Jurnal Pemberdayaan Masyarakat
Volume 5 Issue 1 Year 2026 | Pages 1–10
ykgm.org

E-ISSN 2962-8091
DOI: https://doi.org/10.46843/jpm.v5i1.640

Problem-Based Learning E-Modules to Improve Students' 21st-Century Skills: A Systematic Literature Review

Meirani[1,2]*, Nofriansyah[3], Badeni[1], Osa Juarsa[1], Muhammad Kristiawan[1], Eko Risdianto[1], Yusupov Komaliddin Bakhtiyor Ugli[4]
[1]*Universitas Bengkulu, Indonesia*
[2]*Universitas Muhammadiyah Bengkulu, Indonesia*
[3]*Universitas Pendidikan Indonesia, Indonesia*
[4]*Tashkent State University of Economics, Uzbeskitan*

ABSTRACT

This systematic literature review examines the effectiveness of Problem-Based Learning (PBL) e-modules in developing students' 21st-century skills by synthesizing ten Scopus-indexed empirical studies published between 2015 and 2025. Motivated by the growing demand for student-centered and technology-integrated learning, this review aims to consolidate evidence on how PBL-oriented digital modules support key competencies. Following the PRISMA guidelines, the study employed a transparent selection process and combined thematic synthesis with bibliometric analysis (VOSviewer) to identify research trends, dominant themes, and learning outcomes. The findings indicate that PBL e-modules consistently enhance critical thinking, collaboration, communication, and creativity, with the strongest effects reported in critical thinking and collaborative performance. Student motivation and autonomy emerged as important mediating factors, while variations in instructional design and digital platform quality influenced effectiveness across contexts. These results imply that well-structured PBL design and purposeful digital integration are critical for maximizing the impact of e-modules on 21st-century skills, while also highlighting methodological gaps for future research.

ARTICLE INFORMATION

Keywords:
critical thinking; collaboration; e-modules; problem-based learning (pbl); 21st century skills; systematic literature review

Correspondent Author:
Meirani

Email:
meirani@umb.ac.id

© Yayasan Keluarga Guru Mandiri. This is an open-access article under the CC Attribution 4.0 International License.
Article info: Submitted: 2025-11-02 | Revised: 2025-12-21 | Accepted: 2026-01-11 | Published: 2026-01-15
Recommended citation: Meirani., Nofriansyah., Badeni., Juarsa, O., Kristiawan, M., Risdianto, E., & Ugli, Y. K. B. (2026). Problem-Based Learning E-Modules to Improve Students' 21st-Century Skills: A Systematic Literature Review. *Jurnal Pemberdayaan Masyarakat, 5*(1), 1-10.

INTRODUCTION

Entering the third decade of the 21st century, global education systems are experiencing a fundamental shift in their learning priorities. Educational success is no longer measured solely by the mastery of factual knowledge, but by students' ability to apply knowledge adaptively in complex, real-world contexts. International frameworks such as the World Economic Forum and UNESCO Education 2030 emphasize the importance of 21st-century skills, particularly critical thinking, communication, collaboration, and creativity (the 4Cs), as essential competencies for workforce readiness and active social participation (Kembara et al., 2019; Supena et al., 2021; Nofriansyah et al., 2025; World Economic Forum, 2022) These skills are increasingly viewed as foundational rather than complementary, enabling students to navigate a rapidly changing, technology-driven society. In response to these demands, student-centered instructional approaches have gained prominence, with Problem-Based Learning (PBL) emerging as one of the most widely adopted pedagogical models. PBL engages students in solving authentic problems, encouraging higher-order thinking, collaboration, and reflective learning processes (Anggraeni et al., 2023; Liu & Pásztor, 2022). Numerous empirical studies have demonstrated that PBL positively influences critical thinking, problem-solving abilities,

learning motivation, and collaborative skills across disciplines, making it particularly aligned with the goals of 21st-century education (Surur et al., 2020; Weng et al., 2022).

