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Revisiting Critical Thinking in Early Childhood: A Bibliometric Review of Trends During and After COVID-19 Pandemic

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Abstract

Critical thinking is increasingly recognized as a foundational competence that can be fostered from early childhood. The COVID-19 pandemic intensified scholarly attention to this area by disrupting early childhood education while accelerating pedagogical and technological innovation. This study revisits research trends and thematic developments on critical thinking in early childhood education during and after the COVID-19 period. Using a mixed-method design, the study integrates bibliometric analysis and a narrative literature review of 309 Scopus-indexed publications (2019-2026), analyzed using VOSviewer to identify publication growth, influential sources, subject areas, keyword co-occurrence, and temporal thematic shifts, while the narrative review synthesized recent empirical and conceptual studies. The findings show steady publication growth during COVID-19 and a marked surge in the post-pandemic period, with a substantial increase culminating in a publication peak in 2025. Research themes evolved from assessment, health-related issues, and emergency digital learning toward pedagogical refinement, teacher professional development, early childhood–specific interventions, and ethical integration of digital and AI-based tools. Overall, the literature reflects a shift toward understanding critical thinking as a socially mediated, context-dependent, and developmentally appropriate competence in early childhood education.

Keywords: *Critical Thinking, Early Childhood Education, Bibliometric Analysis, Literature Review, Covid-19, Post-Pandemic Education*

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Introduction

Critical thinking has increasingly been recognized as a foundational competence that should be nurtured from early childhood. Within early childhood education (ECE), in this study, critical thinking is conceptualized as developmentally appropriate reasoning, questioning, and reflective engagement embedded in social interaction rather than formal logical argumentation. Critical thinking is commonly associated with skills such as problem-solving, reasoning, decision-making, creativity, and reflective thinking, all of which support children's cognitive, social, and emotional development (Pollarolo et al., 2023; Rosidah et al., 2024). Early exposure to inquiry-based learning, play-centered pedagogy, and meaningful interactions has been shown to foster children's ability to question, interpret experiences, and construct knowledge (Ramanathan et al., 2022). As global education systems shift toward competency-based curricula, critical thinking is no longer viewed as a higher-order skill reserved for later schooling stages, but as an essential capability that can and should be cultivated during early developmental periods (Thornhill-Miller et al., 2023).

The COVID-19 pandemic profoundly disrupted ECE systems worldwide, leading to prolonged school closures, reduced face-to-face interactions, and a rapid transition to remote or hybrid learning modalities (Ford et al., 2021; Rahiem, 2024). Report by UNESCO highlights that during COVID-19, early learners were among

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the most affected groups due to limited digital access, reduced parental support capacity, and the developmental unsuitability of prolonged screen-based instruction (UNESCO, 2020). At the same time, the pandemic acted as a catalyst for pedagogical innovation, accelerating the adoption of digital learning tools, family-centered learning approaches, and flexible curricula (Boison & Burke, 2025). These changes prompted renewed attention to how higher-order skills such as critical thinking can be supported under constrained, uncertain, and technology-mediated learning environments both during and after the pandemic period (Organisation for Economic Co-Operation and Development, 2024).

Despite the growing body of research on critical thinking in ECE, existing studies remain fragmented across disciplines, methodologies, and geographical contexts. Many investigations focus on specific instructional interventions, assessment tools, or contextual case studies, offering valuable but isolated insights (Ningsih & Farida, 2023; O'Reilly et al., 2022). Moreover, while COVID-19 has stimulated a surge of publications addressing early childhood learning challenges and adaptations, there is a lack of comprehensive synthesis that systematically maps how research on critical thinking in ECE has evolved during and after the pandemic. In particular, bibliometric evidence that captures longitudinal trends, thematic shifts, and intellectual structures within this field remains limited, constraining a holistic understanding of knowledge development and research trajectories.

In response to these gaps, this study aims to systematically examine the scholarly landscape of critical thinking in ECE during and after the COVID-19 period using a combined bibliometric and literature review approach. Specifically, the study seeks to: (1) identify publication trends and growth patterns over time; (2) map key research themes and their interrelationships; (3) determine influential authors, journals, and countries contributing to the field; and (4) synthesize dominant conceptual and pedagogical insights emerging from the literature. Guided by these objectives, the study addresses the following research questions: (1) How has research on critical thinking in ECE evolved between 2019 and 2026? (2) What thematic clusters and conceptual emphases characterize the literature? (3) How has the COVID-19 pandemic shaped research directions and priorities in this domain?

This study contributes to the literature in several ways. First, it provides a systematic, data-driven overview of research on critical thinking in ECE by integrating bibliometric mapping with qualitative literature synthesis. Second, by explicitly situating the analysis within the COVID-19 and post-pandemic context, the study offers timely insights into how global disruptions have reshaped pedagogical discourse and research focus. Third, the findings serve as a reference point for researchers, educators, and policymakers by identifying emerging themes, research gaps, and future directions. Ultimately, this study advances understanding of how critical thinking in ECE is conceptualized, studied, and promoted in an era marked by educational uncertainty and transformation.

Methodology

Research Design

This study adopts a mixed bibliometric and literature review design to systematically examine scholarly work on critical thinking in ECE. The bibliometric approach is employed to quantitatively map the development of the research field, identify influential publications, and reveal underlying intellectual structures (Donthu et al., 2021). Through the analysis of publication patterns, citation relationships, keyword co-occurrence, and collaboration networks, bibliometric analysis enables an objective and reproducible overview of research trends and thematic evolution. To complement this quantitative mapping, a qualitative literature review is conducted to provide deeper interpretive insights into dominant themes, conceptual frameworks, and pedagogical implications. The integration of bibliometric analysis with a literature review allows for both macro-level trend identification and micro-level contextual understanding (Gunawan, 2025a, 2025b), making this design suitable for revisiting developments during and after the COVID-19 period.

