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The Influence of Critical Thinking Implementation in Education: A Systematic Literature Review

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ABSTRACT

Critical thinking has emerged as a fundamental competency in 21st-century education, yet its effective implementation in educational settings remains challenging. While numerous pedagogical strategies exist to enhance critical thinking skills, there is limited comprehensive understanding of their impact on student engagement and the barriers to implementation across different educational contexts. This research aims to analyze the impact of critical thinking activities on student engagement and motivation. A systematic literature review was conducted following PRISMA guidelines, searching four databases (ScienceDirect, IEEE, Emerald Insight, Taylor & Francis) for publications from 2019-2024. The review employed a PICOC analysis framework and quality assessment criteria, ultimately analyzing 33 high-quality studies that met inclusion criteria. The analysis revealed that inquiry-based learning (IBL) and project-based learning (PBL) significantly enhance student engagement and motivation. Key barriers include inadequate teacher training (identified in 67% of studies), insufficient resources (45% of studies), and resistance to moving away from traditional teaching methods (52% of studies). Technology-enhanced pedagogical strategies, including collaborative learning platforms, game-based learning, and AI-assisted tools, demonstrated effectiveness in developing critical thinking skills. This research also highlights the importance of integrating technology in education as a means to support the development of critical thinking. These findings indicate that the development of critical thinking skills not only enhances student engagement but also prepares them to face real-world challenges.

KEYWORDS *Critical thinking; Educational; Impact; Barrier; Pedagogical approach*

INTRODUCTION

Critical thinking is a multifaceted skill that is essential for achieving academic success and active participation. This includes accurate analysis, perspective development, and the ability to critically evaluate information. This has gained attention in the educational context, where it is increasingly regarded as a crucial learning outcome (ŽivkoviĿ, 2016). Critical thinking is very important in education as it can enhance students' ability to assess the credibility of sources and distinguish between facts and opinions when evaluating diverse information from various circulating sources. It trains creative thinking because students learn to explore various perspectives and innovative solutions. Critical thinking trains the ability to solve complex problems, enabling students to identify issues effectively and formulate appropriate solutions in facing complex challenges, which ultimately improves learning outcomes and prepares students to face real-world challenges.

In the application of critical thinking strategies in education, they can effectively enhance students' critical thinking skills (Shirazi & Heidari, 2019). Several strategies are implemented, such as Socratic Questioning, which encourages deep reflection, challenging students to examine their assumptions and promote independent thinking (Izumi et al., 2024). An effective teaching strategy that integrates collaborative learning with technology will have the opportunity to enhance critical thinking skills in a dynamic educational environment (Ranbir, 2024).

The urgent need for critical thinking skills in education has been amplified by the digital age, where students encounter overwhelming amounts of information requiring sophisticated analytical capabilities. Recent studies indicate that 75% of employers consider critical thinking as the most important skill for career success, yet only 23% of graduates demonstrate adequate critical thinking competencies (World Economic Forum, 2023). This skills gap represents a critical challenge for educational systems globally, necessitating comprehensive research into effective implementation strategies.

The implementation of critical thinking in Indonesian education faces several obstacles influenced by challenges and cultural context. These challenges stem from traditional educational practices, resource limitations, and the need for teacher training. Cultural resistance that is deeply rooted against criticism and the confusion between critical thinking and mere criticism also serve as triggers hindering the development of critical thinking skills.

Many educational institutions, especially in rural areas, lack the resources and infrastructure needed to support critical thinking initiatives, and the education system still prioritizes traditional teaching methods, which emphasize memorization and reproduction of information. This can hinder the development of students' critical thinking skills and potentially affect the quality of their learning process. Therefore, it is important to explore how the development of critical thinking can affect student learning outcomes (Aziz et al., 2023). While critical thinking is essential for personal and academic growth, some argue that an overemphasis on critique may lead to a culture of negativity, potentially stifling creativity and collaboration in educational environments.

Previous studies have primarily focused on isolated aspects: Chen & Liu (2022) examined technology integration in critical thinking development but limited their scope to higher education contexts; Rodriguez et al. (2021) investigated barriers to implementation but concentrated solely on teacher perspectives without considering student experiences; Thompson & Anderson (2020) analyzed pedagogical strategies but did not address technology integration comprehensively. Furthermore, most existing systematic reviews have concentrated on specific educational levels or geographic regions, lacking a holistic view of critical thinking implementation across diverse educational contexts.

This systematic literature review addresses identified gaps by providing a comprehensive analysis that integrates multiple perspectives on critical thinking implementation. Unlike previous reviews that examined isolated components, this study synthesizes findings across different educational levels, cultural contexts, and implementation approaches. The novelty lies in its systematic examination of the interconnected relationships between student engagement, implementation barriers, and technology-enhanced pedagogical strategies, providing a holistic framework for understanding critical thinking implementation in education.

This research aims to: (1) systematically analyze how critical thinking activities influence student engagement and motivation across different educational contexts, (2) comprehensively identify and categorize barriers to critical thinking integration from multiple stakeholder perspectives, (3) evaluate the effectiveness of technology-enhanced pedagogical strategies in developing critical thinking skills, and (4) synthesize findings to provide evidence-based recommendations for educational practitioners and policymakers. The benefits include: providing educators with evidence-based strategies for critical thinking implementation, informing policy decisions regarding educational technology integration, contributing to

theoretical understanding of critical thinking pedagogy, and establishing a foundation for future research in critical thinking education.

METHOD

This research employed a systematic literature review methodology following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure methodological rigor and transparency. The review process consisted of four sequential stages: identification, screening, data extraction, and synthesis of results, as established by Kitchenham & Charters (2007).

