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The Physical Learning Environment as a Stimulus for Children's Critical Thinking: A Systematic Review

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ABSTRACT

The physical learning environment in early childhood education plays a central role in shaping children's learning experiences, social interactions, and cognitive development. Grounded in the Reggio Emilia concept of the environment as the "third teacher," this article presents a systematic review of empirical studies examining how physical learning environments support the development of critical thinking and problem-solving skills in early childhood. Using the PRISMA-guided Systematic Literature Review approach, 223 initial records published between 2015 and 2025 were screened, resulting in 20 empirical studies that met inclusion criteria, consisting of 15 empirical articles and 5 essential theoretical or methodological articles. Thematic synthesis generated four major themes: spatial organization that promotes autonomy and collaboration; open-ended materials that stimulate exploration and representational thinking; indoor–outdoor continuity that provides authentic reasoning contexts; and teacher mediation that transforms environmental affordances into meaningful cognitive engagement. Findings indicate that well-designed learning environments that are comfortable, aesthetically rich, and creatively arranged enhance children's motivation, inquiry behaviors, reasoning skills, and ability to solve problems. This review highlights practical implications for teachers, curriculum designers, and school administrators in optimizing the learning environment to foster higher-order thinking in early childhood education.

INTRODUCTION

Early childhood education (ECE) has increasingly emphasized the centrality of the physical learning environment as a pedagogical agent that can shape, guide, and extend children's cognitive engagement (Barrett et al., 2015). Within contemporary ECE discourse, learning is understood not merely as an interaction between teacher and child, but as a dynamic relationship involving sociomaterial configurations spaces, objects, light, textures, and affordances that collectively structure children's opportunities for inquiry. The Reggio Emilia philosophy conceptualizes this relationship through the notion of the environment as the "third teacher," highlighting the intentional design of space as a core dimension of curriculum. Rather than serving as a neutral backdrop, the physical environment stimulates curiosity, supports autonomy, and scaffolds higher-order thinking.

Across international literature, the development of critical thinking and problem-solving in early childhood is closely tied to exploratory learning (Lippard et al., 2018). Young children reason by manipulating materials, negotiating meanings with peers, making predictions, and testing hypotheses.

These processes require environments that offer rich affordances open-ended materials, flexible spatial organization, and indoor–outdoor continuity that expands the range of possible actions. Such environmental features directly enable cognitive behaviors including comparing, analyzing, estimating, evaluating, and constructing explanations.

Despite the theoretical consensus about the importance of learning environments, empirical findings remain fragmented. Studies vary widely in design, setting, and conceptual framing, making it difficult to determine which environmental dimensions most consistently support cognitive outcomes. Some research focuses on nature-based learning spaces, others on classroom arrangement, and others on the pedagogical mediation embedded within environmental interaction. Few studies synthesize these perspectives systematically, and even fewer examine how these environmental features contribute specifically to critical thinking and problem-solving. In the Indonesian context, research similarly highlights the developmental significance of well-prepared learning environments. A study by Hidayat and Yuniar (Hidayat & Yuniar, 2023) notes that "An environment that provides comfort and a pleasant atmosphere with creative environmental design can foster motivation to learn and conducive learning." This perspective aligns closely with global findings and underscores the cultural relevance of intentional environment design as part of quality early childhood practice. However, Indonesian ECE scholarship still lacks consolidated empirical evidence linking environmental qualities to children's cognitive reasoning.

Although existing scholarship underscores the importance of the physical learning environment in supporting children's exploratory behaviour and cognitive growth, empirical evidence in this area remains fragmented and theoretically dispersed (Barrett et al., 2015). Prior research varies widely in focus, ranging from classroom layout and open-ended materials to nature-based spaces and teacher mediation, resulting in limited clarity regarding which environmental dimensions most consistently foster critical thinking and problem-solving (Ceppi & Zini, 1998). Moreover, evidence from Southeast Asian and particularly Indonesian early childhood settings is still limited, and few studies explicitly examine the pathways through which environmental qualities contribute to higher-order cognitive outcomes (Iwabuchi K, 2024). These gaps highlight the necessity and feasibility of conducting a systematic and methodologically rigorous synthesis. The present review addresses this need by employing a PRISMA-guided systematic literature review to consolidate findings from diverse global contexts. Its key contribution lies in offering a novel integrative framework that unites four core environmental dimensions, such as spatial organization, open-ended materials, indoor–outdoor continuity, and teacher mediation, to explain how the environment functions as the "third teacher" in stimulating inquiry, reasoning, and complex problem-solving in early childhood education (Strong-Wilson & Ellis, 2007).

