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Development of Educational Play Tools to Enhance Early Childhood Creativity: A Literature Review on Design, Implementation, and Learning Effectiveness

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ABSTRACT

Creativity is a fundamental developmental capacity in early childhood because it supports imagination, divergent thinking, problem solving, flexibility, and the ability to generate original ideas. Educational play tools can provide meaningful opportunities for these processes when they are designed and implemented in accordance with children's developmental characteristics. This literature review aimed to synthesize recent evidence on the development of educational play tools for enhancing early childhood creativity, with particular emphasis on design characteristics, implementation strategies, and learning effectiveness. A structured literature review was conducted using studies published between 2016 and 2026 and identified through Scopus, Web of Science, ERIC, ScienceDirect, Google Scholar, and SINTA/GARUDA. Thirteen articles met the inclusion criteria and were analyzed using narrative and thematic synthesis. The results showed that 8 of the 13 studies (61.5%) focused on loose parts or other open-ended manipulable materials, while the remaining studies examined digital games, blocks, educational game models, and tangram-based activities. Empirical findings consistently indicated positive effects on creativity. One study reported a significant difference between loose-parts and conventional learning groups ($Z = -2.183$, $p = .029$), while other studies reported increases in mean creativity scores from 16.38 to 22.63 and from 7.769 to 13.385 ($p < .001$). Developed educational games also demonstrated high feasibility and effectiveness, reaching 92% feasibility and 93% effectiveness. Overall, effective educational play tools are characterized by open-endedness, manipulability, safety, flexibility, child autonomy, meaningful exploration, and appropriate teacher scaffolding. These findings support the integration of design, implementation, and effectiveness as a comprehensive framework for creativity-oriented early childhood learning.

KEYWORDS: Early Childhood Creativity; Educational Play Tools; Loose Parts; Play-Based Learning; Creative Learning.

INTRODUCTION

Creativity is increasingly recognized as a fundamental developmental capacity that should be cultivated from early childhood because it supports children's ability to generate ideas, explore alternatives, solve problems, adapt to new situations, and express their understanding of the surrounding world. Rather than being viewed merely as artistic talent, creativity in early childhood represents a multidimensional cognitive and socio-emotional process involving imagination, divergent thinking, curiosity, experimentation, and flexible problem solving. Recent evidence indicates that creativity develops through continuous interactions among children's individual characteristics, learning experiences, social relationships, and environmental opportunities (Xu et al., 2025). From an ecological perspective, therefore, creative development cannot be separated from the learning environment and the materials through which children interact with people, objects, and ideas. Play constitutes one of the most developmentally appropriate contexts for creating such

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interactions. Yogman et al. (2018) explain that play promotes executive functioning, language, social competence, self-regulation, problem solving, and children's sense of agency, while simultaneously providing opportunities for experimentation and imagination. In a constructivist learning perspective, children do not simply receive information but actively construct knowledge by manipulating objects, testing possibilities, observing consequences, and reorganizing their understanding through experience. Accordingly, educational play tools or alat permainan edukatif (APE) should not merely function as entertaining objects; they should constitute pedagogical environments that invite children to investigate, transform, combine, represent, and create. However, early childhood learning practices do not always provide such opportunities. Educational activities may remain dependent on worksheets, predetermined products, teacher-directed instructions, or learning media that provide only one expected answer. Indonesian empirical evidence suggests that learning with more flexible materials can produce different behavioral and developmental outcomes. Nurjanah and Muthmainah (2023), for example, found that children exposed to loose-parts media demonstrated significantly better creativity than children using conventional worksheets or magazines. Wardhani et al. (2021) similarly reported that manipulable materials enabled children to exercise imagination while developing independence, cooperation, responsibility, and confidence. These findings indicate that the pedagogical value of an educational play tool depends not merely on its physical presence but on the possibilities for action, exploration, and meaning-making embedded in its design.