Data Source and Search Strategy

The bibliometric data were retrieved from the Scopus database, selected due to its extensive coverage of peer-reviewed journals across education, social sciences, and interdisciplinary fields. Scopus is particularly

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advantageous for bibliometric studies because of its comprehensive citation metadata and flexible data export features, which support advanced visualization and network analysis. The search was conducted in January 2026 using a structured query designed to capture studies related to ECE and critical thinking. The search string applied was ("childhood education" OR "child education" OR "child" OR "childhood" OR "early childhood" OR "early child") AND ("critical thinking"). The inclusion of broad terms such as "child" and "childhood" may capture studies beyond early childhood education; however, this strategy was intentionally applied to ensure comprehensive coverage, with relevance subsequently examined during qualitative synthesis. This strategy was intended to include both foundational and contemporary studies, ensuring broad coverage of relevant literature while maintaining topical specificity.

Inclusion and Exclusion Criteria

To ensure relevance and analytical consistency, several inclusion and exclusion criteria were applied. First, only documents published between 2019 and 2026 were included, allowing the analysis to capture research dynamics during and after the COVID-19 pandemic. Records from 2026 represent partial-year data and were interpreted cautiously due to potential database indexing delays. Second, only documents indexed in Scopus at the time of data retrieval were considered. Non-scholarly materials such as editorials, notes, and errata were excluded. Applying these criteria resulted in 309 documents, which constituted the final dataset for the bibliometric analysis. These records were exported in compatible formats for further processing and visualization.

Bibliometric Analysis Tools and Indicators

The bibliometric analysis was conducted using VOSviewer (version 1.6.20), a specialized software for constructing and visualizing bibliometric networks. The analysis focused primarily on keyword co-occurrence, which enables the identification of conceptual linkages and thematic clusters within the research domain. To enhance analytical robustness, a minimum threshold of five keyword occurrences was established. This threshold ensured that only substantively relevant and recurrent concepts were included in the mapping process. The resulting visualizations facilitated the identification of dominant research themes, emerging topics, and potential gaps warranting further investigation.

Literature Review Procedure

Following the bibliometric analysis, a systematic literature review was undertaken to synthesize substantive findings related to critical thinking in ECE. The primary source for the review was the Scopus database, using the same search terms to ensure alignment with the bibliometric dataset. The broad range of publications were screened by the authors to ensure that only relevant studies were included in the literature review. To enrich the review and capture relevant policy reports and complementary studies, additional materials were retrieved from Google Scholar using identical keywords. Google Scholar was used solely to supplement policy documents and contextual studies, while all core analytical claims were grounded in Scopus-indexed publications. The literature review applied the following inclusion criteria: (1) publications written in English or Indonesian; (2) fully published journal articles or research reports; and (3) availability of full-text access. This two-stage procedure ensured both methodological consistency and thematic depth, enabling a comprehensive interpretation of trends, insights, and research directions in the field.

Results and Discussion

Bibliometric Findings

The analysis of the 309 selected documents revealed that critical thinking in ECE is increasingly being operationalized through healthy lifestyle education. The thematic synthesis generated four overarching themes describing how critical thinking skills such as inquiry and decision-making are systematically embedded within play-based health activities. These themes do not merely map out instructional practices; they capture the nuanced dynamics between children and educators in constructing early health awareness through reflective

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questioning. To ensure a robust analysis, these themes are interpreted in relation to socio-constructivism, situating the findings within the broader trajectory of scholarly output in the field.

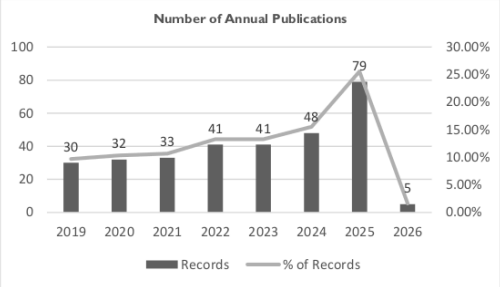

Figure 1. Annual Publication Trends on Critical Thinking in ECE (2019–2026). Source: Author (2026); Processed from Scopus Database

Figure 1 illustrates the annual distribution of publications on critical thinking in ECE between 2019 and 2026. Overall, the results indicate a clear upward trajectory in scholarly output, with notable differences between the COVID-19 period and the post-pandemic phase. During the COVID-19 period (2019–2023), the number of publications increased gradually but steadily. In 2019, a total of 30 documents were published, rising modestly to 32 in 2020 and 33 in 2021. This incremental growth suggests that despite widespread disruptions to educational systems and research activities, scholarly interest in critical thinking within ECE was sustained. A more pronounced increase is observed in 2022, with publications reaching 41, a level that remained stable in 2023. This stabilization may reflect a consolidation phase in which researchers began systematically examining the pedagogical implications of remote learning, parental involvement, and adaptive teaching strategies for fostering critical thinking among young children during pandemic conditions.

In the post-COVID-19 period (2024–2026), publication activity shows a sharper divergence. In 2024, the number of records increased further to 48, indicating renewed research momentum as educational institutions transitioned back to face-to-face or hybrid learning environments. This growth culminated in a substantial peak in 2025, with 79 publications, representing the highest annual output across the observed period. The surge suggests intensified scholarly attention to post-pandemic reflection, evaluation of learning losses or gains, and re-examination of critical thinking development in early childhood within restructured educational contexts. In contrast, the sharp decline observed in 2026, with only five publications, should be interpreted cautiously, as it likely reflects database indexing lag or partial-year data rather than an actual reduction in research interest. Taken together, these findings demonstrate that while research on critical thinking in ECE progressed incrementally during the COVID-19 period, the post-pandemic era (2024 and 2025) was characterized by accelerated scholarly output. This pattern indicates that the pandemic not only disrupted ECE but also stimulated sustained academic inquiry and post-crisis reflection on the development of higher-order thinking skills in early learners.