However, the effectiveness of PBL is closely related to the learning environment and instructional support provided to students. In contemporary education, the integration of digital technology has become increasingly important for enhancing the implementation of PBL. Digital learning environments offer flexibility, interactivity, and access to diverse learning resources, allowing students to engage more deeply with problem-solving tasks and collaborative inquiry (Haleem et al., 2022; Lohr et al., 2024; Nofriansyah et al., 2025). One form of digital learning media that has gained attention is e-modules. E-modules are electronic learning materials that integrate multimedia elements such as videos, simulations, interactive tasks, and formative assessments, enabling students to study independently and flexibly across devices (Logan et al., 2021; Sinaga et al., 2022). When combined with PBL principles, e-modules can function as structured platforms for presenting real-world problem scenarios, guiding inquiry processes, and supporting collaboration both inside and outside the classroom (Ates & Aktamis, 2024; Meng et al., 2023).

This integration of PBL and e-modules is a promising approach for fostering 21st-century skills, particularly in social studies education, where learning is closely connected to real-world social issues. Despite the growing body of research on PBL and digital learning media, existing studies tend to examine these components separately. Many studies focus on the effectiveness of PBL without explicitly considering the role of digital learning media, while others investigate the use of e-modules without grounding their design in PBL principles (Asmayawati et al., 2024; Maksum & Sabrina, 2024). Moreover, prior reviews often address general learning outcomes or Higher-order Thinking Skills (HOTS) rather than providing a focused synthesis on 21st-century skills as an integrated construct.

Additionally, systematic reviews that specifically examine PBL e-modules within the context of social studies education remain limited, particularly those synthesizing evidence from Scopus-indexed empirical studies. Variations in instructional design quality, digital platform implementation, and contextual factors further indicate the need for a comprehensive synthesis to clarify under what conditions PBL e-modules are most effective (Dermawan et al., 2025; Risnawati & Purwaningsih, 2025). This study contributes to the literature by systematically synthesizing Scopus-indexed empirical studies published between 2015 and 2025 that examine the effectiveness of PBL e-modules in developing students' 21st-century skills. Unlike previous studies that address PBL or digital learning media in isolation, this review integrates thematic synthesis and bibliometric analysis to map research trends, dominant skill outcomes, and instructional design characteristics. By focusing on the intersection of PBL, e-modules, and 21st-century skills in social studies education, this study offers a novel and comprehensive perspective, identifies methodological gaps, and outlines directions for future research.

METHOD

This study employed a Systematic Literature Review (SLR) approach combined with bibliometric analysis to synthesize empirical evidence on the effectiveness of Problem-Based Learning (PBL) e-modules in developing students' 21st-century skills. This methodological combination was selected to provide both an in-depth thematic understanding of learning outcomes and a quantitative mapping of research trends within the selected literature. The review was conducted in accordance with the Preferred Articleing Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency, replicability, and methodological rigor. Although the literature search was conducted using the global Scopus database, this review specifically focused on studies affiliated with Indonesian institutions in order to reflect the national educational context and policy environment.

The Systematic Literature Review (SLR) was conducted through several structured stages to ensure transparency and methodological rigor. First, the research question was formulated to guide the review: *How effective are Problem-Based Learning (PBL) e-modules in enhancing students' 21st-century skills?* Second, a comprehensive literature search was performed using the Scopus database, employing the following search string: (TITLE-ABS-KEY("e-module" OR "digital module" OR "online module" OR "interactive module") AND TITLE-ABS-KEY("problem-based learning" OR "PBL") AND TITLE-ABS-KEY("social studies" OR "civics" OR "geography" OR "history" OR "social science") AND TITLE-ABS-KEY("21st century skills" OR "critical thinking" OR "collaboration" OR "communication" OR "creativity" OR "problem solving" OR "HOTS")) AND (PUBYEAR > 2014 AND PUBYEAR < 2026) AND DOCTYPE(ar) AND (SUBJAREA(soci) OR SUBJAREA(arts)). This strategy was designed to obtain peer-reviewed English-language journal articles relevant to PBL e-modules within the context of social education in Indonesia. The search was limited to peer-reviewed journal articles published in English between 2015 and 2025 to ensure inclusion of recent, high-quality empirical studies relevant to social studies education.

Third, inclusion and exclusion criteria were applied. The inclusion criteria consisted of: (a) journal articles (document type *ar*), (b) studies aligned with the field of social education, (c) English-language publications, (d) articles affiliated with Indonesian institutions, and (e) publication years ranging from 2015 to 2025. Exclusion criteria included: (a) studies unrelated to social studies education, (b) articles lacking the keywords "e-module" or "Problem-Based Learning," and (c) studies not available in open-access form.The study selection process followed the PRISMA flow, consisting of identification, screening, eligibility assessment, and inclusion. During the identification stage, 842 data were retrieved from the Scopus database. After removing 798 duplicate records and 44 records automatically excluded, 28 unique articles remained for screening. At the screening stage, title and abstract screening excluded nine articles that were not relevant to the research focus, leaving 19 for full-text assessment. During the eligibility assessment, nine articles were excluded for lacking empirical data or insufficient methodological clarity. Consequently, ten studies met all inclusion criteria and were included in the final systematic review. The entire selection process is summarized in the PRISMA flow diagram (Figure 1).