Given the importance of higher-order cognitive skills for 21st-century learning, and recognizing the theoretical weight placed on the environment in contemporary pedagogy, a systematic review is needed to integrate empirical findings and identify convergent evidence. This systematic literature review synthesizes research on how the physical learning environment functions as the third teacher in fostering critical thinking and problem-solving in early childhood education. By applying PRISMA methodology and reviewing 20 studies from diverse contexts, this review aims to clarify the mechanisms through which environmental features influence cognition and to provide a conceptual foundation for practitioners, researchers, and policymakers seeking to improve the quality of learning spaces in early childhood settings (OECD, 2017).

Despite increasing scholarly attention to the role of the physical learning environment, prior research reveals several unresolved challenges that justify the need for a systematic review. Studies on classroom design have demonstrated measurable effects on children's learning outcomes, yet these effects remain unevenly distributed across environmental variables, leaving uncertainty about which dimensions most reliably support higher-order cognition (Barrett et al., 2015). Research on nature play further indicates positive associations with curiosity, executive function, and creative thinking, but the mechanisms linking these environmental affordances to critical thinking remain theoretically underdeveloped (Ernst & Burcak, 2019). In addition, although early childhood systems in Southeast Asia are undergoing rapid expansion, empirical evidence related to how learning spaces influence cognitive development is still sparse, particularly in Indonesia and neighboring countries, resulting in

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limited contextual understanding of environmental quality and its cognitive implications (Iwabuchi K, 2024). Dialogic studies on sustained shared thinking highlight the importance of pedagogical mediation in helping children articulate reasoning within environmental interactions; however, such research often isolates teacher and child dialogue from the material and spatial features that enable these cognitive exchanges (Macha et al., 2024). Furthermore, classic work on schoolground design shows that outdoor environments can stimulate autonomy, exploration, and problem-solving, yet inconsistencies in design practices and implementation continue to constrain children's opportunities for meaningful environmental engagement (Malone & Tranter, 2003). Collectively, these gaps underscore the need for an integrative synthesis that consolidates fragmented findings and clarifies how specific environmental dimensions function to stimulate children's critical thinking.

The review contributes to the field in three ways. First, it consolidates empirical findings and identifies four key environmental dimensions that have the strongest influence on cognitive outcomes (Barrett et al., 2015a). Second, it situates these findings within theoretical frameworks including Reggio Emilia, affordance theory, and Vygotskian mediation to provide a multi-layered explanation of how environmental interaction supports reasoning. Third, it offers implications for educational practice and environmental design, particularly for contexts such as Indonesia where learning spaces are undergoing rapid transformation. Through this synthesis, the study advances a more coherent understanding of the interplay between environment and cognition in early childhood education.

METHOD

This study employed a Systematic Literature Review (SLR) approach guided by the PRISMA 2020 protocol to ensure transparent, rigorous, and reproducible reporting of the review process (Page et al., 2021). Considering the considerable heterogeneity in research designs, settings, cognitive indicators, and environmental dimensions across the existing literature, this review adopted a configurative orientation using a qualitative thematic synthesis approach. A thematic synthesis was deemed appropriate because the objective was not statistical aggregation but the construction of an integrative explanatory framework that clarifies the mechanisms through which physical learning environments function as the "third teacher" in fostering children's critical thinking and problem-solving skills (Thomas & Harden, 2008). Based on this orientation, the review was structured around three guiding questions: (1) which dimensions of the physical learning environment are most consistently associated with children's cognitive outcomes; (2) how these environmental dimensions support higher-order cognitive processes; and (3) how findings across diverse global and regional contexts including Southeast Asia and Indonesia inform the design of effective early childhood learning environments.