Table 1. Top 10 Authors and Journals

Author (Nationality)	*Records*	*Journal (Scopus Quartile; SCImago Journal Rank)*	*Records*
Nsangi, A. (Uganda)	11	PLoS ONE (Q1; 0.803)	7
Oxman, A.D. (Norway)	11	Thinking Skills and Creativity (Q1; 1.410)	6
Kaseje, M. (Kenya)	10	F1000Research (Q1; 0.537)	4
Lewin, S. (Norway)	10	International Journal of Environmental Research and Public Health (Q2; 0.919)	4
Oxman, M. (Norway)	10	Trials (Q2; 0.893)	4

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Rosenbaum, S. (Norway)	9	Acta Psychologica (Q1; 0.854)	3
Semakula, D. (Uganda)	8	Australian Critical Care (Q1; 0.762)	3
Dahlgren, A. (Norway)	6	BMC Public Health (Q1; 1.359)	3
Mugisha, M. (Rwanda)	6	BMJ Open (Q1; 1.016)	3
Nyirazinyoye, L. (Rwanda)	6	Communications in Computer and Information Science (Q4; 0.182)	3

Table 1 presents the top contributing authors and journals in the literature on critical thinking in ECE. The results reveal a relatively concentrated authorship structure, with a small group of scholars accounting for a substantial share of publications. Nsangi, A. (Uganda) and Oxman, A.D. (Norway) emerge as the most prolific authors, each contributing 11 publications, followed closely by Kaseje, M. (Kenya), Lewin, S. (Norway), and Oxman, M. (Norway). It should be noted that several highly productive authors are primarily affiliated with health and evidence-based medicine disciplines, indicating interdisciplinary spillover rather than exclusive focus on early childhood education. Notably, the dominance of authors affiliated with Norway and several African countries (Uganda, Kenya, Rwanda) suggests strong international engagement and cross-regional research collaboration. This pattern indicates that scholarship on critical thinking in ECE is not geographically confined to traditionally dominant research regions, but instead reflects growing contributions from diverse educational and socio-cultural contexts. Such diversity may enrich the field by incorporating varied pedagogical perspectives, particularly from low- and middle-income countries where educational resilience and innovation have been critical during and after the COVID-19 period.

In terms of publication outlets, the top journals are predominantly high-impact and upper-quartile (Q1 and Q2) Scopus-indexed journals, underscoring the academic credibility and interdisciplinary appeal of the research field. Journals such as *PLoS ONE*, *Thinking Skills and Creativity*, and *F1000Research* lead in publication frequency, reflecting strong interest in critical thinking from education, psychology, and open science perspectives. The presence of public health–oriented journals (e.g., *International Journal of Environmental Research and Public Health*, *BMC Public Health*, and *BMJ Open*) highlights the expanding conceptualization of ECE beyond traditional classroom settings, particularly in relation to child development, well-being, and learning environments shaped by pandemic conditions. Meanwhile, the inclusion of lower-quartile outlets, such as *Communications in Computer and Information Science*, suggests emerging intersections with digital learning and educational technology. Collectively, these findings indicate that research on critical thinking in ECE is both interdisciplinary and increasingly disseminated through reputable, high-visibility journals, reinforcing its growing significance in post-pandemic educational discourse.

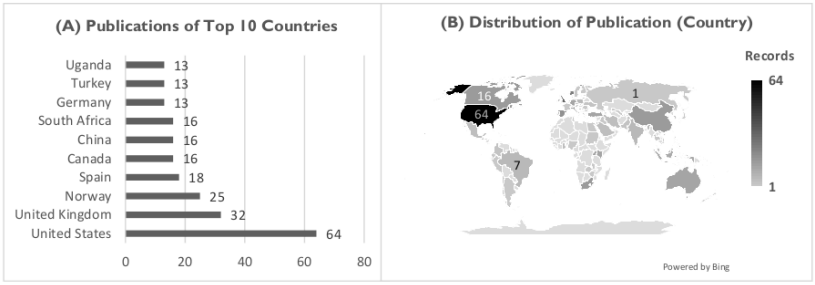

Figure 2. Geographical Distribution of Research Productivity: (A) Top 10 Contributing Countries; (B) Global Heat Map. Source: Author (2026); Created Using VOSviewer

Figures 2A and 2B illustrate the geographical distribution of publications on critical thinking in ECE, highlighting both leading contributing countries and the global spread of research output. As shown in Figure 2A, the United States dominates the field with 64 publications, followed by the United Kingdom (32) and

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Norway (25). A second tier of contributors includes Spain (18), Canada, China, and South Africa (each with 16 publications), while Germany, Turkey, and Uganda contribute 13 publications each. This distribution indicates that research productivity is led by countries with well-established research infrastructures, particularly in North America and Western Europe, while also demonstrating notable contributions from emerging and non-Western research contexts.

Figure 2B further visualizes the global dispersion of research activity, revealing that publications are distributed across multiple continents, including North America, Europe, Asia, Africa, and Oceania. Beyond the most productive countries, moderate levels of output are observed in regions such as East Asia, Australia, and parts of Latin America, while other areas remain underrepresented. This uneven distribution suggests disparities in research capacity, funding availability, and access to international publication platforms. At the same time, the presence of African countries such as Uganda and South Africa among the top contributors underscores the growing engagement of low- and middle-income countries in ECE research, particularly in relation to pedagogical resilience and learning innovation.

Collectively, these figures indicate that scholarship on critical thinking in ECE is globally networked yet geographically concentrated. The prominence of high-income countries suggests continued leadership in shaping theoretical and methodological directions, whereas the increasing visibility of diverse regions points to a gradual broadening of perspectives. This global pattern is particularly relevant in the post-COVID-19 context, as educational challenges and responses have varied significantly across regions, reinforcing the importance of cross-national knowledge exchange and context-sensitive research in advancing critical thinking development in early childhood settings.