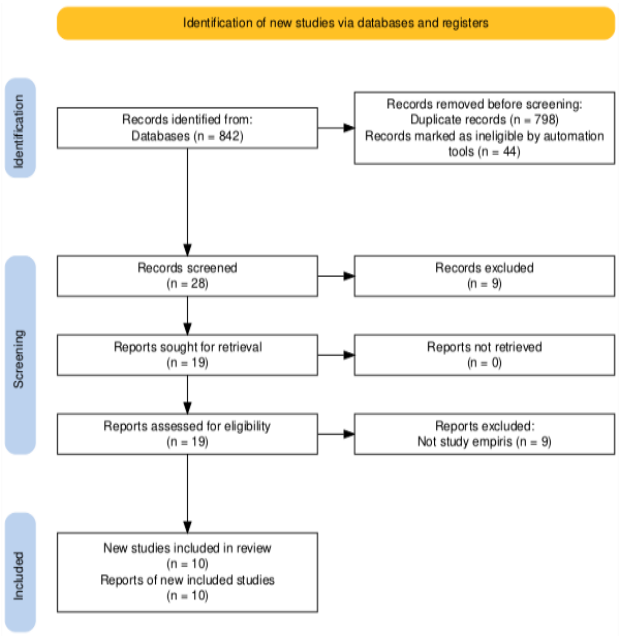

Figure 1. PRISMA diagram

The selection process was systematic and transparent, as summarized in the PRISMA Flowchart (Figure 1). The identification and selection process literature in this study was done using the PRISMA flow. The initial database returns 842 records. At the initial stage, 798 records were deleted due to duplication, and the system automatically removed 44 records that did not meet the fulfillment criteria. Thus, 28 unique records can be continued to screening. Next, during the title and abstract screening, nine records were found to be irrelevant and removed. This left 19 articles that are considered worthy of being obtained in full. All 19 articles were accessible, so we proceeded to the eligibility assessment stage.

During the eligibility assessment of the 19 articles reviewed comprehensively, nine were excluded because they did not meet the criteria for empirical studies. Thus, only 10 articles meet the criteria and conditions systematically entered in the observation. Of the 842 identified data, only 10 studies met the inclusion criteria and were included in this study. It shows that the selection process is strict, required to ensure only relevant and fulfilling literature that meets the criteria and methodologies that can serve as a basis for a systematic analysis. To ensure methodological quality, all eligible studies underwent a methodological screening. The assessment focused on the clarity of the research design, the appropriateness of the data collection methods, and the explicit article of learning outcomes related to 21st-century skills. Studies that lacked empirical evidence, clear methodological descriptions, or measurable learning outcomes were excluded at the eligibility stage. This screening ensured that only methodologically sound studies were included in the synthesis.

RESULTS AND DISCUSSION

To enrich SLR results, a bibliometrics analysis was performed using mapping: 1) Trends in publications per year; 2) Most productive authors and affiliates; 3) Keywords; 4) Journals with the most publications. The visualization results of co-occurrence keywords from VOSviewer are presented in Figure 2. Figure 2 shows a visualization map of the relationships between keywords (keyword co-occurrence) extracted from the articles analyzed in this systematic review. The color of each word reflects the average publication year of the articles containing that keyword (from dark blue = 2022 to yellow = 2023), while the lines indicate the relationship between keywords based on the frequency of co - occurrence. Apart from systematic research, this study employs bibliometric keyword analysis to map the conceptual relatedness of frequently used terms in the literature.

