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Integration of Blended Learning and Inquiry based learning on Students' 21st Century Thinking Ability: A Meta-analysis

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ABSTRACT

Objective: This study aims to determine the influence of blended learning and inquiry based learning on students' 21st-century thinking ability in learning in schools. **Method**. This research is a type of meta-analysis research. Data is obtained through the google scholar database; ScienceDirect, Wiley and ERIC. Obtained 26 articles analyzed. The research data was analyzed with the help of the JASP application by presenting the results of the heterogeneity, publication bias, effect size, funnel plot and forest plot test results. **Results:** The application of blended learning and inquiry-based learning models can improve students' 21st-century thinking skills compared to conventional models (g= 1.062; 95% CI 0.45; 0.93; p < 0.001) Analysis of moderator variables shows that the variation of models, education levels, subjects, and skills of the 21st century has a significant influence. These findings explain that blended learning and inqyiry based learning models are effectively used to improve students' 21st-century thinking skills in schools.. **Novelty:** Blended Learning and Inquiry-Based Learning, into a single meta-analysis framework that focuses on developing students' 21st century thinking skills. Not only does it measure the effectiveness of each model, but it also comprehensively evaluates the synergistic impact of the two on students' critical, creative, communication, and collaborative thinking aspects.

INTRODUCTION

In an era of rapid globalization and digital transformation, 21st-century thinking skills including critical thinking, creative thinking, problem-solving, collaboration, and communication are essential for students to adapt and contribute effectively in modern society (Asnur et al., 2024; Ramalingam et al., 2021). According to Trilling and Fadel (2009), these skills are part of the learning and innovation skills needed to face the complex challenges of this century. Critical thinking skills allow individuals to analyze information in depth, while creative thinking drives innovation and new solutions (Feyza & Seyda, 2023). Effective collaboration and communication are also key in an increasingly integrated and team-based work environment. Care et al. (2018) emphasized that the integration of 4C skills in the educational curriculum can improve students' readiness to face the dynamic world of work. They highlight the importance of a holistic assessment of these skills to ensure balanced development. The application of a 21st-century learning model that emphasizes communication, creativity, critical thinking, and collaboration significantly improves student (Nurhidayat et al., 2024; Dewanto et al., 2023).

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The development of digital technology has revolutionized the world of education in the 21st century, driving a transformation from traditional learning approaches to more innovative, student-centered models. The integration of technologies such as artificial intelligence, virtual reality, and adaptive learning platforms allows for the personalization of the learning process according to individual needs and learning styles (Chamidah et al., 2024). This not only increases student engagement, but also strengthens the development of critical thinking, problem-solving, and creativity skills—competencies that are urgently needed in today's digital society (Zainil et al., 2023; Antonio & Prudente, 2023). Additionally, technology encourages more effective collaboration and communication through digital tools such as interactive whiteboards, game-based learning apps, and virtual learning environments. These innovations allow students to work together on projects across geographical and cultural boundaries, broadening their horizons and social skills. However, technology adoption also requires education systems to adapt, including in terms of teacher training, digital infrastructure, and policies that support technology-based learning (Al-Kamzari & Alias, 2025; Ramalingam et al., 2021).

Technological advances should help the effectiveness of student teaching in schools. However, the problem of students' ability to master 21st-century skills is found. The results of previous research show that the thinking skills of 21st-century students in school are still in the low category (Fitria et al., 2024; Kardoyo et al., 2020; Hujjatusnaini et al., 2022); (Rochmawati et al., 2020; Zulyusri et al., 2023; Wardani & Fiorintina, 2023). In fact, from the basic education level to the university, 21st-century thinking skills are still relatively low (Zainil et al., 2023; Yanto & Enjoni, 2022; Arabloo et al., 2022). In the application of the blended learning model in schools, teachers have difficulty in improving students' critical and creative thinking skills (Zayyinah et al., 2022; Asrizal et al., 2023; Fitri & Asrizal, 2023; Wardani & Fiorintina, 2023; Dewanto et al., 2023; Zulkifli et al., 2022); (Putri et al., 2023; Oktarina et al., 2021). Efforts to improve students' 21st-century skills through creating an effective and enjoyable learning atmosphere.

One of the solutions to develop 21st-century thinking skills in students is the application of blended learning and inquiry-based learning models. The blended learning model can improve students' achievements, attitudes and critical thinking skills in learning activities (Syarifudin et al., 2024; Korkmaz & Karakus, 2009; Ümit Yapici & Akbayin, 2012; Badrus & Arifin, 2021). Blended learning models can drive science process skills and student learning outcomes (Tika & Agustiana, 2021). The application of blended learning is very good for improving students' achievement and 21st-century thinking skills as well as student motivation (Rahman et al., 2020; Sunardi et al., 2021; Zulkifli et al., 2022). In addition, blended implementation can improve literacy, student performance and creative thinking skills (Vo et al., 2017; Wilkes et al., 2020; Shamsuddin & Kaur, 2020; López-Pérez et al., 2013). Blended inquiry-based learning can encourage students to be more active and creative in students (Jelita et al., 2022; Agbi & Yuangsoi, 2022; Aidoo et al., 2022). Through this learning, students can develop critical and cooperative thinking skills as well as science literacy (Mutmainah et al., 2019; Ernawati & Sari, 2022; ika & Agustiana, 2021; Gumilar et al., 2019; Ahmadi et al., 2021). The inquiry based learning model can improve the understanding of concepts and learning achievements as well as students' academic abilities in learning activities (Hussain et al., 2023; Bao & Yunus, 2024; Zain & Jumadi, 2018). However, the results of the study also reported that the blended learning and inquiry-based learning

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models of students had difficulty in managing time and managing independent teaching (Mursid et al., 2022; ElSayad, 2023). In addition, the application of the blended learning and inquiry learning model of students is often constrained in the use of technology, creating a less attractive learning atmosphere (Khodabandelou et al., 2020; Sandström et al., 2016).