Contemporary research has increasingly shifted from viewing toys as supplementary classroom materials toward understanding play environments as intentional learning systems. Gibson et al. (2017) demonstrated through a systematic review that loose-parts interventions provide opportunities for child-led and flexible play, although the evidence base remained methodologically diverse. Dillon (2018) further argued that open-ended materials stimulate imagination, innovation, and exploratory thinking because their functions are not completely predetermined. This principle is consistent with an affordance-oriented perspective: the educational value of an object emerges from the range of meaningful actions that the object allows children to perceive and perform. More recent research strengthens this position. Cankaya et al. (2023) conceptualized loose-parts play as an integrative activity in which object exploration, symbolic play, pretend play, and constructive play may support reasoning, problem solving, self-regulation, and divergent thinking. In nature-based contexts, Dankiw et al. (2020) found consistent positive associations between unstructured nature play and imaginative or dramatic play behavior, suggesting that flexible environments expand children's opportunities to generate their own play narratives. Indonesian studies provide comparable evidence. Dewi et al. (2023) reported positive effects of loose-parts media on young children's cognitive development, while Rahma et al. (2023) observed that varied loose materials encouraged children to produce different creations, express ideas more freely, and participate actively in learning. Selvi (2022) consequently emphasized that educational play tools require attention to quality, functionality, features, safety, comfort, reliability, and attractive design rather than pedagogical content alone.

The state of the art also demonstrates a growing convergence between physical and digital forms of educational play. Behnamnia et al. (2020), after reviewing research on digital game-based learning applications for preschool children, concluded that properly designed digital games can strengthen creative thinking, motivation, critical thinking, and positive attitudes toward learning. Alotaibi's (2024) systematic review and meta-analysis similarly found moderate-to-large effects of game-based learning across cognitive, social, emotional, motivational, and engagement outcomes. Nevertheless, effective educational games require appropriate content, developmentally suitable challenges, interactivity, meaningful feedback, and connections between game experiences and authentic learning. Research on technology education in early childhood likewise indicates that technology becomes pedagogically meaningful when children participate actively in designing, constructing, investigating, and solving problems rather than consuming digital content passively (Eliasson et al., 2023). Sua et al. (2023) reached a comparable conclusion in reviewing early childhood coding curricula, highlighting the importance of examining design, implementation, and evaluation as interconnected dimensions of educational innovation.

Another significant development concerns the role of adults during play. Contemporary play theory no longer treats completely free play and direct instruction as mutually exclusive pedagogical choices. Skene et al. (2022), in a systematic review and meta-analysis of 39 studies, conceptualized guided play as a productive middle ground between child autonomy and intentional adult support. Their findings showed advantages of

guided play for several learning outcomes compared with direct instruction or free play. Thus, educational play tools may be most effective when their design preserves children's agency while enabling teachers to scaffold questioning, experimentation, collaboration, reflection, and increasingly complex forms of creativity.

Despite these advances, the literature remains fragmented. First, many studies examine isolated forms of media loose parts, digital games, natural materials, coding tools, or specific manipulatives without synthesizing the common design characteristics that make an educational play tool creativity-enhancing. Second, substantial attention has been directed toward learning outcomes, whereas fewer studies simultaneously examine the complete sequence of design, classroom implementation, and effectiveness evaluation. Third, creativity is frequently positioned as one outcome among several cognitive or developmental variables rather than being analyzed as the primary construct through dimensions such as originality, flexibility, fluency, imagination, elaboration, and problem-solving behavior.

Methodological limitations are also evident. Cankaya et al. (2023) noted continuing gaps in evidence directly connecting preschool loose-parts experiences and cognitive development, while reviews of play-based learning reveal considerable heterogeneity in definitions, interventions, and implementation practices (Skene et al., 2022). Dean and Wenner (2025) additionally identified geographical imbalances in play-based learning scholarship, with research concentrated largely in North American and European settings. Xu et al. (2025) similarly highlighted limited evidence regarding long-term developmental outcomes, interactions across ecological levels, and cultural adaptability. Although Indonesian studies increasingly demonstrate benefits of loose parts and related learning media, studies such as Nurjanah and Muthmainah (2023), Dewi et al. (2023), and Utami and Sujarwo (2025) predominantly evaluate particular interventions in specific settings. Consequently, an integrative synthesis explaining what should be designed, how it should be implemented, under what pedagogical conditions it functions, and how its effectiveness for creativity should be evaluated remains needed.