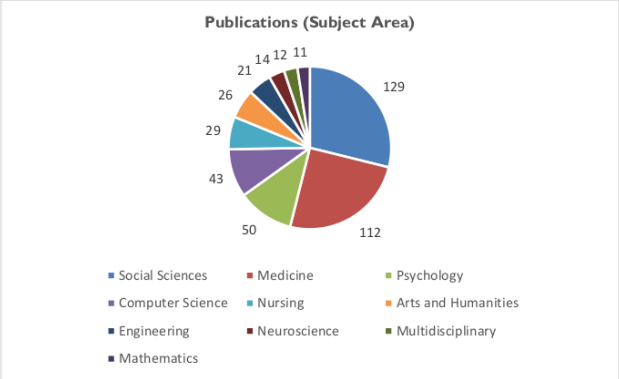

Figure 3. Distribution of Publications by Subject Area. Source: Author (2026); Processed from Scopus Database

The distribution of publications by subject area demonstrates the highly interdisciplinary nature of research on critical thinking in early childhood education. As shown in Figure 4, Social Sciences constitute the largest share of publications (129 records), reflecting the field's strong grounding in educational theory, pedagogy, and social development. This is followed closely by Medicine (112 records) and Psychology (50 records), indicating substantial attention to cognitive development, mental health, and developmental outcomes associated with early critical thinking skills. The presence of Computer Science (43 records) and Engineering (21 records) highlights the growing role of digital technologies, educational software, and learning analytics in fostering critical thinking, particularly in technology-mediated learning environments accelerated during and after the COVID-19 pandemic. Additionally, contributions from Nursing, Arts and Humanities, Neuroscience, Mathematics, and Multidisciplinary categories further underscore the breadth of scholarly engagement,

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suggesting that critical thinking in early childhood is conceptualized not only as an educational construct but also as a cognitive, technological, and health-related phenomenon. Collectively, this diversity reflects a holistic and cross-sectoral approach to understanding and promoting critical thinking skills in early childhood, reinforcing the complexity and multi-dimensionality of the research domain.

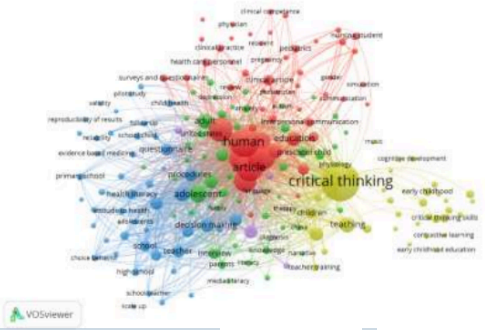

Figure 4. Keyword Co-occurrence Network of Critical Thinking in ECE Research. Source: Author (2026); Created Using VOSviewer

The keyword co-occurrence network reveals multi-cluster intellectual structure underlying research on critical thinking, reflecting the field's interdisciplinary breadth and conceptual diversity. At the center of the map, high-frequency and high-connectivity terms such as *"human," "article,"* and *"education"* function as bridging nodes, linking multiple thematic clusters. It should be noted that these generic keywords largely reflect Scopus indexing and metadata conventions rather than substantive conceptual prominence. Therefore, their role in the network was interpreted cautiously and primarily as structural connectors rather than as indicators of dominant theoretical constructs. Their central positioning indicates that research on critical thinking, particularly in early childhood contexts, is embedded within broader human development and educational research paradigms, rather than existing as an isolated construct.

Several distinct thematic clusters can be identified. The yellow cluster, anchored by the keyword *"critical thinking,"* represents the core pedagogical domain. This cluster is closely associated with terms such as *"teaching," "children," "early childhood," "early childhood education,"* and *"critical thinking skills,"* highlighting a strong emphasis on instructional strategies, skill development, and learning outcomes in early childhood settings. The presence of keywords like *"contrastive learning"* and *"teacher training"* suggests a growing interest in instructional design and professional development as mechanisms for fostering critical thinking from an early age. This cluster reflects the maturation of critical thinking as a central educational objective within ECE research.

The blue cluster predominantly centers on school-based and methodological themes, including *"adolescent," "school," "teacher," "questionnaire," "decision making," "health literacy,"* and *"evidence-based medicine."* Although many of these studies extend beyond early childhood, their strong connections to the central network indicate conceptual spillover between early childhood, primary, and secondary education research. This cluster reflects a trend toward measurement-driven and assessment-oriented studies, emphasizing validation, reliability, and empirical evaluation of thinking-related outcomes across developmental stages.

The red cluster is largely oriented toward medical and health-related research, with prominent keywords such as *"clinical practice," "nursing student," "pediatrics," "autism," "anxiety," "depression,"* and *"interpersonal communication."* The integration of this cluster with the central education-focused nodes indicates that critical thinking is increasingly examined as a transferable competence relevant to clinical decision-making, health communication, and professional education. This trend suggests that insights from health sciences,

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particularly regarding cognitive processes and decision-making, are informing educational research on critical thinking, including early childhood developmental considerations.

Additionally, the green and purple clusters emphasize family, literacy, and knowledge construction, featuring keywords such as *"parents," "family," "media literacy," "knowledge," "language,"* and *"narrative."* These clusters point to an emerging focus on socio-cultural and home-based learning environments, reinforcing the view that critical thinking development in early childhood is shaped not only by formal schooling but also by family interaction and literacy practices. The presence of geographically linked terms (e.g., *"United States," "China"*) further indicates the contextualization of critical thinking research across national education systems.

Overall, the network visualization demonstrates that research on critical thinking is highly interdisciplinary and increasingly interconnected, spanning education, psychology, health sciences, and social sciences. The prominence of early childhood–related keywords within the pedagogical cluster, combined with strong linkages to health and assessment domains, suggests a shift toward holistic and cross-sectoral perspectives. This pattern reflects a broader post-COVID-19 trend in which critical thinking is conceptualized as a foundational, transferable skill essential for navigating complexity, uncertainty, and lifelong learning beginning in early childhood.