Various studies have reported the influence of blended learning and inquiry based learning on students' 21st century thinking skills. However, until now there has been no comprehensive research on the influence of these models. Therefore, this study aims to determine the influence of blended learning and inquiry based learning on students' 21st-century thinking ability in learning in schools.

RESEARCH METHOD

This study uses a meta-analysis research method to determine the influence of blended learning and inquiry-based learning on students' 21st-century thinking ability. Meta-analysis is a research method that collects, analyzes, and draws a statistically significant conclusion from previous research (Juandi et al., 2021; Tamur et al., 2020; Oktarina et al., 2021; Wantu et al., 2024). For meta-analysis in this study, following the guidelines To conduct a meta-analysis, this study follows the guidelines *Preferred Reporting Items for Systematic Review and Meta-Analyses* (PRISMA) (Martin et al., 2022; Lazonder & Harmsen, 2016). This meta-analysis stage is a) collecting research data; b) coding; c) calculate effect size; d) determining of moderate effects of research characteristics (Antonio, 2022; Li et al., 2022;Suyatmo et al., 2023). From the results of data selection through PRISMA, 26 relevant studies were obtained.

Search Article and Inclusion Criteria

The data sources in this study came from the databases of google scholar, Scopus, ERIC, Sciencedirect, Wiley and Taylor of Francis. The data search keyword is blended learning; inquiry-based learning and skills for the 21st century. The data screening process uses the PRISMA method to carry out the research insertion and exclusion process. The inclusion criteria in this meta-analysis are as follows:

1. This research was published in the 2015-2025 range.
2. The research is at the elementary, junior high, high school and university education levels.
3. The research comes from national journals with ISSNs, indexed by Scopus or SINTA.
4. This research is related to blended learning and inquiry based learning in school learning.
5. The research does not cover the health sector.
6. The research must report the number of samples; Effect size values and standard errors.

Figure 1. Explain the inclusions and exclusions in this meta-analysis. The number of studies obtained was 756 studies in the google scholar database; 23 studies from Wiley, 14 studies from ScienceDirect, 5 studies from Taylor of Francis and 43 studies from the ERIC database.

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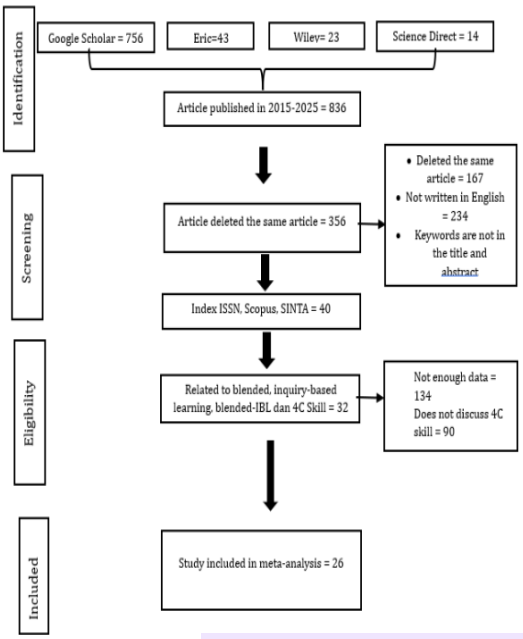

Figure 1. Prisma Flow Diagram

Data Analysis

Data analysis in this study was carried out quantitatively by combining various studies to analyse the effect of size-blended learning and inquiry-based learning on 21st-century thinking skills. The data is analysed using Excel and JASP applications. Furthermore, the JASP application is used to calculate the value of heterogeneity, publication bias, effect size, funnel plot, and forest plot. The classification of the effect size value is g = 0.2 (small effect), g = 0.5 (medium effect), g = 0.8 (large effect), g = 1.2 (very large effect) (Sawilowsky, 2009).

RESULTS AND DISCUSSION

Results

Description of Characteristics of a Meta-Analysis Study

In this study, 27 studies met the inclusion criteria from 836 studies. Articles that meet the inclusion criteria are coded to facilitate data analysis. Furthermore, the article was grouped by author, education level, model, 4C skills, and database, subject and effect size. This meta-analysis consists of 2 models used, namely blended learning and inquiry based learning. The Education Level consists of elementary school to college students. In addition, the skills seen are critical, creative, collaborative and communicative thinking skills. The research data used in this study can be seen in Table 1.

Tabel 1. Characteristics of a Meta-Analysis Study

Journal Code	Education Level	Models	4C Skills	Source	Effect size(g)
PL 1	Elementary	Blended learning	Critical Thinking	ERIC	0.76
PL 2	Secondary School	Inquiry learning	Creative Thinking	Google Scholar	0.92
PL 3	University	Blended learning	Critical Thinking	ScienceDirect	1.34
PL 4	University	Blended learning	Critical Thinking	Wiley	2.90

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Journal Code	Education Level	Models	4C Skills	Source	Effect size(g)
PL 5	University	Blended learning	Critical Thinking	ERIC	1.64
PL 6	Secondary School	Blended learning	Critical Thinking	ERIC	0.43
PL 7	University	Inquiry leaning	Collaborative	ERIC	0.87
PL 8	University	Inquiry learning	Collaborative	Google Scholar	0.31
PL 9	University	Blended learning	Critical and Creative thinking	Wiley	1.71
PL 10	University	Blended learning	Creative Thinking	Wiley	2.37
PL 11	University	Inquiry leaning	Communication	Google Scholar	1.97
PL 12	University	Inquiry learning	Communication	Google Scholar	1.22
PL 13	Elementary	Blended learning	Critical Thinking	ScienceDirect	0.55
PL 14	Elementary	Blended learning	Critical Thinking	ScienceDirect	0.39
PL 15	Elementary	Inquiry leaning	Critical Thinking	ERIC	0.78
PL 16	Elementary	Inquiry learning	Critical Thinking	ERIC	2.34
PL 17	Secondary School	Blended learning	Collaborative	ERIC	1.69
PL 18	Secondary School	Blended learning	Creative Thinking	Google Scholar	0.35
PL 19	Secondary School	Blended learning	Critical Thinking	Google Scholar	0.91
PL 20	Secondary School	Blended learning	Critical Thinking	Google Scholar	1.19
PL 21	University	Blended learning	Critical Thinking	Google Scholar	0.33
PL 22	University	Blended learning	Critical Thinking	Google Scholar	0.65
PL 23	University	Inquiry Learning	Critical and Creative thinking	Google Scholar	1.77
PL 24	University	Inquiry Learning	Creative Thinking	Google Scholar	0.29
PL 25	Elementary	Inquiry Learning	Communication	Wiley	0.37
PL 26	Elementary	Inquiry Learning	Communication	ERIC	1.26