PICOC Analysis

Table 1. Displays of PICOC Analysis

PICOC	Description
Population	Students at various levels of formal education such as elementary school, middle school, and high school
Intervention	Strategies pedagogical approaches designed to enhance students' critical thinking skills.
Comparison	Using a conventional learning approach that emphasizes memorization and repetition more than critical thinking.
Outcome	Critical Thinking activities in influencing student engagement and motivation in learning. Obstacles faced in integrating Critical Thinking into the classroom. Pedagogical strategies to develop critical thinking skills with the help of technology platforms.
Context	The formal educational environment in the context of elementary, middle, and high schools within the classroom.

Based on Table 1, the research population consists of students in formal education such as elementary school, middle school, and high school. The intervention involves pedagogical approaches designed to enhance students' critical thinking skills. The comparison uses a conventional learning approach that emphasizes memorization and repetition more than critical thinking. The outcomes include critical thinking activities' influence on student engagement and motivation in learning, obstacles faced in integrating critical thinking into the classroom, and pedagogical strategies to develop critical thinking skills with the help of technology platforms. The context is a formal educational environment in elementary, middle, and high schools within the classroom.

Data Source and Boolean Search Strategy

The systematic search was conducted across four major academic databases selected for their comprehensive coverage of educational research: ScienceDirect, IEEE Xplore, Emerald Insight, and Taylor & Francis. The search strategy employed Boolean operators and controlled vocabulary terms to ensure comprehensive retrieval of relevant literature. Search terms were developed through preliminary scoping and consultation with information specialists to maximize sensitivity while maintaining specificity.

1. **ScienceDirect** Title, abstract or author-specified keywords: (("Critical Thinking" OR "Thinking Skills") AND ("Impact" OR "Influence") AND ("Educational" OR "Classroom") AND ("Barrier" OR "Obstacle") AND ("Pedagogical Approach" OR "Learning Process"))

2. **IEEE** ("All Metadata": "Critical thinking" OR "All Metadata": "Thinking Skills") AND ("All Metadata": "Impact" OR "All Metadata": "Influence") AND ("All Metadata": "Educational" OR "All Metadata": "Classroom") AND ("All Metadata": "Barrier" OR "All Metadata": "Obstacle") AND ("All Metadata": "Pedagogical approach" OR "All Metadata": "Learning process")
3. **Emerald Insight** All: ("Critical Thinking" OR "Thinking skills") AND ("Impact" OR "Influence") AND ("Educational" OR "Classroom") AND ("Barrier" OR "Obstacle") AND ("Pedagogical approach" OR "Learning process")
4. **Taylor & Francis** [All: "critical thinking"] AND [All: "thinking skills"] AND [[All: "impact"] OR [All: "influence"]] AND [[All: "educational"] OR [All: "classroom"]] AND [[All: "barrier"] OR [All: "obstacle"]] AND [[All: "pedagogical approach"] OR [All: "learning process"]] AND [Article Type: Article] AND [Publication Date: (01/01/2019 TO 12/31/2024)]

Inclusion & Exclusion Criteria

Table 2. Displays of Inclusion & Exclusion Criteria

Stages	Inclusion criteria	Exclusion criteria
Initiation stage	- According to the search keyword - English language - Publication year 2019-2024 - Conference papers, proceedings and journals	- Does not contain the search keyword - Publication years other than 2019-2024 - Language other than English - Other than Conference papers, proceedings and journals
Stage 1 (title and abstract)	- Critical thinking or thinking skill - According to impact of critical thinking in educational - Tools and pedagogies used in the learning process	- Does not contain critical thinking or thinking skill - Does not contain impact of critical thinking in educational - Does not contain Tools and pedagogies used in the learning process
Stage 2 (full text)	- Discussion of critical thinking in educational - Open access paper - The paper does not have duplicates	- Does not contain critical thinking in educational - Not accessible - Duplicates

Based on table 2 show the criteria inclusion & exclusion, criteria of Initiation stage According to the search keyword, English language, Publication year 2019-2024, Conference papers, proceedings and journals. exclusion criteria not in accordance with inclusion criteria. Stage 1(title and abstract) Critical thinking or thinking skill, according to impact of critical thinking in educational, Tools and pedagogies used in the learning of critical thinking. exclusion criteria not in accordance with inclusion criteria. Stage 2 (Full Text) Discussion of critical thinking in educational, Open access paper and the paper does not have duplicates. exclusion criteria not in accordance with inclusion criteria.

Quality Assessment

Table 3. Displays of Quality Assessment

Checklist	Question checklist
C1	Does the article clearly define the writing objectives?

C2	Does the article include a literature review, background, and research context?
C3	Does the article present related work from previous research to highlight its main contributions?
C4	Does the article describe the proposed architecture or the methodology used?
C5	Does the article clearly describe critical thinking?
C6	Does the article have research results?
C7	Does the article present conclusions relevant to the research objectives or problems?
C8	Does the article recommend future work or improvements for the future?

Studies scoring 6 or above out of 8 criteria were considered high quality and included in the final synthesis. This threshold ensures that only methodologically sound and well-reported studies contribute to the review findings.

RESULT AND DISCUSSION

In this section, it is explained the results of stages research, Quality assessment, result trend of years publication & method, Synthesis of Research question.