To address these questions, a comprehensive search was conducted across five major interdisciplinary databases; SciSpace, Google Scholar, ERIC, PubMed, and Semantic Scholar covering publications from January 2015 to October 2025. The search strategy incorporated controlled descriptors and Boolean operators such as "physical learning environment," "third teacher," "Reggio Emilia," "open-ended materials," "environmental affordances," "indoor–outdoor learning," "critical thinking," and "problem solving," derived from seminal literature on environmental design and early cognitive development (Malone & Tranter, 2003; Moore, 1985). The initial search produced 223 records, and after removing 25 duplicates, 198 records remained for title and abstract screening. At this stage, 152 articles were excluded for not meeting criteria related to age range, absence of environmental focus, or lack of cognitive outcomes. The remaining 46 full-text articles were assessed using predefined eligibility criteria (Population: Children aged 3–8 years, Focus: Examination of physical learning environments, Outcomes: Evidence related to critical thinking, reasoning, or problem-solving skills, Design: Empirical, peer-reviewed research reporting observational, experimental, or intervention-based findings and Language: Published in English), resulting in 20 studies that were retained for synthesis, comprising 15 empirical studies and 5 theoretical or methodological papers essential for interpreting mechanisms linking environment and cognition.

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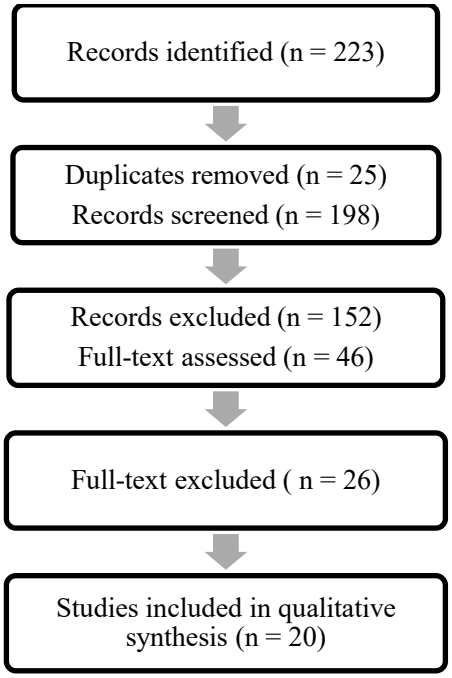

Figure 1. PRISMA Flowchart

Data extraction was performed using a structured coding matrix specifically developed for this review to ensure consistency and completeness. Extracted information included bibliographic details, country and educational setting, research design, sample characteristics, environmental features examined, cognitive outcome indicators, and major findings. To enhance reliability, two reviewers independently coded a subset of the studies to calibrate coding decisions, and discrepancies were resolved through consensus. Methodological quality appraisal was conducted using the Joanna Briggs Institute (JBI) Critical Appraisal Checklists tailored to the respective study designs. The JBI instruments assess methodological congruence, sampling appropriateness, rigor of data collection, adequacy of data analysis, attention to contextual factors, and coherence between evidence and conclusions (Joanna Briggs Institute, 2017; Lockwood et al., 2015). Each empirical study was categorized as high, moderate, or low quality, while theoretical papers were assessed based on conceptual coherence and relevance to the aims of this review.

Given the diversity of designs and outcome measures found across the studies, data analysis followed the three iterative stages of thematic synthesis proposed by (Thomas & Harden, 2008). First, line-by-line coding was conducted on all findings sections to identify recurring descriptions of environmental features, affordances, teacher mediation, and children's reasoning behaviors. Second, related codes were clustered to develop descriptive themes that captured consistent patterns across contexts. Third, analytical themes were generated to provide deeper explanatory insights into how environmental dimensions promote critical thinking and problem-solving. Through this process, four cross-cutting themes were identified spatial organization, open-ended materials, indoor–outdoor continuity, and teacher mediation which collectively illuminate how the physical environment functions as an active pedagogical force.

In addition to the PRISMA flowchart (Figure 1), a research workflow diagram was developed to illustrate the logical sequence of the review, beginning with the formulation of review questions, followed by database searching, screening and eligibility assessments, data extraction, quality appraisal, thematic synthesis, and interpretation of findings. This workflow underscores the systematic and sequential procedures undertaken to produce a coherent and methodologically sound synthesis of how physical learning environments stimulate higher-order cognitive development in early childhood.