Effect size test results of Blended Inquiry-Based Learning on 21st Century Skills

In this meta-analysis, a random-effect model was used to determine the variation of research data included in the meta-analysis. The random effect model allows for the incorporation of data from different studies by accounting for the overall variation and heterogeneity of the study (Borenstein & Hedges, 2009; Santosa et al., 2020; Tamur et al., 2021). The results of the heterogeneity test used a random effect model from 26 studies that analysed the influence of blended inquiry-based learning on students' 21st-century skills, presented in the form of forest plots. Information related to data codes, error standards, point estimation, effect size (g), and 95% CI can be seen in the forest plot in Figure 2.

Figure 2. The distribution of effect size values in forest plots showed significant results. The range of effect size distribution interval CI 95% is between 0.29 to 2.37. Furthermore, the average value of the effect size is 1,062 included in the category of high effect size. In the heterogeneity test, the data is presented through Q, p and I values. (Juandi et al., 2021; Tamur et al., 2020a). Uji heterogenitas berfungsi untuk mengetahui pengaruh blended inquiry based learning terhadap keterampilan berpikir abad-21 siswa. Temuan ini menunjukan adanya perbedaan peningkatkan pembelajaran dengan model blended inquiry beased learning terhadap kemampuan berpikir abad-21 siswa dibandingkan dengan model konvensional lainnya (g= 1.062; 95% CI 0.45; 0.93; p < 0.001) dapat dilihat pada Tabel 2.

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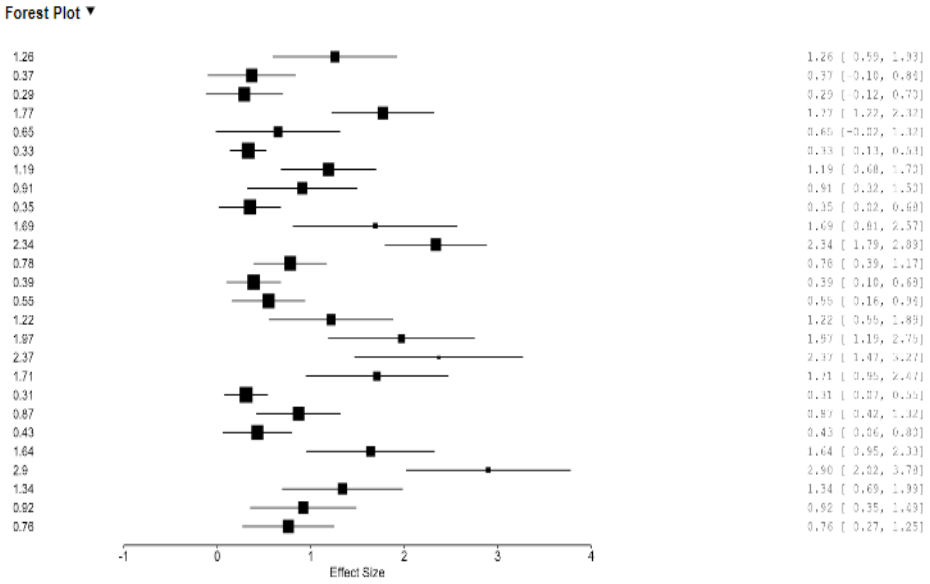

Figure 2. Forest Plot

Tabel 2. Results Meta-Analysis

Variable	Overall	95% CI	
		Lower	Upper
Number of Sample (K)	26		
Heterogeneity of Test	170.081	0.77	1.35
P-Value	< 0.001*		
Standard Score (Z)	7.583	0.318	2.871
Effect size (g)	1.062		
Heterogeneity test (I^2 %)	96.118	94.082	98.071

*p-value < 0.05 significant effect

Results of the Blended Inquiry Based Learning Model Effect on Moderator Variables

The results of the heterogeneity test allow the analysis of the moderator effect of each study. The hypothesis test on the moderator effect functioned to determine the significant influence of p < 0.05. Furthermore, in the analysis of the moderator effect consisting of variables of model variation, level of education, year of publication, and 21st-century skills can be seen in table 3.

Table 3. Moderator Analysis

Moderator	k	Effect Size (g)	Category	Q_b	P-Value
Model Variation				21.017	0.000*
Blended Learning	34	0.92	High Effect		
Inquiry-based learning	48	0.63	Medium effect		
Blended IBL	30	0.31	Small Effect		
Average		0.98			
Level of Education				34.017	
Elementary school	40	0.92	High Effect		

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Moderator	k	Effect Size (g)	Category	Q_b	P-Value
Secondary school	20	1.02	High Effect		
University	60	1.24	High Effect		
Average		1.06			
Subject				11.932	0.003*
Sosial Science	140	1.52	High Effect		
Sains	90	0.93	High Effect		
Average		1.22			
4C				25.081	0.001*
Critical Thinking	46	0.86	High Effect		
Creative	30	1.05	High Effect		
Collaborative	40	0.62	High Effect		
Communication	42	0.73	Medium Effect		

Publication Bias

Publication bias checks in meta-analyses are important to find out whether or not there is bias from each study. Publication bias can arise from various factors that affect (Borenstein & Hedges, 2009; Zulyusri et al., 2023). Publication bias check in this study was through a polt funnel, and Egger's test. The plot funnel functions to determine the symmetry of the collapse of duplicated research results ((Tamur et al., 2021; Oktarina et al., 2021; Ichsan et al., 2023). Egger's test is used to determine whether or not there is a publication bias statistically based on the relationship between the research sample and the reported effects. Therefore, publication bias testing can identify more accurate research results. The results of the publication bias test can be seen in Figure 3. And Table 4.