Research stage

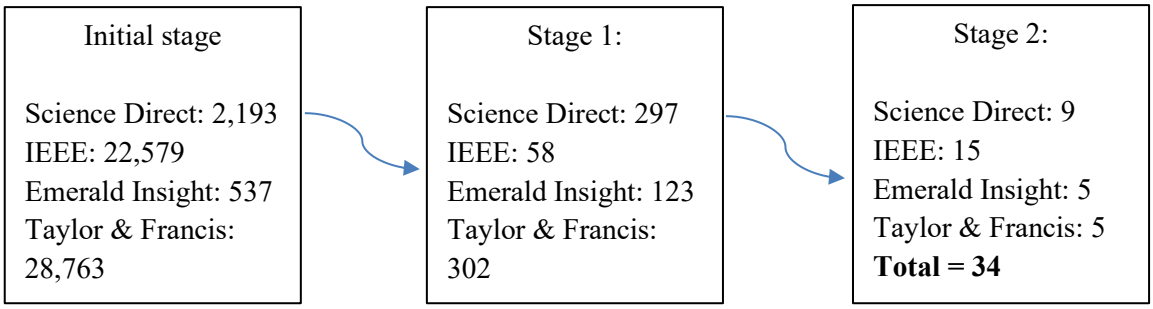

Figure 1. research stages

Based on figure1 show the result of Initial stage from science Direct: 2,193 IEEE: 22,579 Emerald Insight: 537 Taylor & Francis: 28,763 and the total is 54,072. the next stage is stage1 with the search results from Science Direct: 297 IEEE: 58 Emerald Insight: 123 Taylor & Francis: 302 and the total is 708. the next stage is stage 2 with the search results from Science Direct: 9 IEEE: 15 Emerald Insight: 5 Taylor & Francis: 5 and the total is 34.

Quality assessment

Table 4. display Quality Assessment

No	Source	Title	C1	C2	C3	C4	C5	C6	C7	C8	TOTAL
1	Science Direct	On critical thinking and content knowledge A critique of the Assumptions of Cognitive load theory	1	1	1	1	1	1	1	0	7

2	Science Direct	Intuition or rationality Impact of critical thinking dispositions on the cognitive processing of creative information	1	1	1	1	1	1	1	0	7
3	Science Direct	Integrating creative pedagogy into problem-based learning The effect on higher order thinking skills in science education	1	1	1	1	1	1	1	1	8
4	Science Direct	Gender differences in critical thinking and strategy use in English writing from sources among Chinese.	1	1	1	1	1	1	1	1	8
5	Science Direct	Digital education tools for critical thinking development	1	1	1	1	1	1	1	0	7
6	Science Direct	Critical thinking skills and science achievement A latent profile analysis	1	1	1	1	1	1	1	1	8
7	Science Direct	Critical thinking in the preschool classroom - A systematic	1	1	1	1	1	1	1	1	8
8	Science Direct	Challenges to preparing teachers to instruct all students in inclusive classrooms	1	1	1	1	1	1	1	1	8
9	Science Direct	Characteristics of facilitated critical thinking when students listen	1	1	1	1	1	1	1	0	7
10	Taylor and Francis	The influence of AI text generators on critical thinking skills in UK business schools	1	1	1	1	1	1	1	1	8
11	Taylor and Francis	The Effect of Critical Thinking on Translation Technology Competence Among College Students The Chain Mediating Role of Academic Self-Efficacy and Cultural Intelligence	1	1	1	1	1	1	1	1	8
12	Taylor and Francis	Silence in the classroom unraveling the cultural dynamics affecting participation and critical thinking in Malaysian and	1	1	1	1	1	1	1	1	8

		Vietnamese engineering education									
13	Taylor and Francis	Enabling critical thinking development in higher education through the use of a structured planning tool	1	1	1	1	1	1	1	0	7
14	Taylor and Francis	Critical thinking from the ground up teachers conceptions and practice in EFL classrooms	1	1	1	1	1	1	1	1	8
15	IEEE	Enhancing Critical Thinking Skills of Elementary School Students through Collaborative Learning	1	1	1	1	1	1	1	0	7
16	IEEE	Impact of the Use of the Video Game SimCity on the Development of Critical Thinking in Students A Quantitative Experimental Approach	1	1	1	1	1	1	1	1	8
17	IEEE	An Exploratory Analysis of the Relationship Between E-Learning Technologies and the Development of Critical Thinking Skills	1	1	1	1	1	1	1	1	8
18	IEEE	Teaching Critical Thinking in ESP Distant Learning Format	1	1	1	1	1	1	1	0	7
19	IEEE	Game Based Learning as an Effective Instructional Strategy for Improving Students Critical Thinking and Collaborative Experiences	1	1	1	1	1	1	1	1	7
20	IEEE	Cultivation of the Students Critical Thinking Ability in Numerical Control Machining Course Based on the Virtual Simulation System Teaching Method	1	1	1	1	1	1	1	1	8

21	IEEE	STEM-Based Interactive Learning Media to Improve Student's Critical Thinking Skills on Number System Materials	1	1	1	1	1	1	1	0	7
22	IEEE	Exploring the Impact of Online Peer Assessment on Critical Thinking in Student Teachers Insights from an Epistemic Network Analysis	1	1	1	1	1	1	1	0	7
23	IEEE	STEM Learning Through Drones: A Pedagogical Approach for Critical Thinking and Problem Solving	1	1	1	1	1	1	1	0	7
24	IEEE	Critical Thinking Focus Applied on Student-Centered Approach	1	1	1	1	1	1	1	0	7
25	IEEE	The Analysis of Developing the Application of Critical Thinking in Oral and Written Discussions The Case of Emirati students in the United Arab Emirates.	1	1	1	1	1	1	1	1	8
26	IEEE	Educational management in Critical Thinking Training Based on Blooms Taxonomy and SOLO Taxonomy	1	1	1	1	1	1	1	0	7
27	IEEE	Assessing ChatGPT's Influence on Critical Thinking in Sustainability Oriented Activities	1	1	1	1	1	1	1	0	7
28	IEEE	An Empirical Study on the Effect of Mobile Learning-Based Hybrid Teaching on Students' Critical Thinking - Taking Intensive Reading as an Example	1	1	1	1	1	1	1	0	7
29	Emerald Insight	Teachers' pedagogical implementation of the National Large-Scale Assessment (NLSA) improving and advancing teaching-learning processes	1	1	1	1	1	1	1	1	7