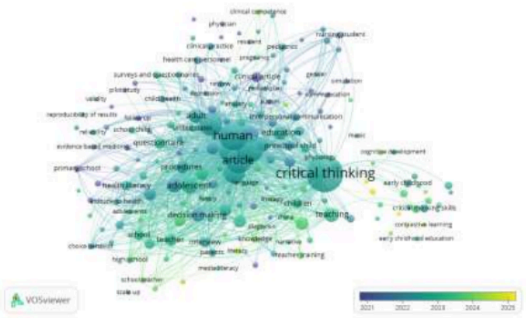

Figure 5. Overlay Visualization of Research Themes and Temporal Trends (2019–2026). Source: Author (2026); Created Using VOSviewer

The overlay visualization presents the temporal evolution of research themes in the literature on critical thinking, with node colors indicating the average publication year. Darker blue and green tones represent themes that were more prominent during the COVID-19 period (2019–2023), while yellow hues indicate themes that have gained prominence in the post-COVID-19 period (2024–2026). This temporal mapping provides insight into how scholarly attention has shifted in response to pandemic-related disruptions and subsequent educational recovery.

During the COVID-19 period (2019–2023), the network is dominated by broadly connected and methodologically oriented keywords such as "human," "article," "education," "questionnaire," "procedures," "adolescent," "decision making," and "clinical article." These nodes appear primarily in blue–green shades and occupy central positions in the network, suggesting that early research during the pandemic focused on conceptual exploration, empirical measurement, and cross-disciplinary adaptation. The prominence of terms related to health ("clinical practice," "nursing student," "pediatrics," "autism," "anxiety," and "depression") reflects the heightened intersection between education, health, and psychology during the pandemic, when learning disruptions and child well-being became intertwined concerns. Additionally, the frequent use of survey-based and questionnaire-driven methods indicates an emphasis on rapidly capturing educational and developmental impacts under constrained research conditions.

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In the post-COVID-19 period (2024–2026), newer and more specialized themes emerge, indicated by yellow-colored nodes located toward the periphery of the network. Keywords such as "early childhood," "early childhood education," "critical thinking skills," "contrastive learning," and "teacher training" become increasingly visible, signaling a shift from emergency-response research toward pedagogical refinement and skill-focused interventions. The temporal progression suggests that scholars have moved beyond general assessments of learning disruption toward more targeted investigations into how critical thinking can be intentionally cultivated in early childhood settings. The growing visibility of instructional and teacher-oriented themes also points to a post-pandemic emphasis on professional capacity building and curriculum redesign to support higher-order thinking in young learners.

Overall, the temporal overlay demonstrates a clear evolution from broad, health- and assessment-driven research during COVID-19 to more pedagogically focused, early childhood–specific inquiries in the post-pandemic era. This shift highlights how the pandemic initially prompted exploratory and cross-sectoral research, while subsequent recovery phases enabled deeper theoretical consolidation and innovation in teaching strategies for critical thinking. The observed temporal trends underscore the maturation of the field and its increasing focus on sustainable, developmentally appropriate approaches to fostering critical thinking in early childhood education beyond the pandemic context.

Review Findings

Conceptualizing Critical Thinking in Early Childhood

For decades, critical thinking was largely conceptualized as a higher-order cognitive skill reserved for adolescents and adults, grounded in formal logic and abstract reasoning. ECE, by contrast, was often framed around socialization, basic literacy, and developmental readiness. However, contemporary research has increasingly challenged this dichotomy, demonstrating that young children are capable of engaging in core elements of critical thinking such as reasoning, inference, evaluation, and reflective judgment when these processes are embedded within socially meaningful contexts (O'Reilly et al., 2025; Schleihauf et al., 2022). This shift represents a paradigmatic move away from deficit-oriented assumptions about young learners toward a more capability-oriented developmental perspective.

Empirical studies provide compelling evidence that critical thinking emerges through interaction rather than maturation alone. Schleihauf et al. (2022) showed that children as young as four can assess the quality of reasons and revise beliefs accordingly, while Amemiya et al. (2024) demonstrated children's ability to reason about disagreement and ambiguity in social discourse. These findings align with sociocultural theories, particularly Vygotskian perspectives, which emphasize that cognitive development is co-constructed through dialogue, scaffolding, and shared meaning-making. From this standpoint, critical thinking is not a static skill but a dynamic social practice.

Design-based and classroom-based studies further strengthen this reconceptualization. (O'Reilly et al., 2025), through the Storythinking Programme, illustrated that preschool children routinely demonstrate analytical and evaluative thinking when pedagogical conditions deliberately create space for questioning, storytelling, and reflection. Importantly, their work highlights that critical thinking in early childhood often manifests differently than in older learners through narrative reasoning, hypothesis generation, and dialogic engagement rather than formal argumentation. This insight cautions against uncritically importing adult-centric frameworks into ECE assessment and instruction.

Nevertheless, conceptual ambiguity remains a persistent challenge in the field. Studies examining educators' perceptions consistently report varied and sometimes inconsistent understandings of what constitutes critical thinking in early childhood (Pollarolo et al., 2023; Taşkın-Gökçe & Kandır, 2026). Some educators emphasize cognitive skills, while others foreground dispositions, social participation, or emotional awareness. While this plurality reflects contextual richness, it also complicates curriculum design, teacher training, and empirical measurement. Critically, the literature suggests that future conceptual work must move beyond binary debates (e.g., skills versus dispositions) and toward integrative models that account for cognition,

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emotion, language, and social interaction. Without such integration, efforts to promote critical thinking risk becoming fragmented, superficial, or developmentally misaligned.