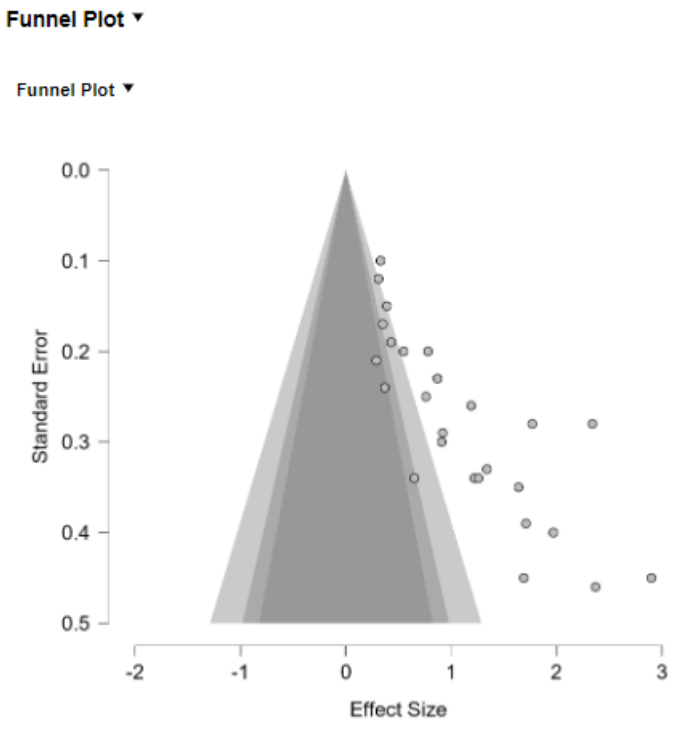

Figure 3. Funnel Plot

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Table 4. Result Egger's Test

Variable	Egger's Test	File Drawer Analysis	Funnel Plot Asymetry
z	0.287		
p	0.082		0.061
Fail Safe N		3.291	
Target Significancy		< 0.001	

Based on Figure 3. The results of the funnel plot analysis are symmetrical. The result of the funnel plot is supported by a p< value of 0.05, then the effect size distribution is symmetrical with the value of p in Egger's Test and p = 0.061. Furthermore, the test Value Rosenthal Fail safe N is 3291 greater compared to the value of 5k+10. So, because the value of 5k+ 10 is smaller than the results of the Rosenthal Fail Safe N test, it can be concluded that there is no publication bias in this study.

Discussion

The results of this study show that blended learning and inquiry based learning have a significant influence on the thinking ability of 21st-century students with an average effect size value of 1,062. blended learning which combines online and face-to-face learning, provides flexibility and access to a wide range of learning resources, and is able to improve student learning performance and attitudes (Cao, 2023); Sukkamart et al., 2025). Inquiry-based learning has also been shown to be effective in developing students' critical thinking skills and high-level thinking skills (Anthony et al., 2022; Antonio & Prudente, 2023). Blended learning facilitates the integration of technology with interactive and reflective classroom activities, while inquiry-based learning emphasizes the process of active exploration, investigation, and problem-solving by students. Both approaches support the development of 4C skills (critical thinking, creativity, collaboration, communication) essential to student success in the 21st century (Fitria et al., 2024; Chernikova et al., 2020; (l-Kamzari & Alias, 2025).

Blended Learning enables a combination of hands-on interaction and the flexibility of digital technology that drives personalization of learning. This approach has been proven to increase students' independence, motivation, and critical thinking skills (Garrison & Vaughan, 2008; Halverson et al., 2017). With digital technology, students can access the material at any time, while face-to-face sessions allow for deepening and discussion. This strategy is in line with the characteristics of today's digital generation who are accustomed to quick access to information and project-based learning approaches and collaborations (Yuliyanti et al., 2023).The integration of the two models has a significant positive impact on students' critical thinking, creativity, collaboration, and communication skills with consistent effect measures across various levels of education and disciplines. These findings confirm that the combination of blended learning and inquiry-based learning creates a dynamic learning environment and supports the development of students' 21st-century skills(Dewanto et al., 2023; Utomo et al., 2023). The importance of implementing integrated learning that combines blended learning and inquiry-based learning in the 21st century education curriculum (Aka et al., 2025). Schools and educators are advised to adopt learning strategies that utilize digital technology while encouraging active student engagement through an inquiry process to prepare students to become critical, creative, and collaborative individuals to face future challenges (Maftuh et al., 2025; Ruswinarsih et al., 2025)

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Blended Learning and Inquiry-Based Learning are separate from learning outcomes, but there are still limited studies that specifically examine the impact of the integration of the two on 21st-century thinking skills. Results from various studies also show varying levels of effectiveness depending on the context of implementation, level of education, and instructional design used (Nurhidayat et al., 2024; Sukontawaree et al., 2022)Therefore, meta-analysis is needed to systematically synthesize empirical findings to obtain a more objective and generalizable picture. Blended Learning and Inquiry-Based Learning in improving students' 21st century thinking skills. Through this approach, it is hoped that the most effective effect size, moderator factors, and implementation patterns can be identified. The results of the research will make a theoretical contribution to the development of 21st-century learning models, as well as provide practical guidance for educators, policy makers, and curriculum designers in designing more adaptive and innovative learning strategies (Ilma et al., 2023).

