PBL) pada mata kuliah program linier. *Jurnal Elemen*, *4*(1), 66-79. https://core.ac.uk/download/pdf/478494059.pdf

Padmavathy, R. D., & Mareesh, K. (2013). Effectiveness of problem based learning in mathematics. *International Multidisciplinary e-Journal*, *2*(1), 45-51.

Muhtadi, A., & Hukom, J. (2025). The effectiveness of the problem-based learning (PBL) model on student self-confidence: A meta-analysis study. *International Journal of Learning and Teaching, 17*(1), 1-13. https://doi.org/10.18844/ijlt.v17i1.9704

Pajares, F., & Miller, M. D. (1994). Role of self-efficacy and self-concept beliefs in mathematical problem solving: A path analysis. *Journal of educational psychology*, *86*(2), 193. https://psycnet.apa.org/record/1994-39235-001

Qomariyah, E. N. (2016). Pengaruh problem based learning terhadap kemampuan berpikir kritis IPS. *Jurnal Pendidikan Dan Pembelajaran*, *23*(2), 132-141.

Rafli, M. F., & Syahputra, E. (2018). The Effect of Problem Based Learning Model on Mathematical Communication Skills and Students' Self-Confidence in Junior High School. In *3rd Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL 2018)* (pp. 412-417). Atlantis Press. https://www.atlantis-press.com/proceedings/aisteel-18/55909134

Ramadhani, R. (2018). The enhancement of mathematical problem solving ability and self-confidence of students through problem based learning. *Jurnal Riset Pendidikan Matematika*, *5*(1), 127-134. https://scholarhub.uny.ac.id/jrpm/vol5/iss1/4/

Retnawati, H., Apino, E., Djidu, H., & Anazifa, R. D. (2018). *Pengantar analisis meta*. Parama Publishing.

Rezaei, A. (2012). Can self-efficacy and self-confidence explain Iranian female students' academic achievement?. *Gender and Education*, *24*(4), 393-409. https://www.tandfonline.com/doi/abs/10.1080/09540253.2011.630314

Rezkillah, I. I., & Haryanto, H. (2020). Pengaruh model pembelajaran problem based learning terintegrasi high order thinking skill terhadap kemampuan berpikir kritis dan sikap percaya diri. *Jurnal Pendidikan Sains Indonesia*, *8*(2), 257-268.

Sani, R. A. (2014). Pembelajaran saintifik untuk implementasi kurikulum 2013. https://digilib.unimed.ac.id/id/eprint/1630/

Savery, J. R. (2015). Overview of problem-based learning: Definitions and distinctions. *Essential readings in problem-based learning: Exploring and extending the legacy of Howard S. Barrows*, *9*(2), 5-15. https://books.google.com/books?hl=en&lr=&id=KhF-BgAAQBAJ&oi=fnd&pg=PA5&dq=Savery,+J.+R.+(2015).+Overview+of+problem-based+learning:+Definitions+and+distinctions.+Interdisciplinary+Journal+of+Problem-Based+Learning,+1(1),+5-22.+https://doi.org/10.7771/1541-5015.1002&ots=aylamXmB-p&sig=2rRgTQHq-QOBu9cdlVqFsmWflXI

Schwartz, P. (2013). *Problem-based learning*. Routledge. https://api.taylorfrancis.com/content/books/mono/download?identifierName=doi&identifierValue=10.4324/9781315042541&type=googlepdf

Shahrill, M., Putri, R. I. I., Zulkardi, & Prahmana, R. C. I. (2018). Processes involved in solving mathematical problems. In *AIP Conference Proceedings, 1952*(1), 020019. https://pubs.aip.org/aip/acp/article-abstract/1952/1/020019/1008296

Shelby, L. B., & Vaske, J. J. (2008). Understanding meta-analysis: A review of the methodological literature. *Leisure Sciences*, *30*(2), 96-110. https://www.tandfonline.com/doi/abs/10.1080/01490400701881366

Sihotang, L., Setiawan, D., & Saragi, D. (2017). The effect of learning strategy and self confidence toward student's learning outcomes in Elementary School. *IOSR Journal of Research & Method in Education (IOSR-JRME)*, *7*(4), 65-72. https://www.academia.edu/download/77865680/7388-0704016572.pdf

Smith, K. J., Grundmann, O., & Li, R. M. (2018). The development and impact of active learning strategies on self-confidence in a newly designed first-year self-care pharmacy course–outcomes and experiences. *Currents in Pharmacy Teaching and Learning*, *10*(4), 499-504 https://www.sciencedirect.com/science/article/pii/S1877129717300217

Solihah, S., Hendriana, H., & Maya, R. (2018). Enhancing the mathematical communication ability and self-confidence of junior high school students using brain-based learning. *Mathematics Education Journal*, *2*(2), 75-82. https://pdfs.semanticscholar.org/a277/5a32ec21aeda1fbfa0ce906ac9ce07028bde.pdf

Sonmez Unal, D., Solovey, E., Arrington, C. M., & Walker, E. (2025). Modeling the phases of rule learning during problem solving with an interactive learning environment. *User Modeling and User-Adapted Interaction*, *35*(1), 7. https://link.springer.com/article/10.1007/s11257-025-09426-4

Srivastava, S. K. (2013). To Study the Effect of Academic Achievement on the Level of Self Confidence. *Journal of Psychosocial Research*, *8*(1).