Pedagogical Approaches for Fostering Critical Thinking

Pedagogical research consistently underscores that critical thinking does not emerge spontaneously, but must be intentionally cultivated through carefully designed learning experiences. Among the most robust approaches are dialogic pedagogy, inquiry-based learning, and questioning strategies. Studies on storytelling and teacher questioning (Bargiela et al., 2022; Liu & Yoon, 2025) demonstrate that open-ended questions activate children's analytical and inferential processes, especially when teachers resist evaluative closure and instead encourage exploration of multiple perspectives.

Importantly, research has shifted from teacher-led questioning toward empowering children as active questioners. Causey & Spencer (2024) showed that teaching children to generate their own questions significantly improves both the quantity and quality of higher-order thinking. This approach reframes children not as passive recipients of knowledge but as epistemic agents capable of directing inquiry, an orientation increasingly aligned with democratic and rights-based perspectives in ECE. Play-based and experiential pedagogies offer another powerful avenue for critical thinking development. Martinez-Lejarreta et al. (2024) illustrated how detective role-play supports hypothesis testing, collaborative reasoning, and evaluative judgment, while Sowmya & Rani (2025) demonstrated that hands-on science experiments foster curiosity, conceptual understanding, and early scientific reasoning. These findings reinforce the idea that play and critical thinking are not oppositional, but mutually reinforcing when play is intellectually rich and socially supported.

However, a critical tension emerges between open-ended exploration and instructional structure. Several studies note that while open play promotes exploration, targeted scaffolding is necessary to develop specific critical thinking skills (Asadi et al., 2025; Martinez-Lejarreta et al., 2024). Overly unstructured approaches may privilege engagement without depth, whereas excessively structured methods risk instrumentalizing thinking into rigid routines. This tension highlights the pedagogical challenge of balancing freedom and guidance. From a critical standpoint, the literature suggests that effective pedagogy for critical thinking in ECE is not defined by a single method, but by pedagogical intentionality, the educator's capacity to design environments, interactions, and prompts that invite children to think deeply, question assumptions, and reflect on meaning. This places considerable demands on teacher expertise and institutional support.

Digital Pedagogy, Technology, and Critical Thinking Post-COVID-19

The COVID-19 pandemic profoundly reshaped early childhood education, accelerating the integration of digital technologies and exposing longstanding inequities in access, pedagogy, and support. Early pandemic-era studies focused primarily on continuity of learning, yet subsequent research began to interrogate whether and how digital modalities could support higher-order skills such as critical thinking. Ilza et al. (2022) provided early evidence that multimedia-based distance learning could foster critical thinking when content was interactive and developmentally appropriate.

Post-pandemic studies deepen this understanding by emphasizing instructional design over technological novelty. Gusmaniarti et al. (2025) demonstrated that the DACAR model structured around demonstration, collaboration, action, and reflection significantly improved early childhood critical thinking even in fully online settings. Their findings challenge deterministic views that online learning is inherently unsuitable for young children, instead highlighting the centrality of pedagogical coherence. At the same time, the rapid expansion of AI, serious games, and educational robotics has raised ethical and developmental concerns. Ou & Parsons (2024) cautioned that poorly designed serious games may limit reflective engagement and reduce opportunities for deeper reasoning. Similarly, Truba et al. (2024) emphasized the need for ethical frameworks that consider neurocognitive, emotional, and social dimensions of digital learning. These critiques underscore the risk of technological solutionism, where tools are adopted without sufficient attention to developmental consequences.

Conversely, emerging research points to promising pathways when technology is used to augment rather than replace human interaction. Tolksdorf et al. (2024) showed that social robots can elicit metatalk and reflective thinking when embedded in guided discussion, while Kalogiannakis & Papadakis (2024) argued that

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computational thinking and AI literacy can enhance analytical reasoning if introduced through playful, scaffolded activities. These studies suggest a shift toward intelligence augmentation rather than automation. Critically, the post-COVID-19 literature calls for a reorientation of digital pedagogy toward ethical, relational, and inquiry-driven models. Without such grounding, digital innovations risk exacerbating inequities and narrowing conceptions of critical thinking to technical proficiency rather than reflective judgment.

Educators' Beliefs, Teacher Training, and Professional Practice

Educators play a pivotal role in mediating children's access to critical thinking opportunities, yet research consistently highlights gaps between policy aspirations and classroom realities. Comparative studies reveal that educators' conceptualizations of critical thinking are deeply shaped by cultural, curricular, and institutional contexts. Taşkın-Gökçe & Kandır (2026) found that Turkish educators emphasize cognitive and academic aspects, whereas Norwegian educators foreground social participation and early intervention, reflecting broader educational philosophies. Similar divergences appear in teacher education contexts. Aragón et al. (2025) reported that pre-service teachers in Spain and Poland hold contrasting views on critical thinking and sustainability, with limited integration of theory into practice. These findings suggest that teacher preparation programs often insufficiently operationalize critical thinking, leaving educators uncertain about how to translate abstract competencies into pedagogical action. Implementation challenges are further compounded by structural constraints. (Zondo et al., 2025) identified overcrowded classrooms, rigid curricula, and limited professional development as significant barriers, while Nyamekye et al. (2025) highlighted how sociocultural norms may inhibit critical pedagogy despite teachers' constructivist beliefs.

These studies reveal that teacher efficacy alone is insufficient without systemic alignment and institutional support. Critically, the literature suggests that professional development often prioritizes content coverage over pedagogical reasoning. Without sustained opportunities to engage with inquiry-based teaching, reflective practice, and classroom experimentation, educators may revert to transmissive approaches that marginalize critical thinking. This is particularly problematic in early childhood settings, where curriculum pressures increasingly mirror those of formal schooling. Future research and policy must therefore address critical thinking not only as a learner outcome, but as a professional competence requiring time, support, and reflective space. Strengthening teacher capacity is central to any sustainable agenda for critical thinking in ECE.