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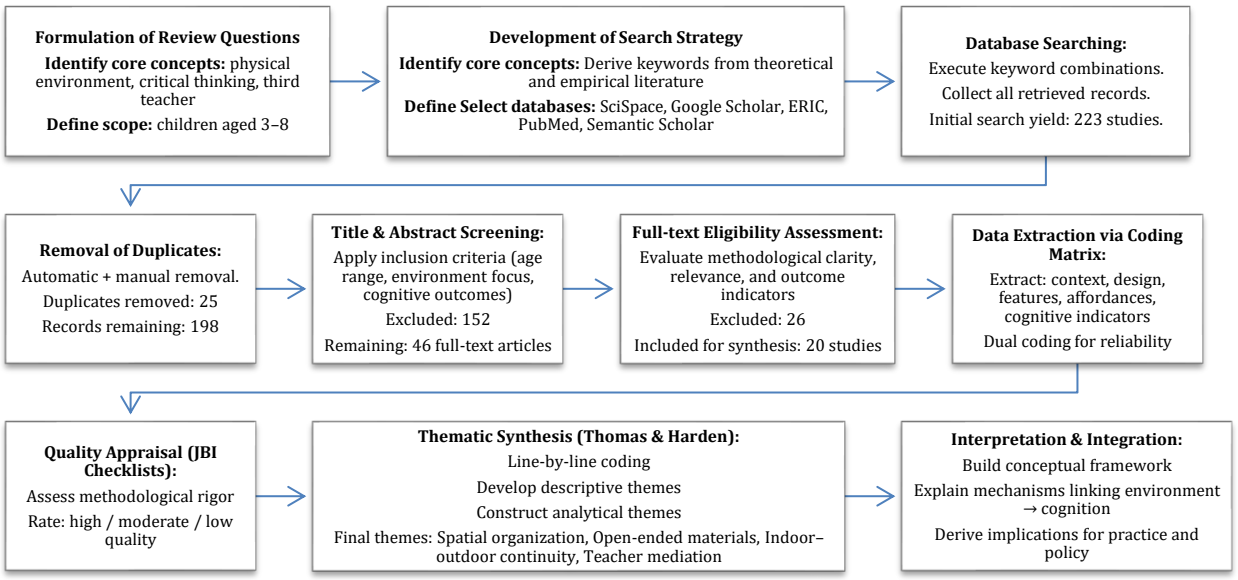

Figure 2. Research Workflow

Figure 2 illustrates the sequential workflow of the systematic review, beginning with the formulation of review questions and development of the search strategy, followed by database searching, screening, and eligibility assessment. The process continues with data extraction using a structured coding matrix, methodological quality appraisal with the JBI checklists, and a multi-stage thematic synthesis to generate analytical themes. This workflow reflects the methodological rigor and transparency underlying the construction of the integrative framework linking physical learning environments to children's critical thinking.

RESULTS AND DISCUSSION

The synthesis of 20 selected studies revealed four dominant themes regarding how the physical learning environment functions as a third teacher in supporting young children's cognitive development. The themes spatial organization, open-ended materials, indoor–outdoor continuity, and teacher mediation emerged consistently across multiple cultural and methodological contexts. Collectively, the findings affirm that cognitive competencies in early childhood are strongly influenced by intentional environmental design rather than instructional practices alone.

Spatial Organization and Cognitive Autonomy

Spatial organization consistently appeared as a foundational environmental factor influencing children's autonomy, decision-making, and emergent reasoning. Empirical work on classroom layout demonstrates that flexible, clearly structured spaces support higher levels of cognitive engagement, enabling children to navigate tasks independently and sustain focus (McCluskey et al., 2023; Misirli et al., 2019). Studies examining innovative learning environments further indicate that children engage in more complex planning, strategy selection, and collaborative negotiation when spatial transitions are intuitive and materials are visibly accessible (Tobia et al., 2022). Similar patterns were identified in research evaluating the evaluative dimensions of physical learning environments, emphasizing the role of spatial cues in supporting regulation of attention and problem-solving behaviors (Matthews & Lippman, 2019; WangQian et al., 2025). These findings suggest that spatial clarity does not merely enhance comfort but provides cognitive scaffolding that strengthens autonomy and encourages children to enact reasoning processes without direct adult intervention.

Open-Ended Materials and Exploratory Reasoning

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Open-ended materials loose parts, natural objects, and versatile manipulatives were found to stimulate exploratory reasoning by promoting divergent thinking, hypothesis generation, and trial-and-error exploration. Case study research from North Carolina preschools highlights that children interacting with open-ended materials demonstrate more sustained inquiry, deeper reflection, and flexible cognitive responses to emerging challenges (Zamani, 2016). Similarly, studies of exploratory play identify that open-ended materials allow children to symbolically represent ideas, test structural properties, and manipulate objects in iterative cycles of experimentation (Oncu, 2015; Trinanda & Yaswinda, 2022). Additional evidence from early childhood creativity research shows that such materials enhance children's analytical reasoning by expanding opportunities for problem representation and strategy revision (Cankaya et al., 2025). Collectively, these findings confirm that open-ended materials operate as powerful cognitive affordances that intrinsically prompt children to question, explore, and reason.