Muhtadi, A., & Hukom, J. (2025). The effectiveness of the problem-based learning (PBL) model on student self-confidence: A meta-analysis study. *International Journal of Learning and Teaching, 17*(1), 1-13. https://doi.org/10.18844/ijlt.v17i1.9704

https://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=09735410&AN=89906741&h=xhaiGWUU2%2BTkeSmH8P4b3aZ69cRzAepw0H1rfqpJNDObRNQ1XZ3XTJxR%2BQRP7UnZqXnsA1juaIgTX%2FvTmi1Sgw%3D%3D&crl=c

Stankov, L., Lee, J., Luo, W., & Hogan, D. J. (2012). Confidence: A better predictor of academic achievement than self-efficacy, self-concept and anxiety?. *Learning and individual differences*, *22*(6), 747-758. https://www.sciencedirect.com/science/article/pii/S1041608012000799

Su, Y. S., Chang, C. Y., Wang, C. H., & Lai, C. F. (2022). A study of students' learning perceptions and behaviors in remote STEM programming education. *Frontiers in Psychology*, *13*, 962984. https://www.frontiersin.org/articles/10.3389/fpsyg.2022.962984/full

Sukoco, H., & Mahmudi, A. (2016). Pengaruh pendekatan brain-based learning terhadap kemampuan komunikasi matematis dan self-efficacy siswa SMA. *Pythagoras: Jurnal Matematika dan Pendidikan Matematika*, *11*(1), 11-24. https://scholarhub.uny.ac.id/pythagoras/vol11/iss1/2/

Suparman, D. J., & Tamur, M. (2021). Problem-based learning for mathematical critical thinking skills: A meta-analysis. *Journal of Hunan University Natural Sciences*, *48*(2). https://www.jonuns.com/index.php/journal/article/view/521

Suparman, S., Yohannes, Y., & Arifin, N. (2021). Enhancing mathematical problem-solving skills of Indonesian junior high school students through problem-based learning: a systematic review and meta-analysis. *Al-Jabar: Jurnal Pendidikan Matematika*, *12*(1), 1-16. https://ejournal.radenintan.ac.id/index.php/al-jabar/article/view/8036

Susanti, N., Juandi, D., & Tamur, M. (2020). The effect of problem-based learning (PBL) model on mathematical communication skills of junior high school students–A meta-analysis study. *JTAM (Jurnal Teori Dan Aplikasi Matematika)*, *4*(2), 145-154. https://journal.ummat.ac.id/index.php/jtam/article/view/2481/0

Tan, O. S. P. B. L. (2021). Innovation: Using Problems to Power Learning in the 21st Century. *Singapore: Gale Cengage*.

Trisna Nugraha, S. (2021). Does Students' Demography Cause Heterogeneity of Students' Mathematical Critical Thinking Abilities through Problem-Based Learning? A Meta-Analysis. *Journal of Hunan University Natural Sciences*, *48*(8). https://www.jonuns.com/index.php/journal/article/view/687

Verma, R. K., & Kumari, S. (2016). Effect of self-confidence on academic achievement of children at elementary stage. *Indian Journal of Reseach*, *5*(1), 81-83.

Voica, C., Singer, F. M., & Stan, E. (2020). How are motivation and self-efficacy interacting in problem-solving and problem-posing?. *Educational Studies in Mathematics*, *105*(3), 487-517. https://link.springer.com/article/10.1007/s10649-020-10005-0

Wijnia, L., Noordzij, G., Arends, L. R., Rikers, R. M., & Loyens, S. M. (2024). The effects of problem-based, project-based, and case-based learning on students' motivation: A meta-analysis. *Educational Psychology Review*, *36*(1), 29. https://link.springer.com/article/10.1007/s10648-024-09864-3

Williams, D. M., & Rhodes, R. E. (2016). The confounded self-efficacy construct: conceptual analysis and recommendations for future research. *Health psychology review*, *10*(2), 113-128. https://www.tandfonline.com/doi/abs/10.1080/17437199.2014.941998

Yew, E. H., & Goh, K. (2016). Problem-based learning: An overview of its process and impact on learning. *Health professions education*, *2*(2), 75-79. https://www.sciencedirect.com/science/article/pii/S2452301116300062

Yunita, Y., Juandi, D., Tamur, M., Adem, A. M. G., & Pereira, J. (2020). A meta-analysis of the effects of problem-based learning on students' creative thinking in mathematics. *Beta: Jurnal Tadris Matematika*, *13*(2), 104-116. http://jurnalbeta.ac.id/index.php/betaJTM/article/view/380

Zhao, L., Zhao, B., & Li, C. (2023). Alignment analysis of teaching–learning-assessment within the classroom: how teachers implement project-based learning under the curriculum standards. *Disciplinary and Interdisciplinary Science Education Research*, *5*(1), 13. https://link.springer.com/article/10.1186/s43031-023-00078-1