Socio-Cultural, Community, and Equity-Oriented Perspectives

Recent literature expands the lens of critical thinking beyond classrooms to encompass community spaces, cultural narratives, and social justice concerns. Studies such as Hakkoymaz (2025) demonstrate that children's libraries function as powerful informal learning environments, enabling critical thinking through dialogue, access to diverse texts, and collaborative workshops, particularly for children in disadvantaged contexts. Cultural analyses further complicate universalist assumptions about critical thinking. Nyamekye et al. (2025) argued that Ghanaian sociocultural constructions of childhood may constrain critical inquiry, highlighting tensions between respect for authority and questioning practices. These findings caution against exporting Western-centric models of critical thinking without cultural adaptation, emphasizing the need for contextually responsive pedagogies.

Critical literacy approaches offer another avenue for equity-oriented practice. Trigos-Carrillo & Urrea-Hernández (2024) showed that engaging children with issues of oppression and empathy through literature fosters both critical awareness and prosocial dispositions. Similarly, Jones et al. (2025) advocated for post-humanist perspectives that center children's voices, relationships with the environment, and alternative temporalities as foundations for reflective thinking. These approaches collectively challenge narrow skill-based frameworks, positioning critical thinking as intertwined with values, identity, and agency. They also highlight the ethical dimension of critical thinking: who gets to question, whose knowledge counts, and how power circulates in educational spaces. From a critical standpoint, equity-oriented research urges scholars and practitioners to consider not only how to teach critical thinking, but for what purposes and for whom. Without such reflection, critical thinking risks becoming a depoliticized slogan rather than a transformative educational practice.

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Nevertheless, further empirical research is required to examine how equity-oriented pedagogies can be systematically implemented across diverse early childhood contexts.

Emerging Trends and Persistent Gaps

Recent reviews and syntheses indicate growing methodological sophistication and thematic diversification in the field. Asadi et al. (2025) and Arkan & Bal (2025) identified increasing use of explicit instruction, problem-based learning, and authentic tasks, alongside emerging interest in digital well-being, sustainability, and interdisciplinary integration. These trends suggest a maturation of the research landscape. However, persistent gaps remain. Longitudinal studies are scarce, limiting understanding of how early critical thinking trajectories evolve over time. Dispositions such as open-mindedness, skepticism, and intellectual humility remain underexplored relative to cognitive skills. Moreover, the field continues to suffer from conceptual fragmentation, with studies operating under divergent definitions and assessment frameworks.

Critically, much of the literature remains intervention-focused, emphasizing short-term gains rather than systemic transformation. Few studies examine how institutional cultures, assessment regimes, and policy environments shape the sustainability of critical thinking practices in early childhood education. These gaps reinforce the importance of bibliometric and integrative reviews to map trends, identify silences, and guide future inquiry. As the field moves beyond pandemic-driven adaptation, there is a pressing need for theoretically grounded, longitudinal, and context-sensitive research agendas.Taken together, the literature reveals that critical thinking in early childhood education is no longer a marginal or speculative concept, but a central educational concern shaped by pedagogy, technology, culture, and policy. The challenge ahead lies not in demonstrating that young children can think critically, but in designing equitable, ethical, and sustainable systems that enable them to do so meaningfully.

Discussion

This study provides an integrated understanding of critical thinking research in ECE by triangulating bibliometric mapping with a narrative literature review. The findings demonstrate that critical thinking in ECE is not a peripheral topic, but a rapidly diversifying, interdisciplinary, and methodologically evolving research domain. Importantly, the bibliometric clusters and temporal patterns closely mirror the conceptual, pedagogical, and technological shifts identified in the reviewed studies, reinforcing the robustness of the observed trends.

The bibliometric analysis demonstrated a post-pandemic shift toward interdisciplinary, ethically grounded, and pedagogically refined approaches to early childhood critical thinking. This interdisciplinary configuration aligns with recent empirical studies that position critical thinking as both a cognitive competence and a contextual practice shaped by health, well-being, digital literacy, and social participation (Arkan & Bal, 2025; O'Reilly et al., 2025). Compared to earlier reviews that framed critical thinking in ECE primarily within educational psychology (e.g., O'Reilly et al. 2022), the current findings indicate a broadening epistemic landscape, where early childhood critical thinking is increasingly examined in relation to sustainability, health education, and technology-mediated learning.

The prominence of medical and health-related clusters, particularly those involving pediatrics, nursing students, and clinical competence, suggests a post-pandemic recalibration of priorities. This aligns with studies emphasizing decision-making, health literacy, and reasoning under uncertainty as essential life skills that should be nurtured from early childhood (Ou & Parsons, 2024; Tolksdorf et al., 2024). In contrast to traditional ECE research, which often isolates cognitive outcomes, this interdisciplinary convergence reflects a shift toward functional and real-world relevance of critical thinking. Consistent with the bibliometric keyword clusters, the review confirms that pedagogical research has moved beyond abstract skill acquisition toward situated, dialogic, and participatory approaches. Clusters related to teaching, questioning, storytelling, and play correspond closely with empirical evidence showing that critical thinking emerges through social interaction, narrative reasoning, and guided inquiry rather than direct instruction alone (Causey & Spencer, 2024; Martinez-Lejarreta et al., 2024).

When compared with earlier intervention-based studies that emphasized structured problem-solving or explicit instruction (Yarali & Aytar, 2020), more recent work highlights the importance of balance between scaffolding and openness. For instance, the Storythinking Programme (O'Reilly et al., 2025) and detective

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mystery play studies demonstrate that children as young as three can engage in evaluative and inferential thinking when pedagogical conditions are intentionally designed. This aligns with the bibliometric prominence of communication, interpersonal interaction, and language as central nodes, reinforcing the idea that early critical thinking is relational and dialogic, not merely cognitive. Critically, however, the literature also reveals a persistent gap between pedagogical ideals and classroom realities. As identified in studies from South Africa and Ghana (Nyamekye et al., 2025; Zondo et al., 2025), structural constraints such as overloaded curricula and limited professional development continue to hinder sustained implementation. This tension suggests that while pedagogical knowledge has advanced, institutional alignment remains uneven, particularly in low-resource contexts.