Accordingly, this literature review aims to critically synthesize contemporary evidence concerning the development of educational play tools for enhancing creativity in early childhood, with particular attention to three interconnected dimensions: design characteristics, pedagogical implementation, and learning effectiveness. Specifically, the review seeks to identify developmentally appropriate design principles; examine how educational play tools facilitate exploration, imagination, divergent thinking, collaboration, and problem solving; analyze the roles of teachers, child agency, learning environments, and material characteristics during implementation; and evaluate the empirical evidence regarding their effectiveness. The novelty of this review lies in moving beyond a conventional inventory of educational toys toward an integrative Design Implementation Effectiveness framework. Within this framework, effective APE is conceptualized as open-ended, manipulable, safe, attractive, adaptable, contextually meaningful, and capable of generating multiple solutions rather than predetermined responses. Implementation is understood as an interaction between children's agency and intentional pedagogical scaffolding, while effectiveness is interpreted through observable creative processes and developmental outcomes. This synthesis therefore connects material design, play pedagogy, creativity theory, and empirical evidence within a unified analytical framework.

Overall, contemporary evidence establishes play as an essential learning mechanism and suggests that appropriately designed educational play tools can create rich conditions for imagination, exploration, flexible thinking, problem solving, and creative expression. Nevertheless, the effectiveness of such tools cannot be inferred solely from their novelty or attractiveness; it depends on the interaction among design affordances, developmental appropriateness, child autonomy, teacher scaffolding, implementation context, and assessment strategy. A systematic synthesis of these dimensions is therefore necessary to establish stronger conceptual and empirical foundations for developing educational play tools that meaningfully enhance creativity in early childhood education.

METHOD

This study employed a structured literature review approach to synthesize empirical and conceptual evidence concerning the development of educational play tools for enhancing creativity in early childhood, particularly in relation to their design characteristics, classroom implementation, and learning effectiveness. A literature review was treated as an independent research method rather than merely a descriptive summary

because systematic synthesis enables researchers to integrate fragmented findings, identify theoretical patterns, and reveal gaps requiring further investigation (Snyder, 2019; Kraus et al., 2022). The review procedure was organized systematically following the principles proposed by Booth et al. (2016), Xiao and Watson (2019), and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) developed by Page et al. (2021). PRISMA was used primarily to strengthen transparency in identification, screening, eligibility assessment, and final study inclusion.

The literature search covered publications from 2016 to 2026, thereby representing contemporary developments in early childhood education, educational play, creativity, learning media, and play-based pedagogies. Electronic searches were conducted across Scopus, Web of Science, ERIC, ScienceDirect, Google Scholar, and SINTA/GARUDA. Search terms were formulated individually and in Boolean combinations, including “educational play tools,” “educational toys,” “educational games,” “early childhood creativity,” “creative thinking,” “play-based learning,” “learning media,” “loose parts,” “educational game design,” “early childhood education,” and their Indonesian equivalents. The systematic use of predefined concepts and keyword combinations was intended to reduce arbitrary article selection, consistent with the recommendations of Xiao and Watson (2019) and Palmatier et al. (2018), who emphasize explicit search procedures as a central component of rigorous review research.

Studies were included when they: (1) were peer-reviewed journal articles published within the specified period; (2) focused on children in early childhood or preschool education; (3) investigated educational games, play materials, manipulatives, loose parts, digital or physical educational play tools; (4) addressed creativity, divergent thinking, imagination, problem solving, or closely related developmental outcomes; and (5) provided sufficient information concerning design, implementation, and/or effectiveness. Articles were excluded when they concerned populations outside early childhood education, discussed games without educational or developmental objectives, lacked clear methodological information, were duplicate publications, or consisted primarily of editorials, book reviews, theses, and non-peer-reviewed materials. Such explicit eligibility criteria improve methodological consistency and reduce selection bias in evidence synthesis (Munn et al., 2018; Page et al., 2021).