Indoor–Outdoor Continuity and Problem-Solving Complexity

Studies focusing on outdoor learning environments emphasize that continuity between indoor and outdoor spaces enriches children's problem-solving complexity. Research shows that natural landscapes offer multisensory stimuli that require children to observe, infer, predict, and adapt strategies when interacting with dynamic environmental features (Julia Torquati et al., 2017; Koepp et al., 2022). Nature-based play encourages deeper engagement with causal relationships such as water flow, plant growth, and physical forces all of which demand higher-order reasoning. Broader developmental reviews confirm that regular access to outdoor play environments enhances analytical thinking, spatial reasoning, and strategic adaptability (Mcclain & Vandermaas-Peeler, 2016). The synthesis indicates that children who move fluidly between indoor reflection spaces and outdoor exploratory contexts develop more complex problem-solving repertoires, suggesting that environmental continuity expands cognitive demands in meaningful and developmentally appropriate ways.

Teacher Mediation and Environmental Scaffolding

Although the physical environment provides the foundational cognitive affordances, teacher mediation remains essential in activating and extending these opportunities. Research shows that practices such as sustained shared thinking, reflective dialogue, and inquiry-based questioning significantly enhance children's ability to justify ideas, evaluate evidence, and articulate reasoning sequences (Salmon & Barrera, 2021). Studies comparing play-based and formal learning environments indicate that teacher scaffolding is most effective when aligned intentionally with environmental affordances, allowing children to integrate their observations with guided cognitive structuring (Skene et al., 2022). Contemporary research on play-based continua confirms that teacher roles including facilitator, co-investigator, and dialogic partner shape the ways children engage with environmental features to construct meaningful cognitive pathways (Pyle & Danniels, 2017). These findings underscore that the third teacher operates optimally when human mediation and environmental design are integrated, forming a cohesive cognitive ecology.

The findings of this review reaffirm the central claim of the Reggio Emilia philosophy that the environment serves as a "third teacher," shaping the ways children think, explore, and solve problems (Johnstone et al., 2022; Robson & Mastrangelo, 2017). Across the twenty empirical studies synthesized, the physical learning environment emerged not as a passive background variable but as an active cognitive ecology a constellation of spatial, material, and social affordances that jointly scaffold children's reasoning processes. This understanding aligns with (Gibson, 2014) affordance theory, which posits that environments provide concrete action possibilities that children can perceive and activate. When classrooms are intentionally designed, these affordances become catalysts for exploration, hypothesis testing, reflection, and collaborative inquiry.

Four dominant mechanisms were identified in this review. First, spatial organization strongly influenced children's autonomy and decision-making. Clearly defined learning zones, visual openness, and predictable pathways enabled children to navigate tasks independently, plan actions, and sustain engagement. Research in Reggio-inspired settings shows that spatial clarity communicates expectations and supports children's metacognitive awareness of how and where learning happens (Fernández-Santín

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& Feliu-Torruella, 2020). Second, material richness especially open-ended, natural, and loose-part materials stimulated experimentation and divergent thinking. These materials afford multiple uses, enabling children to construct, combine, represent, and transform ideas, which are fundamental processes in early critical thinking (Agustini et al., 2024; Haenilah et al., 2021).

Third, indoor–outdoor continuity emerged as a consistent catalyst for deeper inquiry. Studies in Nordic and European contexts demonstrate that nature-based or outdoor learning environments promote observational acuity, causal reasoning, and resilience during problem-solving tasks (Kiviranta et al., 2024). (Wang, 2022) similarly found that physical activity and naturalistic exploration enhance children's reasoning and emotional regulation, suggesting that cognitive development is inseparable from embodied interaction with the environment. The reviewed studies revealed that when indoor and outdoor spaces are treated as interconnected zones of inquiry, children demonstrate more sophisticated scientific thinking such as predicting outcomes, comparing phenomena, and explaining causes.