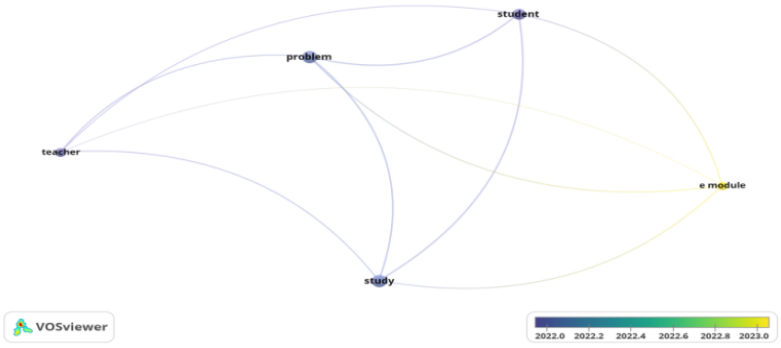

Figure 2. Keywords visualization

Visualization done using the device software VOSviewer, which produces a keyword co-occurrence map of 11 articles selected in the range 2022 to 2023. Visualization results show that the term “e-module” becomes the center of the map network, marked in yellow, reflecting the latest average publication year (2023). The keywords show a strong connection with terms such as

“student”, “teacher”, “problem”, and “study”, indicating that the latest research emphasizes the use of digital e-modules in context-based learning that involves teachers and students actively. Keywords “student” and “teacher” come on stage as key concepts that connect various concepts. Both represent subject matter in the learning process based on technology, particularly in the context of the Independent Curriculum. In addition, the keyword "problem," which is closely related to "Problem-Based Learning (PBL)," indicates that the PBL approach is one of the key methods in the development and implementation of e-modules.

The word "study" as a connector between the nodes also shows that research on this topic tends to take an exploratory, applied approach to the effectiveness of digital learning media based on the problem. From the analysis, it can be concluded that in the period of two years. Lastly, there is a strong trend in the literature for developing e-modules based on PBL to increase the skills of 21st-century students through active teacher roles and student-centered learning processes. Before explaining the results analysis studies in detail, below is a summary of the nine articles selected through the systematic review process. The summary covers the article title, year of publication, research methods used, research focus, and the main findings from each study. Table 1 provides a comprehensive description of the characteristics and contributions of each study to understanding and applying the Problem-Based Learning (PBL) approach.

Table 1. Summary of Studies in SLR on Problem-Based Learning

Author	Key Findings
(Surur et al., 2020)	PBL is more effective than direct instruction; cognitive style also plays a role
(Century et al., 2020)	PBL improves student learning outcomes and participation in CS & ELA
(Rohlfsen et al., 2020)	PBL is less effective than Live Patient Encounters in clinical training
(Aristin et al., 2023)	PBL effectively improves learning outcomes and interest in learning geography.
(Rahayu & Rosti, 2023)	PBL with e-modules had a significant effect on HOTS (p=0.000). Learning interest did not have a significant effect on HOTS.
(Wijayanto et al., 2023)	All three models improve skills, but PBL proved most effective in improving communication and collaboration.
(Sedayu et al., 2024)	PBL+OER is effective; self-efficacy is influential; the interaction is not significant.
(Rusli et al., 2024)	PBL e-modules are needed for chemistry topics that students find difficult to understand.
(Pitorini et al., 2025)	All aspects of critical thinking skills showed improvement during the learning process. Students were able to provide more in-depth and structured answers.
(Setiadi et al., 2025)	The experimental group's critical thinking scores significantly improved (p<0.001). The e-module was assessed as extremely viable and practical by professionals and students.

Methodological research was used in 10 studies, with the quasi-experimental approach dominating (6 studies). In comparison, two studies use a qualitative approach through interviews and case studies, one study uses a method survey comparison, and one other study uses R&D. The focus study in articles covers the implementation of PBL in various disciplines, including social science, computer science, education, medicine, geography, chemistry, and compares with discovery learning. The main findings of this study generally support the effectiveness of PBL as a learning approach. PBL

has been proven to increase student learning, creativity, participation, and interest in studying. Studies also highlight the importance of adding support factors, such as cognitive style, self-efficacy, and the use of learning media-based technologies such as Open Educational Resources (OER) and PBL e-modules. Figure 3 shows the trend in the number of study publications on Problem-Based Learning (PBL) from 2015 to 2025. There is an increase in publications in 2024 after a decline in 2023.