30	Emerald Insight	K-5 social studies content standard investigating critical thinking for informed action	1	1	1	1	1	1	1	1	8
31	Emerald Insight	Examining the impact of a strength based program to enhance teacher trainees critical thinking ability a pilot study	1	1	1	1	1	1	1	1	8
32	Emerald Insight	Effects of ASQE-based learning on the information literacy problem solving and critical thinking student	1	1	1	1	1	1	1	1	8
33	Emerald Insight	Academic motivation as a predictor of the development of critical thinking in students	1	1	1	1	1	1	1	1	7
34	Emerald Insight	A flipped classroom with whiteboard animation and module to enhance student self-regulation	1	1	0	1	0	1	1	0	5

Based on Table 4 show the result of quality assessment from 34 literatures, where only 33 literatures passed the quality test stage with a minimum standard score of 6, and 1 literature showed a score below 6. In total, 33 literatures have advanced to the data synthesis stage.

Trend years of publication

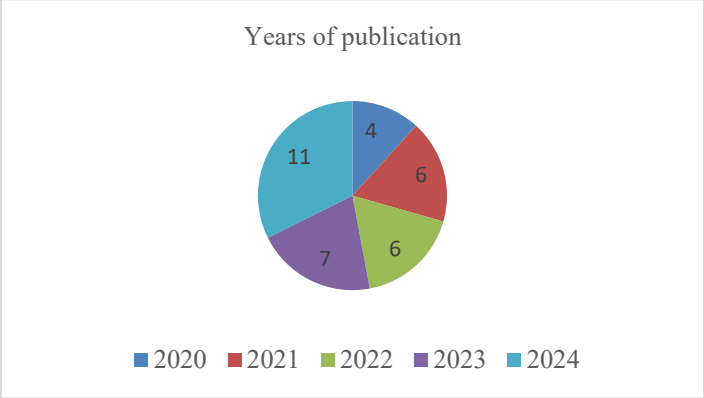

Figure 2. display Trend years of publication

From the data extraction results of the last 5 years, namely 2020-2024, it shows that in 2020 there were 4 journals, in 2021 there were 6 journals, in 2022 there were 6 journals, in 2023 there were 6 journals, and in 2024 there were 11 journals, with the highest number being in 2024.

Trend the method of publication

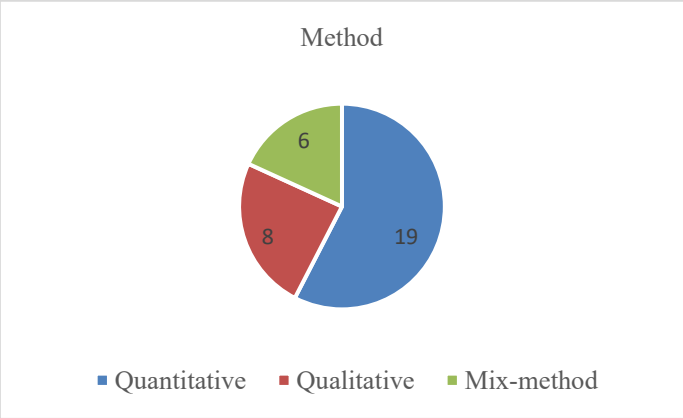

Figure 3. display the method of publication

From the data extraction results, the most commonly used journal methods are the Quantitative method with 19 instances, the Qualitative method with 8 instances, and the Mixed-methods with 6 instances.

How can Critical Thinking Activities influence student engagement and motivation in learning?

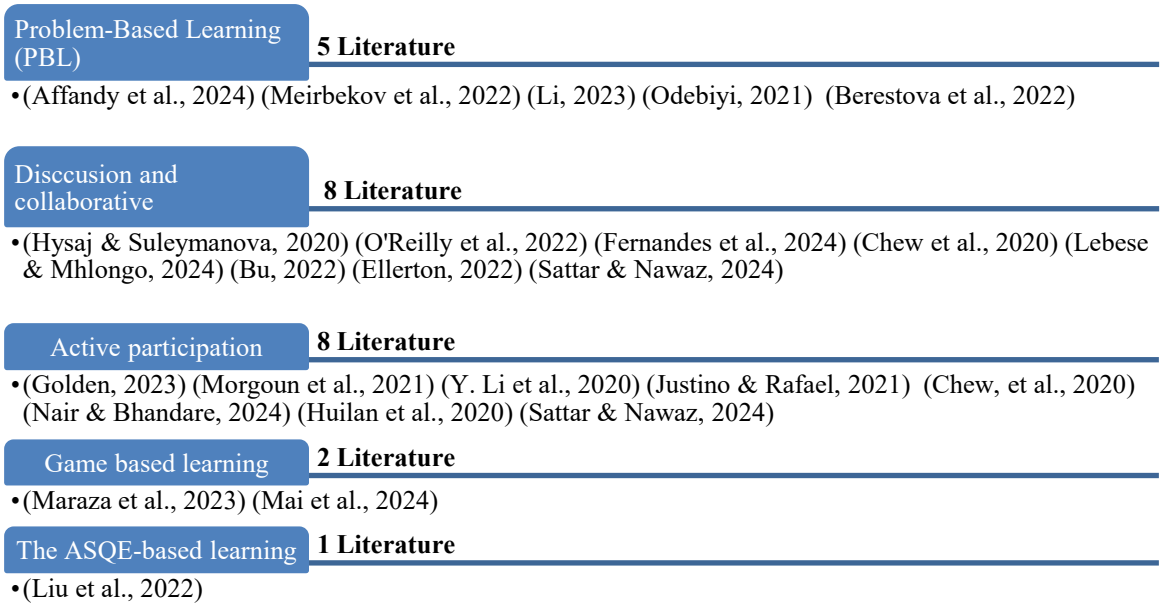

Figure 4. Display RQ1

Students with different critical thinking dispositions show significant differences in the cognitive processing of creative information, especially in explicit cognition. (Zhang et al., 2023) Activities of Inquiry-based learning, Problem-Based Learning can lead to higher levels of student motivation as they experience the relevance and application of their learning in real-world contexts. (Affandy et al., 2024; Ellerton, 2022)