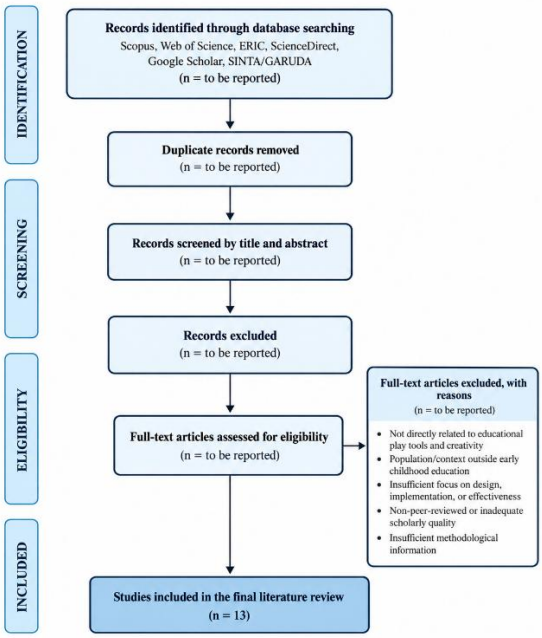


Figure 1. Prisma 2020 Flow Diagram of study selection

Following title and abstract screening and subsequent full-text eligibility assessment, 13 articles constituted the final review corpus. Each article was examined using a structured extraction matrix containing authorship and year, country and educational context, participant characteristics, type of educational play tool, theoretical foundation, research design, design characteristics, implementation procedures, creativity indicators, assessment instruments, major findings, limitations, and implications. This structured extraction

strategy reflects the integrative principles proposed by Torraco (2016) and Snyder (2019), in which literature is compared conceptually and methodologically rather than summarized study by study.

The extracted evidence was subsequently analyzed through narrative and thematic synthesis. Findings were coded and organized into three overarching analytical domains: (1) educational play tool design, (2) pedagogical implementation, and (3) effectiveness in enhancing early childhood creativity. Within these domains, recurring themes included open-endedness, manipulability, safety, visual attractiveness, child autonomy, teacher scaffolding, exploratory learning, originality, flexibility, fluency, imagination, and problem-solving behaviors. Comparison across studies considered consistency, contradictions, methodological quality, contextual differences, and strength of empirical evidence rather than relying solely on the statistical significance reported in individual studies. This procedure supports the purpose of integrative reviews to move from description toward conceptual synthesis and theory development (Torraco, 2016; Paul & Criado, 2020). Overall, the method provided a transparent and theoretically grounded foundation for identifying how educational play tools can be designed and implemented to foster creativity meaningfully within early childhood learning environments.

RESEARCH RESULTS AND DISCUSSION

Research Results

Characteristics of the Reviewed Studies

The synthesis of 13 selected articles demonstrated a consistent body of evidence supporting educational play tools as developmentally appropriate media for stimulating creativity in early childhood. The reviewed studies covered physical loose-parts materials, conventional educational game tools, blocks, tangram-based games, and digital game-based learning. Although the interventions varied substantially in technological complexity, a common characteristic across successful approaches was the opportunity provided for children to manipulate materials, generate alternatives, experiment with ideas, and construct products without depending entirely on predetermined teacher examples.

Loose-parts-based learning represented the most frequently investigated approach in the review corpus. Eight of the 13 studies examined loose parts directly or used open-ended manipulable materials as the primary learning medium. The remaining studies investigated digital game-based learning, general educational game models, conventional educational game tools such as blocks, and tangram-based educational games. This distribution indicates a strong contemporary research interest in open-ended and reusable materials, particularly because the same object can be rearranged, combined, separated, and reconstructed according to children's ideas. Studies by Eriani et al. (2022), Nurjanah and Muthmainah (2023), Lismayani et al. (2023), Sardi and Mayar (2023), and Yuliani and Kristiana (2024) consistently associated this flexibility with greater opportunities for creative thinking and independent exploration.

Table 1. Characteristics and Main Findings of the 13 Reviewed Studies

Study	Type of Educational Play Tool	Design / Participants	Main Creativity-Related Finding
Behnamnia et al. (2020)	Digital game-based learning applications	Case study; 7 preschool children aged 3–6	Digital games supported creative learning when they incorporated interaction, problem solving, exploration, and child engagement.
Wardhani et al. (2021)	Loose parts	Early childhood classroom study	Manipulable loose materials facilitated active play and supported broader social and developmental behaviors relevant to creative learning.
Eriani et al. (2022)	Loose parts	One-group pretest–posttest	Open-ended loose parts positively influenced children's creative-thinking ability by enabling materials to be recombined and redesigned.
Dewi et al. (2023)	Loose parts	Quasi-experiment; 31 children	Loose parts produced positive effects on cognitive development through active manipulation and exploration.