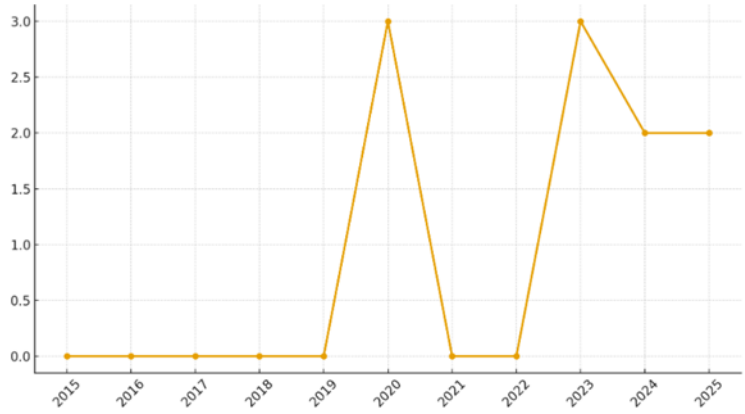

Figure 3. Trend Publication

Based on the chart trend publication regarding Problem-Based Learning (PBL) in the 2015–2025 period, it can be seen that the dynamics are sufficient and interesting. In the period 2015 to 2019, no relevant publications interpreting the study related to PBL have yet attracted the attention of the leading academics, or are not yet documented in an extensive publication database. Point: beginning emergence publication recorded in 2020, with three articles, likely triggered by the need for innovative learning during the COVID-19 pandemic. These conditions push researchers and practitioners to explore the PBL approach as an alternative learning model that is more interactive, contextual, and appropriate for distance and hybrid learning (Dolmans et al., 2016). Furthermore, the trend publication experience improved significantly in 2023 with the third-highest number of articles, indicating an acceleration of PBL research.

This surge shows that, post-pandemic, PBL is increasingly getting attention worldwide, especially in its integration with digital technologies such as e-modules, application-based learning, and online platforms. This is in line with orientation education in the 21st century, which emphasizes the importance of mastery of skills such as critical thinking, collaboration, creativity, and communication (Griffin et al., 2012). In 2024 and 2025, the relative PBL publication amount was stable, with 2 per article. This stability reflects the fact that PBL is not just a trend for a moment, but has been a theme of established, sustainable research. Research in this period generally focused on the development of device-based PBL, its integration with other approaches such as Socratic Dialogue, and its implementation across various fields of knowledge, including geography, chemistry, and science. Thus, the pattern publication describes a shift in existence toward a more learner-centered education. PBL is proven capable of addressing contemporary challenges in education by providing contextualized experiences, developing higher-level thinking skills, and pushing the use of technology in education in a more intensive way (Ge et al., 2025; Sedayu et al., 2024).

Based on the PRISMA-guided selection process, ten Scopus-indexed empirical studies published between 2015 and 2025 were included in this systematic review. The selected studies covered various educational levels and disciplines within social studies and related fields, with research designs predominantly employing quasi-experimental methods, complemented by qualitative case studies and research-and-development approaches. The results indicate that the majority of reviewed studies

reported improvements in students' 21st-century skills, particularly critical thinking and collaboration, following the implementation of PBL e-modules. Several studies also reported positive outcomes in communication skills, creativity, and student motivation, although these outcomes were less consistently measured across studies. Quantitative findings frequently showed statistically significant gains in higher-order thinking skills, while qualitative evidence highlighted increased student engagement, participation, and autonomy during learning activities.

In terms of instructional design, the reviewed studies commonly integrated real-world problem scenarios, structured inquiry phases, and interactive digital features within e-modules. These design characteristics were associated with more explicit learning guidance and more active student involvement. However, variations were observed in the quality of e-module design, technological sophistication, and implementation context, which corresponded to differences in reported learning outcomes. From a bibliometric perspective, keyword co-occurrence analysis revealed that terms such as *"e-module," "student," "teacher,"* and *"problem-based learning"* formed the central nodes of the research network. The visualization also indicated an increasing research focus on digitally supported PBL approaches in recent years, particularly after 2020. Publication trends showed a gradual rise in studies addressing PBL digital learning interventions, reflecting growing scholarly interest in integrating pedagogy and technology to support 21st-century skill development. The findings synthesized in this review indicate that integrating Problem-Based Learning (PBL) into e-modules supports the development of students' 21st-century skills, particularly critical thinking and collaboration. Rather than suggesting uniform effectiveness across contexts, the reviewed studies highlight that learning gains are closely associated with how PBL is designed and implemented within digital learning environments. This supports the view that PBL functions most effectively as a structured pedagogical process rather than as a standalone instructional label.