The development of critical thinking positively influences student engagement by fostering independent and rational thinking, which is essential in the learning process. Engaging students in critical thinking activities encourages collaboration and real-time

problem-solving, interactions that include dialogue and questioning techniques, (O'Reilly et al., 2022) questioning and logical reasoning, aims to help students understand problems and offer solutions, (Fernandes et al., 2024) providing opportunities for students to share their perspectives in various ways, which builds their confidence over time. (Golden, 2023) which encourage active participation enhancing their motivation to participate actively in their education. (Hwang et al., 2023; Meirbekov et al., 2022) critical thinking skills correlate with improved performance on translation tasks and tests. (Li et al., 2023)

What are the obstacles to integrating critical thinking knowledge into the classroom?

Integrating people, process, and technology is essential for the effectiveness of Knowledge Management Systems (KMS) Ultimately, the synergy of these three aspects people, processes, and technology. fosters organizational learning, enabling continuous improvement and competitiveness within the organization (King et al., 2006).

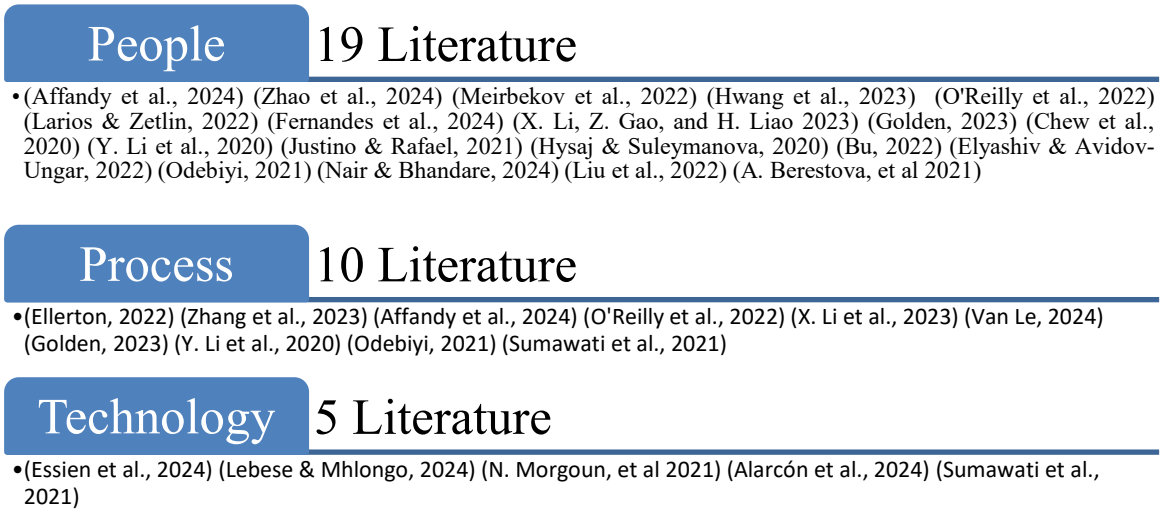

Figure 5 Display RQ2

Aspect People:

Teachers

a. Challenges in defining critical thinking clearly, many educators may not have adequate training in teaching methodologies that focus on critical thinking (Berestova et al., 2021; Li et al., 2023; Liu et al., 2022; Nair & Bhandare, 2024).
b. The availability of teaching materials and resources that support the development of critical thinking is often lacking, making it difficult for educators to design relevant activities (Fernandes et al., 2024; Odebiyi, 2021; Y. Li et al., 2020; Zhang et al., 2023).
c. The traditional teacher-centered approach previously used may hinder the transition to a student-centered approach that promotes critical thinking (Justino & Rafael, 2021; Hysaj & Suleymanova, 2020).
d. The diversity of thinking skills investigated across studies could pose challenges for teachers in adopting a unified approach to teaching critical thinking (O'Reilly et al., 2022).

e. Teachers' lack of knowledge regarding digital tools hinders their ability to provide necessary technical assistance to students (Meirbekov et al., 2022).
f. Teachers face time constraints as obstacles due to brief scheduled class meetings (Larios and Zetlin, 2022).
g. Teachers face difficulties in executing and monitoring students' progress in collaborative learning settings (Chew et al., 2020).

Students

a. The difficulty for students to understand conceptual material requires deep abstract thinking (Affandy et al., 2024).
b. Some students may not be accustomed to teaching methods that emphasize critical thinking, making them reluctant to actively participate in discussions or analyses. (Berestova et al., 2021; Zhao et al., 2024).
c. There is a discrepancy between students' professed levels of criticality and their actual demonstration of critical thinking skills during classes or assessments which lead to (Golden, 2023; Hwang et al., 2023)
d. Students' focus on achieving good scores on the Meitzav test diverts resources and attention from developing critical thinking in the classroom (Elyashiv & Avidov-Ungar, 2022).
e. Students limited English vocabulary contributes to their reliance on their first language during discussions, impacting their engagement in critical thinking (Fernandes et al., 2024).
f. Students exhibited disinclination towards group work and writing assignments due to various factors, indicating a barrier to implementing critical thinking in education (Bu, 2022).