Nurjanah & Muthmainah (2023)	Loose parts	Quasi-experiment; 44 children, 22 experimental and 22 control	Creativity was significantly better in children using loose parts than in children using worksheets/magazines; $Z = -2.183$, $p = .029$.
Lismayani et al. (2023)	Loose parts	Quasi-experiment; 16 children	Experimental-group creativity increased substantially after intervention; the reported mean increased from approximately 16.38 to 22.63.
Sardi & Mayar (2023)	Loose parts	Qualitative case study	Children became more active, curious, creative, and able to solve problems; development shifted toward expected and very well-developed categories.
Alotaibi (2024)	Game-based learning	Systematic review/meta-analysis; 136 studies, 1,426 participants	Game-based learning produced significant positive effects on cognitive development ($g = 0.46$), engagement ($g = 0.44$), motivation ($g = 0.40$), social development ($g = 0.38$), and emotional development ($g = 0.35$).
Yuliani & Kristiana (2024)	Natural-material loose parts	Qualitative study; 18 children aged 5–6	Creativity developed through well-planned stages of introduction, exploration, expansion, play strategy, and independent material organization.
Anggraini et al. (2025)	Educational game tools / wooden blocks	Descriptive qualitative study	Despite limited physical resources, teacher use of open-ended questions and thematic facilitation supported fluency and flexibility of children's thinking.
Puspita et al. (2026)	Educational game model	R&D; teacher implementation trial	The model achieved 92% feasibility; children's mean creativity-related performance increased from 46.4% at pretest to 83.5% at posttest.
Hardila & Rakimahwati (2026)	Tangram-based educational game	ADDIE R&D; implementation with 15 children	Content validity = 93.3%, media validity = 89.41%, practicality = 91%, and effectiveness = 93%.
Wulandari et al. (2026)	Loose parts	One-group pretest–posttest; 13 children	Creativity increased from 7.769 to 13.385; paired-test significance was $p < .001$, with a reported mean difference of 5.615 points.

Note. Numerical values are presented only where explicitly reported by the original studies.

Findings on Educational Play Tool Design

The first major theme concerned the design characteristics of effective educational play tools. Across the reviewed evidence, creativity-enhancing tools were rarely characterized by highly prescriptive procedures. Instead, they typically allowed multiple combinations, solutions, and forms of representation. Loose parts illustrate this principle most clearly because children can move, separate, connect, combine, redesign, and assign different symbolic meanings to the same materials. Eriani et al. (2022) explicitly describe this flexibility as central to the stimulation of creative thinking. The findings further suggest that open-endedness alone is insufficient. Effective APE designs incorporated age appropriateness, safety, manipulability, visual attractiveness, accessibility, and opportunities for progressive challenge. The tangram-based educational game developed by Hardila and Rakimahwati (2026), for example, obtained scores of 93.3% for content validity and 89.41% for media validity, while reaching 91% practicality and 93% effectiveness. These findings indicate that creativity-oriented educational tools can simultaneously possess structured educational objectives and permit flexible problem solving. Digital forms showed a similar pattern. Behnamnia et al. (2020) found that digital game-based learning for preschool children is most closely connected with creativity when technology supports interaction and exploratory problem solving rather than passive screen consumption. Thus, physical and digital media appear to share common design principles: active manipulation, multiple possibilities, feedback, meaningful challenges, and opportunities to generate children's own responses.