Several studies emphasize that PBL e-modules facilitate deeper learning by engaging students with real-world social problems and encouraging analytical reasoning, reflection, and collaborative problem-solving. In social studies education, this contextual orientation is particularly relevant, as students are required to interpret social phenomena, evaluate multiple perspectives, and construct reasoned solutions. The digital format of e-modules further enhances this process by providing flexible access to learning materials, interactive features, and opportunities for self-paced inquiry, thereby fostering student autonomy and engagement.

These findings are consistent with prior meta-analyses examining the impact of PBL on higher-order skills. Meta-analytic evidence has demonstrated that PBL has a moderate to strong effect on students' critical thinking and collaborative abilities across educational levels (Anggraeni et al., 2023; Liu & Pásztor, 2022). Similarly, Maksum and Sabrina (2024) stated that PBL interventions make significant contributions to the development of 21st-century skills. However, the present review extends these findings by underscoring the role of digital e-modules as instructional scaffolds, which help structure problem-solving processes, clarify learning expectations, and support consistent implementation of PBL, particularly in social studies contexts.

The bibliometric patterns identified in this review further reinforce this interpretation. The increasing co-occurrence of keywords related to e-modules, students, teachers, and problem-based learning suggests a growing scholarly focus on digitally mediated, student-centered learning environments. This trend reflects a broader shift in educational research toward integrating pedagogical approaches with digital technologies to address the complex skill demands of contemporary education. Notably, the reviewed studies also reveal that the impact of PBL e-modules is context-dependent. Studies reporting weaker outcomes often point to challenges such as limited technological infrastructure, insufficient instructional guidance, or low student readiness for independent inquiry. This finding aligns with previous research emphasizing that PBL requires

adequate scaffolding and facilitation to function effectively (Edelson et al., 1999; Lazonder & Harmsen, 2016). In this regard, e-modules may either enhance or constrain learning outcomes depending on the extent to which their design aligns with students' needs and instructional goals.

Rather than repeatedly asserting the general effectiveness of PBL, this discussion highlights the conditions under which PBL e-modules are most likely to support 21st-century skill development. Evidence from the reviewed studies suggests that learning outcomes are strengthened when digital modules incorporate authentic problem scenarios, structured inquiry phases, opportunities for collaboration, and reflective activities. These elements enable students to engage meaningfully with content while developing cognitive, social, and metacognitive skills. From a practical perspective, these findings suggest that educators and instructional designers should focus not only on adopting PBL e-modules but also on ensuring that digital content is pedagogically coherent, contextually relevant, and supported by appropriate facilitation. For future research, the limited number of empirical studies and the predominance of quasi-experimental designs indicate a need for more longitudinal, mixed-methods investigations to better understand how PBL e-modules influence the sustained development of 21st-century skills across diverse student populations.

CONCLUSION

This systematic literature review demonstrates that PBL e-modules have the potential to support the development of students' 21st-century skills, particularly critical thinking and collaboration, when implemented within well-designed digital learning environments that integrate authentic problem contexts, structured inquiry processes, and interactive features to promote collaboration and reflection in social studies education. However, several limitations should be considered when interpreting these findings, including the relatively limited number of included empirical studies (n = 10), the specific focus on social studies contexts, which may restrict generalizability to other subject areas, and the predominance of quasi-experimental designs in the primary studies, with limited use of longitudinal or mixed-method approaches. From a practical perspective, these findings imply that educators and instructional designers should prioritize pedagogical coherence by ensuring clear problem structures, appropriate scaffolding, and alignment between digital features and targeted 21st-century skills. The mere adoption of PBL or digital modules without careful instructional design is unlikely to yield optimal outcomes. Future research is therefore encouraged to expand the empirical base through more studies, broader disciplinary contexts, and more rigorous research designs to strengthen the evidence base and provide deeper insights into the long-term impact of PBL e-modules on 21st-century skill development across diverse educational settings.

DECLARATION OF GENERATIVE AI

The authors declare that no generative AI or AI-assisted technologies were used in the writing process of this manuscript.

CONFLICTING INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

FUNDING INFORMATION STATEMENT

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

Anggraeni, D. M., Prahani, B. K., Suprapto, N., Shofiyah, N., & Jatmiko, B. (2023). Systematic Review of Problem Based Learning Research in Fostering Critical Thinking Skills. *Thinking Skills and Creativity*, *49*.