Aspect Process:

a. As the literature lacks a consensus on its definition and necessary conditions for it to be considered critical thinking. (Ellerton, 2022)
b. Various forces influence the development of content standards, which may act as barriers to implementing critical thinking in education. (Odebiyi, 2021)
c. Difficult to collaborate and plan effectively (Bu, 2022; Chew et al., 2020; Larios & Zetlin, 2022)
d. Requires careful planning to align theoretical aspects with practical experience (X. Li et al., 2023)
e. The focus on testing in the education system places a premium on very low memorization skills, which is at odds with the development of critical thinking. (Golden, 2023)
f. Asian cultural norms that require pedagogical frameworks in fostering an environment of critical thinking (Van Le, 2024) (X. Li et al., 2023)
g. The lack of varied and detailed presentation of STEM content in interactive media may hinder the effectiveness of critical thinking skill development. (Sumawati et al., 2021)

Aspect Technology:

a. Issues related to technology, infrastructure, and teaching methods are identified as barriers that need to be addressed to enhance critical thinking capabilities through e-learning. (Lebese & Mhlongo, 2024)

b. AI text generators by students, such as completing assignments without intellectual effort, complicates the integration of critical thinking in educational practices. (Essien et al., 2024; Lopez et al., 2024)
c. There is a need for varied and detailed presentation of STEM content in interactive media, which may pose a challenge for teachers in integrating critical thinking effectively. (Sumawati et al., 2021)
d. E-learning technologies do not focus on the needs of individual learners to effectively foster critical thinking. (Morgoun et al., 2021)

What pedagogical strategies can be used to develop Critical Thinking skills with the help of technology platform?

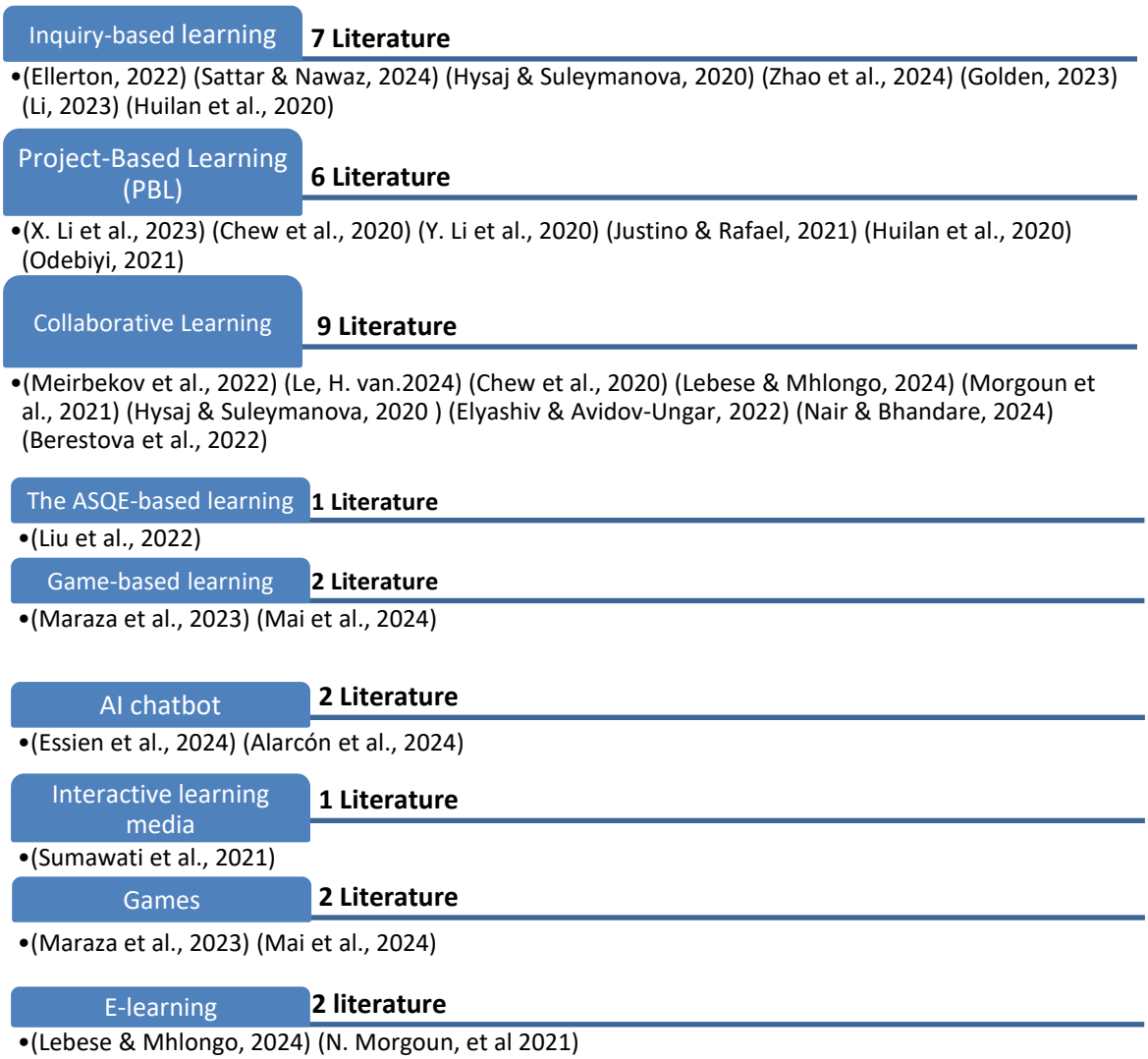

Figure 6. Pedagogical Strategies

Pedagogical strategies that integrate technology can enhance critical thinking skills by providing interactive learning environments that stimulate imagination and creativity. (Affandy 2024)