Fourth, teacher mediation played a pivotal role in amplifying the cognitive potential of the environment. Although affordances make certain types of thinking possible, sociocultural theory (Vygotsky, 1978) reminds us that learning is mediated through language, dialogue, and shared meaning-making. The review shows that teacher behaviors such as sustained shared thinking, inquiry prompts, reflective questioning, and co-analysis of materials significantly enhanced children's reasoning. This indicates that the environment and the teacher function synergistically. A well-designed environment invites inquiry, but intentional teacher mediation extends it, helping children articulate justifications, evaluate alternatives, and refine their ideas.

These international insights also resonate with emerging Indonesian research. (Hidayat & Yuniar, 2023) highlight how aesthetically designed reading corners foster comfort, sustained attention, and positive learning dispositions conditions necessary for critical thinking to emerge. (Rosidah et al., 2024) demonstrate that inquiry-based experiences in Indonesian PAUD settings can cultivate curiosity and analytical skills, although many studies still underemphasize the role of physical design. This SLR therefore fills a critical gap by positioning the physical environment at the center of cognitive development, complementing local pedagogical frameworks that focus on teacher practices and learning models. The alignment between international findings and Indonesian contexts suggests that principles of environmental design such as clarity, beauty, openness, and access to natural elements are not culturally bound but broadly applicable.

Despite these converging findings, several gaps remain. Most studies were qualitative, relying heavily on observation and descriptive documentation (Fleer et al., 2014). While these designs capture rich interactions, they limit causal conclusions regarding how specific environmental features influence cognitive outcomes. There is also a geographical skew: much of the literature derives from Western or high-resource contexts. Research from Southeast Asia remains limited, underscoring the need for culturally grounded investigations of environmental affordances in diverse settings, including urban and rural Indonesian PAUD. Furthermore, only a few studies used validated measures of critical thinking, problem-solving, or early STEM reasoning. Strengthening methodological diversity through mixed-methods, quasi-experimental designs, and longitudinal tracking would enhance the robustness of future evidence.

Another notable gap concerns teacher capacity. Many studies report that teachers often underutilize environmental affordances because of limited training in environment-based pedagogy. This indicates a need for professional development that helps educators "read" the environment, curate materials responsively, and strategically position themselves as co-thinkers rather than mere supervisors. International guidelines, such as those from (ACECQA, 2018), emphasize that the environment cannot function as the third teacher unless educators intentionally mediate its affordances. This point is particularly relevant in Indonesian PAUD, where teacher workload and curriculum constraints often limit opportunities for inquiry-based, child-led exploration. Recent empirical evidence documents that PAUD teachers frequently face excessive workloads and time constraints, which significantly limit their ability to design and mediate environment-rich, inquiry-based learning activities (Fiatunnabilah et al., 2025). Moreover, even where environmental resources are available, many early childhood institutions struggle to integrate them effectively into daily pedagogical practice; the implementation of environment-based learning is often inconsistent and hampered by limited pedagogical guidance (KF et

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al., 2024). These findings reinforce the need for directed professional development, including capacity-building in environmental literacy, material curation, and dialogic mediation if the vision of the environment as a "third teacher" is to be realized reliably across diverse Indonesian PAUD contexts.

Overall, this review demonstrates that the physical learning environment has substantial but underutilized potential to foster critical thinking and problem-solving in early childhood education (Barrett et al., 2015; Matthews & Lippman, 2019; Strong-Wilson & Ellis, 2007). When spatial design, material provision, outdoor integration, and teacher mediation are intentionally aligned, children engage in deeper observation, explanation, justification, and evaluation the core components of higher-order thinking. This synthesis provides a foundation for educational decision-makers, school leaders, and teacher educators to recognize environmental design not as an aesthetic afterthought, but as a central dimension of curriculum, pedagogy, and quality assurance in early childhood education.

The findings of this systematic review offer several implications for strengthening early childhood education practice, particularly in settings that aim to develop critical thinking and problem-solving through intentional environmental design. First, educators and school leaders should view the physical environment not as a decorative element, but as an integral pedagogical tool. Following the Reggio Emilia perspective, spaces should be curated with clear learning zones, visual coherence, and aesthetically inviting arrangements that communicate expectations and support children's autonomy (Strong-Wilson & Ellis, 2007). Simple design decisions such as ensuring visibility, reducing clutter, and providing accessible materials can significantly increase children's opportunities for independent exploration and reasoning.