Aristin, N. F., Hastuti, K. P., Arisanty, D., Adyatma, S., & Donna, C. (2023). Effectiveness of Problem-Based Learning Models to Improve Learning Outcomes of Geography in the New Normal Learning Era.. *Journal of Education and Learning*, *17*(4), 623–632.

Asmayawati, A., Yufiarti, Y., & Yetti, E. (2024). Pedagogical Innovation and Curricular Adaptation in Enhancing Digital Literacy: A Local Wisdom Approach for Sustainable Development in Indonesia Context. *Journal of Open Innovation: Technology, Market, and Complexity*, *10*(1).

Ates, C. B., & Aktamis, H. (2024). Investigating the Effects of Creative Educational Modules Blended with Cognitive Research Trust (CoRT) Techniques and Problem Based Learning (PBL) on Students' Scientific Creativity Skills and Perceptions in Science Education. *Thinking Skills and Creativity*, *51*, 101471.

Century, J., Ferris, K. A., & Zuo, H. (2020). Finding Time for Computer Science in the Elementary School Day: A Quasi-Experimental Study of a Transdisciplinary Problem-Based Learning Approach. *International Journal of STEM Education*, *7*(1).

Dermawan, D. D., Wuryandani, W., Herwin, H., Eliza, F., Nurzaman, I., Giwangsa, S. F., ... & Jannah, M. (2025). Improving Critical Thinking Ability in Elementary Schools with Interactive E-Modules. *Online Journal of Communication and Media Technologies*, *15*(2), e202513.

Dolmans, D. H. J. M., Loyens, S. M. M., Marcq, H., & Gijbels, D. (2016). Deep and Surface Learning in Problem-Based Learning: A Review of the Literature. *Advances in Health Sciences Education*, *21*(5).

Edelson, D. C., Gordin, D. N., & Pea, R. D. (1999). Addressing the Challenges of Inquiry-Based Learning Through Technology and Curriculum Design. *Journal of the Learning Sciences*, *8*(3–4), 391–450.

Ge, W. L., Zhu, X. Y., Lin, J. B., Jiang, J. J., Li, T., Lu, Y. F., Mi, Y. F., & Tung, T. H. (2025). Critical Thinking and Clinical Skills by Problem-Based Learning Educational Methods: An Umbrella Systematic Review. *BMC Medical Education*, *25*(1), 455.

Griffin, P., McGaw, B., & Care, E. (2012). Assessment and Teaching of 21st Century Skills. In *Assessment and Teaching of 21st Century Skills*. Springer.

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the Role of Digital Technologies in Education: A Review. *Sustainable Operations and Computers*, *3*, 275–285.

Kembara, M. D., Rozak, R. W. A., & Hadian, V. A. (2019). Research-Based Lectures to Improve Students' 4C (Communication, Collaboration, Critical Thinking, and Creativity) Skills.. In *Proceedings of the 1st International Seminar on Social Sciences and Humanities (ISSEH 2018)*. Atlantis Press.

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

Liu, Y., & Pásztor, A. (2022). Effects of Problem-Based Learning Instructional Intervention on Critical Thinking in Higher Education: A Meta-Analysis. *Thinking Skills and Creativity*, *45*.

Logan, R. M., Johnson, C. E., & Worsham, J. W. (2021). Development of an E-Learning Module to Facilitate Student Learning and Outcomes. *Teaching and Learning in Nursing*, *16*(2), 139–142.

Lohr, A., Sailer, M., Stadler, M., & Fischer, F. (2024). Digital Learning in Schools: Which Skills Do Teachers Need, and Who Should Bring Their Own Devices? *Teaching and Teacher Education*, *152*.

Maksum, H., & Sabrina, E. (2024). The Effect of the Problem-Based Learning Model on 21st Century Student Skills: A Meta-Analysis. *The Indonesian Journal of Computer Science*, *13*(2).

Meng, N., Dong, Y., Roehrs, D., & Luan, L. (2023). Tackle Implementation Challenges in Project-Based Learning: A Survey Study of PBL E-Learning Platforms. *Educational technology research and development*, *71*(3), 1179-1207.

Nofriansyah, N., Ahman, E., Supriatna, E., Rahayu, S., & Riyadi, S. (2025). Improvement of Student Learning Outcomes Through the Team Games Tournament (TGT) Cooperative Learning Model.. *Research and Development Journal of Education*, *11*(1), 630.