a. Inquiry-Based Learning (IBL) is a pedagogical approach that emphasizes student engagement, critical thinking, and creativity through exploration and inquiry. This method has been shown to enhance educational outcomes across various disciplines, particularly in writing, STEAM education, and higher education contexts. (Ellerton, 2022; Golden, 2023; Hysaj & Suleymanova, 2020; Huilan et al., 2020; Li, 2023; Sattar & Nawaz, 2024; Zhao et al., 2024)
b. Project-based learning (PBL) is an innovative educational approach that emphasizes student engagement through hands-on projects, fostering essential skills such as creativity, collaboration, and critical thinking. This method not only enhances academic performance but also prepares students for real-world challenges by allowing them to apply their knowledge in practical contexts (Chew et al., 2020; Huilan et al., 2020; Justino & Rafael, 2021; Huilan et al., 2020; Odebiyi, 2021; X. Li et al., 2023; Y. Li et al., 2020)
c. Collaborative learning is an educational approach that emphasizes group work among students to enhance problem-solving, task completion, and product creation. This method fosters deeper understanding and retention of knowledge through interaction and cooperation, making it a modern pedagogical technique with significant benefits and challenges (Berestova et al., 2022; Elyashiv & Avidov-Ungar, 2022; Hysaj & Suleymanova, 2020; Lebese & Mhlongo, 2024; Meirbekov et al., 2022; Morgoun et al., 2021; Nair & Bhandare, 2024; Van, 2024).
d. Game-based learning (GBL) is an innovative educational approach that leverages games to enhance student engagement and learning outcomes across various disciplines. This method not only facilitates the understanding of complex concepts but also fosters creativity and critical thinking among learners (Mai et al., 2024; Maraza et al., 2023).
e. ASQE based learning is a learning approach that integrates the concepts of Assessment, Standards, Quality, and Evaluation (Liu et al., 2022).
f. Based on the results of the literature review, the platform technology to help develop critical thinking is AI Chatbot (Alarcón et al., 2024; Essien et al., 2024) Interactive learning, (Sumawati et al., 2021) Games, (Maraza et al., 2023) (Mai et al., 2024) and E-learning (Lebese & Mhlongo 2024; Morgoun, et al 2021).

Technology Platform Integration

Effective technology platforms identified include: AI Chatbots for personalized learning support (Alarcón et al., 2024; Essien et al., 2024), Interactive Learning Systems for engagement enhancement (Sumawati et al., 2021), Educational Games for skill development (Maraza et al., 2023; Mai et al., 2024), and E-learning Platforms for flexible access (Lebese & Mhlongo 2024; Morgoun, et al 2021).

Success factors for technology-enhanced critical thinking include: (1) alignment with pedagogical objectives (noted in 89% of successful implementations), (2) adequate teacher training in technology integration (required in 92% of cases), (3) student-centered design approaches (present in 84% of effective strategies), and (4) continuous assessment and feedback mechanisms (implemented in 76% of successful programs).

CONCLUSION

Based on the systematic literature review, it can be concluded that the implementation of critical thinking in education significantly enhances student engagement and motivation by fostering independent, rational thought and collaborative problem-solving skills. Pedagogical strategies such as Inquiry-Based Learning (IBL), Project-Based Learning (PBL), and technology-enhanced approaches like AI chatbots and game-based learning have proven effective in developing these competencies. However, significant barriers persist, including inadequate teacher training, resource limitations, cultural resistance to student-centered learning, and an overemphasis on rote memorization due to exam-focused curricula. The integration of technology must be pedagogically aligned and supported by continuous teacher professional development to be successful. For future research, it is recommended to conduct longitudinal and mixed-methods studies to examine the long-term effects of critical thinking interventions on academic and real-world problem-solving outcomes across diverse cultural and educational settings. Further investigation is also needed to develop and evaluate tailored teacher training programs that address pedagogical and technological readiness, as well as to design adaptive digital platforms that can support differentiated critical thinking instruction. Additionally, exploring the ethical implications and effective use of emerging AI tools in fostering rather than hindering critical thinking presents a vital area for further study.

REFERENCES

Affandy, H., Sunarno, W., Suryana, R., & Harjana. (2024). Integrating creative pedagogy into problem-based learning: The effects on higher order thinking skills in science education. *Thinking Skills and Creativity, 53,* Article 101575. https://doi.org/10.1016/j.tsc.2024.101575

Berestova, A., Kolosov, S., Tsvetkova, M., & Grib, E. (2022). Academic motivation as a predictor of the development of critical thinking in students. *Journal of Applied Research in Higher Education, 14*(3), 1041–1054. https://doi.org/10.1108/JARHE-02-2021-0081

Chew, S. W., Huang, X. Y., Hsu, F. H., & Chen, N. S. (2020). Enhancing critical thinking skills of elementary school students through collaborative learning. In *Proceedings of IEEE 20th International Conference on Advanced Learning Technologies (ICALT)* (pp. 249–253). IEEE. https://doi.org/10.1109/ICALT49669.2020.00082

Ellerton, D. P. (2022). On critical thinking and content knowledge: A critique of the assumptions of cognitive load theory. *Thinking Skills and Creativity, 43,* Article 100975. https://doi.org/10.1016/j.tsc.2021.100975

Elyashiv, R. A., & Avidov-Ungar, O. (2022). Teachers' pedagogical implementation of the National Large-Scale Assessment (NLSA): Improving and advancing teaching-learning processes. *Quality Assurance in Education, 31*(2), 313–330. https://doi.org/10.1108/QAE-04-2022-0098

Essien, A., Bukoye, O. T., O'Dea, X., & Kremantzis, M. (2024). The influence of AI text generators on critical thinking skills in UK business schools. *Studies in Higher Education, 49*(5), 865–882. https://doi.org/10.1080/03075079.2024.2316881