CONCLUSION

Fundamental Finding : From the results of this study, it can be concluded that the application of blended learning and inquiry based learning models can improve students' 21st-century thinking skills compared to conventional models (g= 1.062; 95% CI 0.45; 0.93; p < 0.001) Analysis of moderator variables shows that variations in models, education levels, and skills of the 21st century have a significant influence. These findings explain that blended learning and inqyiry based learning models are effectively used to improve students' 21st-century thinking skills in schools. This integrative model combines the flexibility of technology with the power of inquiry pedagogy in building students' deep understanding and problem-solving skills. Consistent effectiveness across different levels of education suggests that this model is adaptive to diverse learning contexts. Thus, the application of this integration-based learning model is recommended as a pedagogical strategy that is relevant and responsive to the demands of education in the digital era and future complexity.. **Implication :** The effectiveness of integrating Blended Learning and Inquiry-Based Learning in enhancing students' 21st-century thinking skills provides a solid foundation for educators and policymakers to adopt and develop more interactive, flexible, and student-centered learning models. By combining digital technology and an inquiry approach that encourages exploration and problem-solving, teachers can create a learning environment that is more dynamic and relevant to the needs of the times. In addition, these findings also encourage educational institutions to provide adequate training and resources so that teachers are able to implement both methods effectively.**Limitation :** The limitations of the variety of studies analysed, where most of the available research comes from a specific educational context so that the results may be less generalizable to all levels or areas of education. In addition, differences in study design, duration of interventions, and instruments for measuring 21st-century thinking ability between studies may also affect the consistency of these meta-analysis findings**. Future Research :** Further research is suggested to explore more deeply the influence of the integration of Blended Learning and Inquiry-Based Learning on a variety of more diverse educational contexts, including different levels and cultural backgrounds.

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REFERENCES

Agbi, A., & Yuangsoi, P. (2022). Enhancement of Critical Thinking Skills in Students Using Mobile-Blended Learning With a Collaborative Inquiry-Based Approach. *Humanities, Arts and Social Sciences Studies*, *22*(1), 9–20.

Ahmadi, F., Isdaryanti, B., Rachmadtullah, R., Shofwan, I., & Zulfaturrohmah, F. (2021). The effectiveness of blended learning model integrated with inquiry-based learning framework in understanding pre-service elementary school teachers' social competence. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, 3739–3745. https://doi.org/10.46254/an11.20210677

Aidoo, B., Anthony-Krueger, C., Gyampoh, A. O., Tsyawo, J., & Quansah, F. (2022). A Mixed-Method Approach to Investigate the Effect of Flipped Inquiry-Based Learning on Chemistry Students Learning. *European Journal of Science and Mathematics Education*, *10*(4), 507–518. https://doi.org/10.30935/scimath/12339

Aka, K. A. (2025). Meta-Analysis of Integrated Learning on 21st Century Skills : Is Integrated. *European Journal of Educational Research*, *14*(2), 625–643.

Al-Kamzari, F., & Alias, N. (2025). A systematic literature review of project-based learning in secondary school physics: theoretical foundations, design principles, and implementation strategies. *Humanities and Social Sciences Communications*, *12*(1), 1–18. https://doi.org/10.1057/s41599-025-04579-4

Anthony, B., Kamaludin, A., Romli, A., Raffei, A. F. M., Phon, D. N. A. L. E., Abdullah, A., & Ming, G. L. (2022). Blended Learning Adoption and Implementation in Higher Education: A Theoretical and Systematic Review. In *Technology, Knowledge and Learning* (Vol. 27, Issue 2). Springer Netherlands. https://doi.org/10.1007/s10758-020-09477-z

Antonio, R. P. (2022). Effectiveness of Blended Instructional Approach in Improving Students' Scientific Learning Outcomes: AMeta-Analysis. *Journal of Higher Education Theory and Practice*, *22*(5), 221–239. https://doi.org/10.33423/jhetp.v22i5.5217

Antonio, R. P., & Prudente, M. S. (2023). Effects of Inquiry-Based Approaches on Students' Higher-Order Thinking Skills in Science: A Meta-Analysis. *International Journal of Education in Mathematics, Science and Technology*, *12*(1), 251–281. https://doi.org/10.46328/ijemst.3216

Arabloo, P., Hemmati, F., Rouhi, A., & Khodabandeh, F. (2022). The Effect of Technology-Aided Project-Based EnglishLearning on Critical Thinking and Problem Solving as Indicesof 21st Century Learning. *Journal of Modern Research in English Language Studies*, *9*(1), 125–150.

Asnur, L., Jalinus, N., Faridah, A., Apra, T., Ambiyar, R. D., & Utami, F. (2024). *Video-blogs (Vlogs) -based Project : A Meta Analysis*. *14*(5), 1553–1557.

Asrizal, Usmeldi, & Azriyanti, R. (2023). Meta-Analysis of the Influence of the STEM-Integrated Learning Model on Science Learning on 21st Century Skills. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 339–347. https://doi.org/10.29303/jppipa.v9i8.3094

Badrus, B., & Arifin, Z. (2021). The Effect of The Blended Learning Model on The

IJORER : International Journal of Recent Educational Research
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p-ISSN : 2721-852X ; e-ISSN : 2721-7965
IJORER, Vol. 6, No. 4, July 2025
Page 1324-1339

Improvement of Student Learning Outcomes. *Nazhruna: Jurnal Pendidikan Islam*, *4*(1), 108–116. https://doi.org/10.31538/nzh.v4i1.836

Bao, Y., & Yunus, H. M. (2024). A review on the impact of blended learning, learning styles, and the community of inquiry model on student interest in learning in higher education. *Educational Administration*, *30*(6), 1114–1120.

Borenstein, M., & Hedges, L. V. (2009). *Introduction to Meta-Analysis Introduction*.