The temporal overlay analysis highlights a clear distinction between COVID-19-era research (2019–2023) and post-COVID-19 trajectories (2024–2026). During the pandemic, studies largely focused on maintaining learning continuity through multimedia and distance education, demonstrating that critical thinking could still be developed under constrained conditions (Ilza et al., 2022). This period is reflected in bibliometric clusters dominated by online learning, questionnaires, and validation. Post-pandemic research, however, exhibits a marked thematic shift toward digital ethics, AI integration, and computational thinking, as evidenced by emerging keywords such as critical thinking skills, early childhood education, contrastive learning, and cognitive development. Studies such as Gusmaniarti et al. (2025) and Kalogiannakis & Papadakis (2024) illustrate that technology is no longer treated merely as a delivery medium, but as a cognitive and epistemic tool capable of shaping how children reason, collaborate, and reflect.

Nevertheless, critical perspectives caution against uncritical technological adoption. Ethical analyses of serious games and AI-based interventions warn that poorly designed technologies may suppress reflection and reduce opportunities for dialogic reasoning (Ou & Parsons, 2024). This concern is echoed in the bibliometric visualization, where technology-related clusters remain connected yet secondary to human-centered nodes such as education, children, and communication. This suggests a growing scholarly consensus that technology should augment, not replace, human mediation in early critical thinking development.

Another important alignment between the bibliometric results and the narrative review lies in the emergence of socio-cultural and equity-oriented research clusters. Keywords related to culture, family, library, and community correspond with studies demonstrating that critical thinking is deeply shaped by cultural norms, social expectations, and access to learning resources (Hakkoymaz, 2025; Nyamekye et al., 2025). Compared with earlier universalist models of critical thinking, recent studies adopt more context-sensitive and critical pedagogical lenses, emphasizing children's voices, agency, and participation (Jones et al., 2025; Trigos-Carrillo & Urrea-Hernández, 2024). This expansion challenges narrow, test-oriented interpretations of critical thinking and reframes it as a socially situated, ethically grounded practice. From a critical standpoint, these findings underscore the risk of reproducing inequities if critical thinking is framed solely as an individual cognitive trait detached from cultural and structural contexts.

Taken together, the bibliometric and review findings suggest that critical thinking in early childhood education is undergoing a conceptual redefinition. Rather than being viewed as a simplified version of adult reasoning, it is increasingly understood as a developmentally distinctive, socially mediated, and contextually embedded competence. This reconceptualization aligns with sociocultural and constructivist theories, while also extending them into digital and interdisciplinary domains. Practically, the findings imply that effective promotion of critical thinking in ECE requires: (i) Pedagogical intentionality rather than isolated interventions; (ii) Teacher professional development focused on inquiry, dialogue, and reflective practice; and (iii) Ethically grounded technology integration that preserves human interaction. Despite the growing body of research, several gaps remain. Longitudinal evidence tracking the sustainability of early critical thinking development is limited, and dispositions such as intellectual humility and open-mindedness remain underexplored relative to cognitive skills. Furthermore, the bibliometric dominance of certain regions suggests the need for more Global South and culturally diverse studies. Future research should therefore integrate longitudinal, cross-cultural, and design-based approaches, while also examining how policy, assessment systems, and institutional cultures shape early critical thinking trajectories.

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Conclusion

This study provides a comprehensive synthesis of research on critical thinking in early childhood education by integrating bibliometric mapping with a critical narrative literature review. By examining publications from 2019 to 2026, the study captures the dynamic evolution of scholarly attention during and after the COVID-19 pandemic. The findings indicate that critical thinking has emerged as a central and increasingly interdisciplinary focus within early childhood research, extending beyond traditional educational frameworks to encompass psychological, health-related, technological, and socio-cultural dimensions.

The bibliometric results demonstrate a gradual increase in research output during the COVID-19 period, reflecting scholars' efforts to understand and respond to educational disruptions. This was followed by a substantial post-pandemic expansion characterized by pedagogically oriented and theoretically consolidated studies. Keyword co-occurrence and temporal analyses reveal a clear thematic shift from early pandemic concerns with measurement, health, and emergency remote learning toward post-COVID-19 emphases on early childhood–specific pedagogies, teacher capacity building, play-based inquiry, and ethical digital integration.

The narrative review further illustrates that young children are capable of engaging in critical thinking when supported through intentional, dialogic, and developmentally appropriate pedagogical practices. Across diverse cultural and institutional contexts, effective approaches consistently foreground social interaction, inquiry, storytelling, play, and guided reflection. At the same time, the literature highlights persistent challenges, including conceptual ambiguity, uneven teacher preparation, structural constraints, and risks associated with uncritical adoption of digital technologies.

Overall, this study reinforces the view that critical thinking in early childhood education should be understood as a holistic and socially situated competence rather than a simplified version of adult reasoning. The findings carry several forward-looking implications: first, they highlight the need for pedagogical intentionality, positioning critical thinking as an embedded and continuous dimension of early learning rather than as isolated instructional interventions; second, they underscore the importance of sustained teacher professional development that strengthens inquiry-based, reflective, and dialogic practices across diverse early childhood settings; and third, they call for the ethically grounded integration of digital and AI-based tools, ensuring that technological innovation supports developmental appropriateness, equity, and children's agency rather than undermining them. By systematically mapping research trends and synthesizing key insights, this study offers a valuable reference for researchers, educators, and policymakers seeking to advance critical thinking in early childhood education in an increasingly complex and post-pandemic educational landscape.

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