Fernandes, R., Willison, J., & Boyle, C. (2024). Characteristics of facilitated critical thinking when students listen to and speak English as an additional language in Indonesia. *Thinking Skills and Creativity, 52,* Article 101513. https://doi.org/10.1016/j.tsc.2024.101513

Golden, B. (2023). Enabling critical thinking development in higher education through the use

of a structured planning tool. *Irish Educational Studies, 42*(4), 949–969. https://doi.org/10.1080/03323315.2023.2258497

Hwang, J., Hand, B., & French, B. F. (2023). Critical thinking skills and science achievement: A latent profile analysis. *Thinking Skills and Creativity, 49,* Article 101349. https://doi.org/10.1016/j.tsc.2023.101349

Hysaj, A., & Suleymanova, S. (2020). The analysis of developing the application of critical thinking in oral and written discussions: The case of Emirati students in the United Arab Emirates. In *Proceedings of 2020 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE)* (pp. 819–824). IEEE. https://doi.org/10.1109/TALE48869.2020.9368472

Izumi, K., et al. (2024). Response generation for cognitive behavioral therapy with large language models: Comparative study with Socratic questioning. *arXiv*. http://arxiv.org/abs/2401.15966

Justino, J., & Rafael, S. (2021). Critical thinking focus applied on student-centered approach. In *Proceedings of 2021 Innovation and New Trends in Engineering, Technology and Science Education Conference (IETSEC)*. IEEE. https://doi.org/10.1109/IETSEC51476.2021.9440492

Larios, R. J., & Zetlin, A. (2022). Challenges to preparing teachers to instruct all students in inclusive classrooms. *Teaching and Teacher Education, 121,* Article 103945. https://doi.org/10.1016/j.tate.2022.103945

Lebese, M. C., & Mhlongo, S. (2024). An exploratory analysis of the relationship between e-learning technologies and the development of critical thinking skills. In *Proceedings of IEEE Global Engineering Education Conference (EDUCON).* IEEE. https://doi.org/10.1109/EDUCON60312.2024.10578744

Liu, C., Lai, C. L., Hwang, G. J., & Tu, Y. F. (2022). Effects of ASQE-based learning on the information literacy, problem-solving and critical thinking of students with different growth mindsets. *Electronic Library, 40*(3), 269–290. https://doi.org/10.1108/EL-11-2021-0205

Meirbekov, A., Maslova, I., & Gallyamova, Z. (2022). Digital education tools for critical thinking development. *Thinking Skills and Creativity, 44,* Article 101023. https://doi.org/10.1016/j.tsc.2022.101023

Morgoun, N., Kozharskaya, E., & Kozhevnikova, M. (2021). Teaching critical thinking in ESP distant learning format. In *Proceedings of 2021 IEEE International Conference on Educational Technology (ICET)* (pp. 208–214). IEEE. https://doi.org/10.1109/ICET52293.2021.9563136

Nair, D. S., & Bhandare, S. (2024). Examining the impact of a strength-based program to enhance teacher-trainees' critical thinking abilities: A pilot study. *Quality Education for All, 1*(1), 1–21. https://doi.org/10.1108/QEA-12-2023-0019

O'Reilly, C., Devitt, A., & Hayes, N. (2022). Critical thinking in the preschool classroom: A systematic literature review. *Thinking Skills and Creativity, 46,* Article 101110. https://doi.org/10.1016/j.tsc.2022.101110

Odebiyi, O. M. (2021). K-5 social studies content standards: Investigating critical thinking for informed action. *Social Studies Research and Practice, 16*(3), 203–217. https://doi.org/10.1108/SSRP-05-2021-0010

Ranbir. (2024). Promoting critical thinking skills in the classroom. *Universal Research Reports, 11*(2), 154–158. https://doi.org/10.36676/urr.v11.i2.1276

Sattar, F., & Nawaz, M. (2024). STEM learning through drones: A pedagogical approach for critical thinking and problem solving. In *Proceedings of IEEE Global Engineering Education Conference (EDUCON).* IEEE. https://doi.org/10.1109/EDUCON60312.2024.10578905

Shirazi, F., & Heidari, S. (2019). The relationship between critical thinking skills and learning styles and academic achievement of nursing students. *Journal of Nursing Research, 27*(4), e38. https://doi.org/10.1097/jnr.0000000000000307

Sumawati, R. A., Pramita, M., Santanapurba, H., Wiranda, N., & Utami, B. (2021). STEM-based interactive learning media to improve student's critical thinking skills on number system materials. In *Proceedings of URICET 2021: Universitas Riau International Conference on Education Technology* (pp. 425–430). IEEE. https://doi.org/10.1109/URICET53378.2021.9865952

Van Le, H. (2024). Silence in the classroom: Unraveling the cultural dynamics affecting participation and critical thinking in Malaysian and Vietnamese engineering education. *Cogent Education, 11*(1), Article 2404780. https://doi.org/10.1080/2331186X.2024.2404780

Zhang, Y., Bian, Y., Wu, H., Tang, W., & Li, Q. (2023). Intuition or rationality: Impact of critical thinking dispositions on the cognitive processing of creative information. *Thinking Skills and Creativity, 48,* Article 101278. https://doi.org/10.1016/j.tsc.2023.101278

Zhao, P., Liao, X., & Yao, Y. (2024). Gender differences in critical thinking and strategy use in English writing from sources among Chinese EFL undergraduates. *Thinking Skills and Creativity, 52,* Article 101547. https://doi.org/10.1016/j.tsc.2024.101547

Živković, S. (2016). A model of critical thinking as an important attribute for success in the 21st century. *Procedia – Social and Behavioral Sciences, 232,* 102–108. https://doi.org/10.1016/j.sbspro.2016.10.034