Cao, W. (2023). A meta-analysis of effects of blended learning on performance, attitude, achievement, and engagement across different countries. *Frontiers in Psychology*, *14*. https://doi.org/10.3389/fpsyg.2023.1212056

Chamidah, D., Suwono, H., Susilo, H., Sulisetijono, S., Munzil, M., & Zubaidah, S. (2024). Navigating the Global Landscape on Project-Based Learning and 21St-Century Skills Research (2020–2023): a Bibliometric Analysis. *Malaysian Journal of Learning and Instruction*, *21*(2), 187–238. https://doi.org/10.32890/mjli2024.21.2.7

Chernikova, O., Heitzmann, N., Stadler, M., Holzberger, D., Seidel, T., & Fischer, F. (2020). Simulation-Based Learning in Higher Education: A Meta-Analysis. *Review of Educational Research*, *90*(4), 499–541. https://doi.org/10.3102/0034654320933544

Dewanto, D., Wantu, H. M., Dwihapsari, Y., Santosa, T. A., & Agustina, I. (2023). Effectiveness of The Internet of Things (IoT)-Based Jigsaw Learning Model on Students' Creative Thinking Skills: A- Meta-Analysis. *Jurnal Penelitian Pendidikan IPA*, *9*(10), 912–920. https://doi.org/10.29303/jppipa.v9i10.4964

ElSayad, G. (2023). Higher education students' learning perception in the blended learning community of inquiry. *Journal of Computers in Education*, *11*(4), 1061–1088. https://doi.org/10.1007/s40692-023-00290-y

Ernawati, E., & Sari, T. M. (2022). Implementation of free inquiry approach based on blended learning on creative thinking and student collaboration skills. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *8*(3), 216–225. https://doi.org/10.22219/jpbi.v8i3.22254

Feyza, N. E., & Seyda, S. Y. (2023). 21st Century Skills and Learning Environments: ELT Students Perceptions. *Educational Research and Reviews*, *18*(6), 114–128. https://doi.org/10.5897/err2023.4332

Fitri, A. D., & Asrizal. (2023). Development of Physics E-Module Integrated with PBL Model and Ethnoscience to Improve Students' 21st Century Skills. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 10610–10618. https://doi.org/10.29303/jppipa.v9i12.5877

Fitria, D., Asrizal, A., Dhanil, M., & Lufri, L. (2024). Impact of Blended Problem-Based Learning on Students' 21st Century Skills on Science Learning: A Meta-Analysis. *International Journal of Education in Mathematics, Science and Technology*, *12*(4), 1032–1052. https://doi.org/10.46328/ijemst.4080

Gumilar, S., Ismail, A., Budiman, D. M., & Siswanto, S. (2019). Inquiry instructional model infused blended experiment: Helping students enhance critical thinking skills. *Journal of Physics: Conference Series*, *1157*(3). https://doi.org/10.1088/1742-6596/1157/3/032009

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

Hussain, M., Azlan, M., Zainuri, A., Nuryazmin, Zulkifli, M., Rafeizah, Rahman, A., & Anesman. (2023). Effect of an Inquiry-Based Blended Learning Module on

IJORER : International Journal of Recent Educational Research
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p-ISSN : 2721-852X ; e-ISSN : 2721-7965
IJORER, Vol. 6, No. 4, July 2025
Page 1324-1339

Electronics Technology Students' Academic Achievement. *Journal of Technical Education and Training*, *15*(2), 21–32. https://doi.org/10.30880/jtet.2023.15.02.003

Ichsan, I., Suharyat, Y., Santosa, T. A., & Satria, E. (2023). Effectiveness of STEM-Based Learning in Teaching 21 st Century Skills in Generation Z Student in Science Learning: A Meta-Analysis. *Jurnal Penelitian Pendidikan IPA*, *9*(1), 150–166. https://doi.org/10.29303/jppipa.v9i1.2517

Ilma, A. Z., Wilujeng, I., Widowati, A., Nurtanto, M., & Kholifah, N. (2023). A Systematic Literature Review of STEM Education in Indonesia (2016-2021): Contribution to Improving Skills in 21st Century Learning. *Pegem Egitim ve Ogretim Dergisi*, *13*(2), 134–146. https://doi.org/10.47750/pegegog.13.02.17

Jelita, N. T., Odja, A. H., & Setiawan, D. G. E. (2022). Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbantuan Video Dengan Implementasi Blended Learning Terhadap Hasil Belajar. *ORBITA: Jurnal Pendidikan Dan Ilmu Fisika*, *8*(1), 109. https://doi.org/10.31764/orbita.v8i1.8147

Juandi, D., Kusumah, Y. S., Tamur, M., Perbowo, K. S., & Tanu, T. (2021). Heliyon A meta-analysis of Geogebra software decade of assisted mathematics learning : what to learn and where to go ? *Heliyon*, *7*(October 2020), e06953. https://doi.org/10.1016/j.heliyon.2021.e06953

Kardoyo, Nurkhin, A., Muhsin, & Pramusinto, H. (2020). Problem-based learning strategy: Its impact on students' critical and creative thinking skills. *European Journal of Educational Research*, *9*(3), 1141–1150. https://doi.org/10.12973/EU-JER.9.3.1141

Khodabandelou, R., Jalil, H. A., Ali, W. Z. W., & Daud, S. bin M. (2020). Moderation Effect of Gender on Relationship between Community of Inquiry and Perceived Learning in Blended Learning Environments. *Contemporary Educational Technology*, *5*(3), 257–271. https://doi.org/10.30935/cedtech/6128

Korkmaz, O., & Karakus, U. (2009). The impact of blended learning model on student attitudes towards geography course and their critical thinking dispositions and levels. *The Turkish Online Journal of Distance Education*, *8*(4), 51–63.