Table 2. Synthesized Design Principles Identified Across the Literature

Design Dimension	Evidence Synthesized from the Studies	Expected Creative Function
Open-endedness	Objects can produce multiple constructions or solutions	Originality and divergent thinking

Manipulability	Materials can be moved, combined, separated, rotated, or reconstructed	Experimentation and flexibility
Variety of materials	Natural, recycled, geometric, physical, or digital elements	Idea generation and elaboration
Developmental appropriateness	Tasks correspond to children's age and cognitive–motor capacity	Sustained engagement
Visual and sensory attractiveness	Shape, texture, spatial composition, and interactive elements	Curiosity and motivation
Problem-oriented challenges	Children solve construction or play-based problems	Creative problem solving
Multiple possible outcomes	No single model is imposed as the only correct product	Independence and originality
Safety and usability	Materials are accessible, practical, and safe	Exploration without unnecessary constraint
Contextual relevance	Objects are connected with children's environment and experience	Meaningful imagination
Feedback/interactivity	Especially important in educational and digital games	Reflection and iterative improvement

The collective evidence therefore indicates that the strongest design principle is not technological sophistication but creative affordance: the extent to which the tool enables children to perform different actions, reinterpret materials, test possibilities, and create outcomes that are not completely predetermined.

Findings on Learning Implementation

The second major theme was that the effectiveness of educational play tools depended strongly on how teachers implemented them. APE did not function as an independent causal mechanism detached from pedagogy. Instead, creativity emerged through interactions among the child, material, learning task, peers, teacher, and physical environment. Yuliani and Kristiana (2024) found that successful loose-parts implementation required systematic preparation, introduction of play strategies, exploratory stages, expansion of children's ideas, and routines for independently organizing play materials. Anggraini et al. (2025) similarly observed that even under conditions of restricted APE availability, teachers could stimulate children's creativity by using open-ended questions, observation, thematic integration, and adaptive facilitation. Their observations indicated improvements particularly in fluency and flexibility of thinking. This finding differentiates effective facilitation from highly directive instruction. When teachers determine in advance what every child must produce, opportunities for originality become restricted. In contrast, the reviewed studies consistently support a facilitator role in which teachers prepare materials and environments, introduce problems or themes, provide prompts when necessary, observe children's strategies, and allow children to determine much of the creative process themselves.

Table 3. Implementation Factors Associated with Creativity Development

Implementation Factor	Synthesized Evidence	Pedagogical Implication
Child autonomy	Children choose, manipulate, and redesign materials	Preserve ownership of ideas
Open-ended questioning	Teachers ask “what if,” “how,” and alternative-solution questions	Extend flexibility and reasoning
Teacher scaffolding	Assistance is provided without prescribing the final product	Balance freedom and learning goals
Repeated exploration	Children use materials across multiple sessions	Encourage elaboration and refinement
Thematic integration	Play materials are connected with meaningful classroom themes	Strengthen contextual learning
Collaborative play	Children exchange materials, ideas, and strategies	Encourage social creativity
Reflection and communication	Children describe products or solutions	Strengthen creative expression
Accessible environment	Materials are visible and reachable	Increase independent exploration

Empirical Evidence of Learning Effectiveness

Quantitative findings provided additional support for the effectiveness of creativity-oriented educational play. Nurjanah and Muthmainah (2023) compared 22 children receiving loose-parts activities with 22 children using conventional worksheet or magazine-based learning. The loose-parts group demonstrated significantly better creativity, with a reported Mann–Whitney/Wilcoxon-related comparison of $Z = -2.183$, $p = .029$. Within the experimental group, pretest–posttest differences were also significant ($Z = -4.145$, $p < .001$). Lismayani et al. (2023) similarly reported a marked improvement in the experimental group. Their detailed results indicate an increase from approximately 16.38 before treatment to 22.63 after loose-parts intervention, whereas the comparison group's improvement was substantially smaller. The post-intervention distribution showed that children increasingly occupied the *Developing as Expected* and *Very Well Developed* categories. The most recent quasi-experimental evidence reported by Wulandari et al. (2026) also demonstrated a strong within-group change: the mean creativity score increased from 7.769 at pretest to 13.385 at posttest, corresponding to a reported difference of approximately 5.615 points, with $p < 0.001$. Evidence from developed educational games showed comparable directionality. Puspita et al. (2026) reported that their educational game model was considered 92% feasible by participating teachers, while the children's average outcome increased from 46.4% before implementation to 83.5% afterward. Hardila and Rakimahwati (2026) likewise reported 93% effectiveness for their tangram-based educational game. At a broader level, Alotaibi's (2024) meta-analysis synthesized 136 studies involving 1,426 participants and reported significant effects of game-based learning on cognitive development ($g = 0.46$), engagement ($g = 0.44$), motivation ($g = 0.40$), social outcomes ($g = 0.38$), and emotional outcomes ($g = 0.35$). Although these outcomes extend beyond creativity itself, they demonstrate that game-based pedagogy creates a broader developmental environment characterized by cognitive activation, engagement, and motivation all of which are relevant conditions for creative learning.