Second, the strategic provision of open-ended and natural materials should be prioritized. Loose parts, natural objects, blocks, and manipulatives encourage experimentation, comparison, transformation, and symbolic representation processes foundational to critical thinking (Agustini et al., 2024; Haenilah et al., 2021). Teachers should rotate materials periodically, scaffold their use through reflective dialogue, and design tasks that invite children to test hypotheses or negotiate solutions collaboratively.

Third, practitioners should intentionally connect indoor and outdoor learning environments. Nature-rich and open outdoor spaces have been shown to strengthen children's observational skills, causal reasoning, and resilience during problem-solving tasks (Kiviranta et al., 2024; Wang, 2022). Schools can integrate outdoor inquiry experiences such as sensory trails, garden investigations, and natural loose-parts play, ensuring that children regularly engage with dynamic, real-world phenomena that stimulate scientific thinking.

Fourth, the review highlights the need to strengthen teacher mediation skills. Environmental affordances alone are insufficient without intentional teacher interaction. Professional development should equip teachers to engage in sustained shared thinking, ask open-ended questions, acknowledge children's reasoning processes, and scaffold analytical thinking within everyday routines and play experiences. International quality frameworks, such as (ACECQA, 2018), emphasize that teacher practices must align with environmental design for the environment to function effectively as the third teacher.

Finally, this review underscores the importance of context-responsive implementation in Indonesia. As evidenced by local studies, aesthetically pleasing, comfortable, and well-organized spaces such as reading corners can increase children's motivation and engagement (Hidayat & Yuniar, 2023). Schools and policymakers should consider cultural values, classroom size, community resources, and curriculum expectations when designing environments that foster inquiry and reasoning. Even in low-resource contexts, meaningful improvements can be achieved through low-cost materials, community support, and teacher creativity in arranging spaces that invite exploration.

Collectively, these implications demonstrate that intentional environmental design, coupled with responsive teacher mediation, can transform early childhood classrooms into cognitive laboratories where young children learn to observe, question, justify, and solve problems. The environment must therefore be positioned as a central pillar in curriculum planning, teacher development, and quality assurance within early childhood education.

CONCLUSION

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This systematic literature review synthesizes evidence from 20 empirical studies investigating the influence of the physical learning environment conceptualized as the "third teacher" on the development of critical thinking and problem-solving skills in early childhood education. The review demonstrates that thoughtfully designed learning environments play a decisive and measurable role in fostering higher-order cognitive processes among young children (Barrett et al., 2015; Julia Torquati et al., 2017; Matthews & Lippman, 2019; McCluskey et al., 2023). Across the reviewed studies, environments characterized by aesthetic quality, flexible spatial organization, rich material affordances, and opportunities for exploration consistently supported children's ability to observe, reason, hypothesize, collaborate, and generate solutions to real-world problems.

The findings affirm the Reggio Emilia premise that the environment functions not merely as a backdrop for learning but as an active pedagogical agent (Fernández-Santín & Feliu-Torruella, 2020). Classrooms that are intentionally organized to promote autonomy and inquiry such as through open-ended materials, interactive learning centers, nature-based settings, and transparent display of children's thinking show stronger alignment with children's cognitive growth (McCluskey et al., 2023; Misirli et al., 2019). The evidence also highlights the importance of environmental cues that create psychological comfort and motivation. As emphasized in relevant Indonesian literature, "An environment that provides comfort and a pleasant atmosphere for children, especially when complemented by creative spatial arrangements, can foster learning motivation and support a conducive learning process." reinforcing that aesthetics, emotional climate, and spatial design are integral components of cognitive engagement (Barrett et al., 2015b; Hidayat & Yuniar, 2023).

Despite the promising findings, the review identifies several gaps. Research in low-resource settings remains limited, and there is a need for longitudinal and experimental studies that directly measure causal pathways between environmental design and cognitive outcomes (Matthews & Lippman, 2019; Skene et al., 2022). Additionally, few studies integrate culturally responsive or locally grounded design principles, including those relevant to Indonesian early childhood contexts.

Overall, this review concludes that the physical learning environment is a significant and underutilized lever for enhancing critical thinking and problem-solving skills in early childhood education (Barrett et al., 2015; Robson & Mastrangelo, 2017). By positioning the environment as a pedagogical partner, educators and policymakers can more effectively design learning spaces that cultivate curiosity, creativity, and cognitive resilience in young learners. Strengthening environmental design within early childhood settings thus represents a strategic and evidence-based pathway toward improving the quality of learning experiences and supporting children's holistic development.

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