Lazonder, A. W., & Harmsen, R. (2016). Meta-Analysis of Inquiry-Based Learning: Effects of Guidance. *Review of Educational Research*, *86*(3), 681–718. https://doi.org/10.3102/0034654315627366

Li, B., Yu, Q., & Yang, F. (2022). The Effect of Blended Instruction on Student Performance: A Meta-Analysis of 106 Empirical Studies from China and Abroad. *Best Evidence in Chinese Education*, *10*(2), 1395–1403. https://doi.org/10.15354/bece.22.ar018

López-Pérez, M. V., Pérez-López, M. C., Rodríguez-Ariza, L., & Argente-Linares, E. (2013). The influence of the use of technology on student outcomes in a blended learning context. *Educational Technology Research and Development*, *61*(4), 625–638. https://doi.org/10.1007/s11423-013-9303-8

Maftuh, B., Supriatna, M., & Anakotta, R. (2025). Promoting Cultural Literacy Through a Local Wisdom-Based Learning Model : A Research and Development Study in Elementary Schools. *IJORER : International Journal of Recent Educational Research*, *6*(3), 615–631.

Martin, F., Wu, T., Wan, L., & Xie, K. (2022). A Meta-Analysis on the Community of Inquiry Presences and Learning Outcomes in Online and Blended Learning

IJORER : International Journal of Recent Educational Research
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p-ISSN : 2721-852X ; e-ISSN : 2721-7965
IJORER, Vol. 6, No. 4, July 2025
Page 1324-1339

Environments. *Online Learning Journal*, *26*(1), 325–359. https://doi.org/10.24059/olj.v26i1.2604

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

Mutmainah, Taruh, E., Abbas, N., & Umar, M. K. (2019). The Influence of Blended Learning-Based Guided Inquiry Learning Model and Self-Efficacy on Students' Scientific Literacy. *European Journal of Education Studies*, *6*(6), 137–150. https://doi.org/10.5281/zenodo.3445474

Nurhidayat, E., Mujiyanto, J., Yuliasri, I., & Hartono, R. (2024). Technology integration and teachers' competency in the development of 21st-century learning in EFL classroom. *Journal of Education and Learning*, *18*(2), 342–349. https://doi.org/10.11591/edulearn.v18i2.21069

Oktarina, K., Suhaimi, Santosa, T. A., Razak, A., Irdawati, Ahda, Y., Lufri, & Putri, D. H. (2021). Meta-Analysis: The Effectiveness of Using Blended Learning on Multiple Intelligences and Student Character Education During the Covid-19 Period. *International Journal of Education and Curriculum Application*, *4*(3), 184–192. http://journal.ummat.ac.id/index.php/IJECA/article/view/5505

Putri, M. E., Ahda, Y., Anhar, A., & Putri, D. H. (2023). Effect of Problem-Based Learning Models and Prior Knowledge toward Critical Thinking Skills on Human Digestive and Circulatory System. *Jurnal Penelitian Pendidikan IPA*, *9*(5), 3905–3914. https://doi.org/10.29303/jppipa.v9i5.3697

Rahman, Z., Rijanto, T., Basuki, I., & Sumbawati, M. S. (2020). The Implementation of Blended Learning Model on Motivation and Students' Learning Achievement. *International Journal for Educational and Vocational Studies*, *2*(9), 767–775. https://doi.org/10.29103/ijevs.v2i9.2694

Ramalingam, S., Yunus, M. M., & Hashim, H. (2021). Exploring ESL learners' blended learning experiences and its' effectiveness through web-based technologies. *International Journal of Evaluation and Research in Education*, *10*(4), 1436–1445. https://doi.org/10.11591/IJERE.V10I4.21465

Rochmawati, A., Wiyanto, & Ridlo, S. (2020). Analysis of 21 st century skills of student on implementation project based learning and problem posing models in science learning. *Journal of Primary Education*, *9*(1), 58–67.

Ruswinarsih, S., Widaty, C., Nur, R., Reski, P., Adhitya, M., & Putra, H. (2025). The Role of Mentor Teachers in Non-Academic Guidance : Case Study of Senior High School Teaching Assistance Program. *IJORER : International Journal of Recent Educational Research*, *6*(3), 696–708.

Sandström, N., Eriksson, R., Lonka, K., & Nenonen, S. (2016). Usability and affordances for inquiry-based learning in a blended learning environment. *Facilities*, *34*(7–8), 433–449. https://doi.org/10.1108/F-12-2014-0097

Santosa, T. A., Agustina, N., & Yulianti, S. (2020). Jenis Tumbuhan Liar Dalam Upacara Adat Kenduri Seko Di Kerinci. *Pendekar: Jurnal Pendidikan Berkarakter*, *3*(1), 6–10. http://journal.ummat.ac.id/index.php/pendekar/article/view/2798

Sawilowsky, S. S. (2009). Very large and huge effect sizes. *Journal of Modern Applied Statistical Methods*, *8*(2), 597–599. https://doi.org/10.22237/jmasm/1257035100

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p-ISSN : 2721-852X ; e-ISSN : 2721-7965
IJORER, Vol. 6, No. 4, July 2025
Page 1324-1339

Shamsuddin, N., & Kaur, J. (2020). Students' learning style and its effect on blended learning, does it matter? *International Journal of Evaluation and Research in Education*, *9*(1), 195–202. https://doi.org/10.11591/ijere.v9i1.20422

Sukkamart, A., Chachiyo, W., Chachiyo, M., Pimdee, P., Moto, S., & Tansiri, P. (2025). Enhancing computational thinking skills in Thai middle school students through problem-based blended learning approaches. *Cogent Education*, *12*(1). https://doi.org/10.1080/2331186X.2024.2445951

Sukontawaree, N., Poonputta, A., & Prasitnok, O. (2022). Development of Problem-Solving Abilities in Science by Inquiry-Based Learning With Cooperative Learning for Grade 4 Students. *Journal of Educational Issues*, *8*(2), 771. https://doi.org/10.5296/jei.v8i2.20418

Sunardi, J., Geok, S. K., Komarudin, K., Yuliarto, H., & Meikahani, R. (2021). Effect of blended learning, motivation, study hour on student learning achievement. *Jurnal Keolahragaan*, *9*(2), 168–177. https://doi.org/10.21831/jk.v9i2.40508

Suyatmo, S., Yustitia, V., Santosa, T. A., Fajriana, F., & Oktiawati, U. Y. (2023). Effectiveness of the Inquiry Based Learning Model Based on Mobile Learning on Students' Creative Thinking Skills: A Meta-Analysis. *Jurnal Penelitian Pendidikan IPA*, *9*(9), 712–720. https://doi.org/10.29303/jppipa.v9i9.5184

Syarifudin, A., Sanulita, H., Hajati, E. N., & Lumbantoruan, J. H. (2024). The Impact of the Blended Learning Model on Student Learning Independence during the Learning Process. *Journal of Education Technology*, *8*(1), 106–115. https://doi.org/10.23887/jet.v8i1.69311

Tamur et al. (2020a). The Effectiveness of the Application of Mathematical Software in. *International Journal of Instruction*, *13*(4), 867–884.