Nofriansyah, N., Sutarni, N., Hufad, A., Vhalery, R., Rahayu, S., Meilia, M., Meirani, M., & Amri, A. (2025). Digital Transformation of Economics Education: Development of the Ekonara Application Based on Local Culture. Journal of Engineering Science and Technology Special Issue On, 20(4), 174–181.

Pitorini, D. E., Suciati, S., & Harlita, H. (2025). Using an E-Module Based on Problem-Based Learning Combined With Socratic Dialogue to Develop Students' Critical Thinking Skills: A Qualitative Study. *Journal of Educators Online*, *22*(1).

Rahayu, A., & Rosti, R. (2023). Interactive Digital Teaching Module Based on Differentiated Instruction and Its Impact on Students' Problem-Solving Skills. *Jurnal Penelitian Pendidikan IPA*, *9*(Special Issue), 1128–1136.

Risnawati, R., & Purwaningsih, D. (2025). Effectiveness of E-Modules Based Learning on Project Based Learning in Chemistry Learning: A Meta-Analysis. *Jurnal Penelitian Pendidikan IPA*, *11*(5), 92–99.

Rohlfsen, C. J., Sayles, H., Moore, G. F., Mikuls, T. R., O'Dell, J. R., McBrien, S., ... & Cannella, A. C. (2020). Innovation in Early Medical Education, No Bells or Whistles Required. *BMC Medical Education*, *20*(1), 39.

Rusli, N. S., Ibrahim, N. H., Hanri, C., & Surif, J. (2024). E-Module Problem-Based Learning on Chemical Equilibria to Improve Students' Higher-Order Thinking Skills: An Analysis. *International Journal of Evaluation and Research in Education*, *13*(1), 8822.

Sedayu, A., Herpratiwi, H., Yulianti, D., & Distrik, I. W. (2024). Impact of OER-Assisted Problem-Based Learning on Creative Thinking and Self-Efficacy in Physics Education. *Qubahan Academic Journal*, *4*(3), 748–762.

Setiadi, M. I., Yulianti, D., Rohman, F., & Firdaus, R. (2025). Problem-Based E-Module for Enhancing Fifth-Grade Critical Thinking in Integrated Science and Social Studies. *Sekolah Dasar: Kajian Teori dan Praktik Pendidikan*, *34*(1), 129–144.

Sinaga, P., Setiawan, W., & Liana, M. (2022). The Impact of Electronic Interactive Teaching Materials (EITMs) in E-Learning on Junior High School Students' Critical Thinking Skills. *Thinking Skills and Creativity*, *46*.

Supena, I., Darmuki, A., & Hariyadi, A. (2021). The Influence of 4C (Constructive, Critical, Creativity, Collaborative) Learning Model on Students' Learning Outcomes. *International Journal of Instruction*, *14*(3), 873–892.

Surur, M., Degeng, I. N. S., Setyosari, P., & Kuswandi, D. (2020). The Effect of Problem-Based Learning Strategies and Cognitive Styles on Junior High School Students' Problem-Solving Abilities. *International Journal of Instruction*, *13*(4), 35–48.

Susanti, L., Hirza, B., & Atikah, D. (2022). Peningkatan Hasil Belajar Matematika Melalui Penerapan Model Problem Based Learning Siswa Kelas VIII SMP Negeri 4 Pendopo Barat. *Jurnal Penelitian Tindakan*, *1*(1), 1–12.

Weng, X., Cui, Z., Ng, O. L., Jong, M. S. Y., & Chiu, T. K. F. (2022). Characterizing Students' 4C Skills Development During Problem-Based Digital Making. *Journal of Science Education and Technology*, *31*(3), 372–385.

Wijayanto, B., Utomo, D. H., Handoyo, B., & Aliman, M. (2023). Problem-Based Learning Using E-Module: Does It Effect on Student's High Order Thinking and Learning Interest in Studying Geography? *Journal of Technology and Science Education*, *13*(3), 613–631.

World Economic Forum. (2022). *The future of jobs report 2025*. World Economic Forum. https://reports.weforum.org/docs/WEF_Future_of_Jobs_Report_2025.pdf

Yuliani, L., Hufad, A., Komar, O., Sukmana, C., Hasanah, V. R., Darusman, Y., Karwati, L., Hamdan, A., & Setiawan, B. (2025). Bibliometric Analysis of Project-Based Learning in Early Childhood Education: Trends in Empathy for Disability and Bicultural Practices. *Cogent Education*, *12*(1).