Tamur, M., Juandi, D., & Kusumah, Y. S. (2020b). The effectiveness of the application of mathematical software in indonesia; a meta-analysis study. *International Journal of Instruction*, *13*(4), 867–884. https://doi.org/10.29333/iji.2020.13453a

Tamur, M., Subaryo, S., Ramda, A. H., Nurjaman, A., Fedi, S., & Hamu, A. (2021). the Effect of Jigsaw Type of Cooperative Learning on Critical Thinking Ability of Junior High School Students. *Journal of Honai Math*, *4*(2), 173–182. https://doi.org/10.30862/jhm.v4i2.201

Tika, I. N., & Agustiana, I. G. A. T. (2021). The Effect of a Blended Learning Project Based Learning Model on Scientific Attitudes and Science Learning Outcomes. *Jurnal Ilmiah Sekolah Dasar*, *5*(4), 557–566. https://doi.org/10.23887/jisd.v5i4.39869

Ümit Yapici, I., & Akbayin, H. (2012). The effect of blended learning model on high school students' biology achievement and on their attitudes towards the internet. *Turkish Online Journal of Educational Technology*, *11*(2), 228–237.

Utomo, W., Suryono, W., Santosa, T. A., & Agustina, I. (2023). The Effect of STEAM-Based Hybrid Based Learning Model on Students ' Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, *9*(9), 742–750. https://doi.org/10.29303/jppipa.v9i9.5147

Vo, H. M., Zhu, C., & Diep, N. A. (2017). The effect of blended learning on student performance at course-level in higher education: A meta-analysis. *Studies in Educational Evaluation*, *53*, 17–28. https://doi.org/10.1016/j.stueduc.2017.01.002

Wantu, H. M., Muis, A., Zain, A., Hiola, S. F., Agustina, I., Santosa, T. A., Yastanti, U., & Nugraha, A. R. (2024). Effectiveness of Think-Pair-Share and STEM Models on Critical Thinking in Early Childhood Education. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *8*(5), 1320–1330. https://doi.org/10.31004/obsesi.v8i5.6202

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IJORER, Vol. 6, No. 4, July 2025
Page 1324-1339

Wardani, I. S., & Fiorintina, E. (2023). Building Critical Thinking Skills of 21st Century Students through Problem Based Learning Model. *JPI (Jurnal Pendidikan Indonesia)*, *12*(3), 461–470. https://doi.org/10.23887/jpiundiksha.v12i3.58789

Wilkes, S., Kazakoff, E. R., Prescott, J. E., Bundschuh, K., Hook, P. E., Wolf, R., Hurwitz, L. B., & Macaruso, P. (2020). Measuring the impact of a blended learning model on early literacy growth. *Journal of Computer Assisted Learning*, *36*(5), 595–609. https://doi.org/10.1111/jcal.12429

Yanto, F., & Enjoni, A. (2022). The effectiveness of the problem-based learning model to improve the students' 21 st century skills. *Indonesian Research Journal in Education*, *6*(2), 232–242.

Yuliyanti, D., Purwianingsih, W., & Peristiwati, P. (2023). The application of blended learning with rADI model to improve argumentation skills and concept mastery. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *9*(3), 521–530. https://doi.org/10.22219/jpbi.v9i3.25416

Zain, A. R., & Jumadi. (2018). Effectiveness of guided inquiry based on blended learning in physics instruction to improve critical thinking skills of the senior high school student. *Journal of Physics: Conference Series*, *1097*(1). https://doi.org/10.1088/1742-6596/1097/1/012015

Zainil, M., Kenedi, A. K., Rahmatina, Indrawati, T., & Handrianto, C. (2023). The influence of a STEM-based digital classroom learning model and high-order thinking skills on the 21st-century skills of elementary school students in Indonesia. *Journal of Education and E-Learning Research*, *10*(1), 29–35. https://doi.org/10.20448/jeelr.v10i1.4336

Zayyinah, Z., Erman, E., Supardi, Z. A. I., Hariyono, E., & Prahani, B. K. (2022). STEAM-Integrated Project Based Learning Models: Alternative to Improve 21st Century Skills. *Proceedings of the Eighth Southeast Asia Design Research (SEA-DR) & the Second Science, Technology, Education, Arts, Culture, and Humanity (STEACH) International Conference (SEADR-STEACH 2021)*, *627*, 251–258. https://doi.org/10.2991/assehr.k.211229.039

Zulkifli, Z., Satria, E., Supriyadi, A., & Santosa, T. A. (2022). Meta-analysis: The effectiveness of the integrated STEM technology pedagogical content knowledge learning model on the 21st century skills of high school students in the science department. *Psychology, Evaluation, and Technology in Educational Research*, *5*(1), 32–42. https://doi.org/10.33292/petier.v5i1.144

Zulyusri, Z., Santosa, T. A., Festiyed, F., Yerimadesi, Y., Yohandri, Y., Razak, A., & Sofianora, A. (2023). Effectiveness of STEM Learning Based on Design Thinking in Improving Critical Thinking Skills in Science Learning: A Meta-Analysis. *Jurnal Penelitian Pendidikan IPA*, *9*(6), 112–119. https://doi.org/10.29303/jppipa.v9i6.3709

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