Overall Thematic Synthesis

Across the 13 studies, the findings can be organized into three interconnected components: Design → Implementation → Effectiveness. The design dimension establishes what the educational play tool allows children to do; the implementation dimension determines how these possibilities are activated during learning; and effectiveness represents the resulting changes in creativity and related developmental competencies.

The synthesis identified four creativity indicators that appeared repeatedly across the literature: fluency, flexibility, originality, and elaboration. Fluency was reflected in children's capacity to generate multiple ideas or constructions; flexibility appeared when children shifted strategies or used materials in different ways; originality was represented by unique products or solutions; and elaboration involved extending, refining, and adding details to ideas. Problem solving, imagination, curiosity, and independent exploration appeared as closely associated processes.

Table 4. Integrative Results of the Design Implementation Effectiveness Synthesis

Dimension	Dominant Findings	Creativity Outcomes
Design	Open-ended, manipulable, attractive, safe, flexible, reusable, developmentally appropriate	Provides possibilities for divergent responses
Implementation	Child-centered exploration combined with teacher scaffolding and open-ended questioning	Activates imagination and independent idea generation
Process	Experimentation, combining materials, reconstructing, discussing, solving problems	Fluency, flexibility, originality, elaboration
Effectiveness	Predominantly positive changes across experimental, qualitative, R&D, and synthesis studies	Higher creativity and related cognitive engagement
Supporting conditions	Material variety, repeated opportunities, teacher competence, sufficient play time	Sustained creative engagement
Potential constraint	Over-directive instructions, fixed outcomes, limited materials, insufficient exploration time	Restricts creative alternatives

Overall, 8 of the 13 reviewed studies (61.5%) centered primarily on loose parts or closely related open-ended manipulable materials, whereas the other five investigated educational games through digital applications, conventional EGT, general game-based models, or tangram-based designs. The dominance of loose-parts research should not be interpreted as evidence that loose parts are intrinsically superior to every

other educational game format; rather, it demonstrates that open-ended physical materials currently constitute the most frequently represented approach in this 13-study review corpus.

Summary of Research Results

The combined conceptual and empirical findings indicate that educational play tools are most effective for early childhood creativity when three requirements converge. First, the design must provide multiple possibilities rather than a single predetermined solution. Second, implementation must maintain child agency while teachers provide intentional but non-dominating scaffolding. Third, effectiveness assessment should capture creative processes particularly fluency, flexibility, originality, elaboration, imagination, and problem solving rather than judging only whether children reproduce a model correctly.

The evidence also indicates that creativity-enhancing APE does not necessarily require expensive or technologically advanced materials. Loose natural objects, recycled materials, wooden blocks, tangrams, and appropriately designed digital games can all function effectively when they permit exploration and reconstruction. This finding reinforces an important conceptual conclusion from the literature review: the educational quality of a play tool lies less in the object itself than in the creative possibilities embedded in its design and activated through pedagogically appropriate implementation.

Discussion

The findings of this review demonstrate that educational play tools can provide a powerful pedagogical environment for developing early childhood creativity when their design, implementation, and evaluation are coherently aligned. Across the 13 reviewed studies, the effectiveness of educational play tools was not determined primarily by technological sophistication or monetary value, but by the degree to which the materials provided children with opportunities to manipulate objects, generate alternative ideas, experiment, reconstruct products, and independently solve problems. This interpretation is consistent with contemporary understandings of play as a cognitively active process through which children develop executive functioning, symbolic representation, social competence, self-regulation, and flexible problem solving (Yogman et al., 2018; Dankiw et al., 2020; Cankaya et al., 2023). In this sense, educational play tools should be understood not merely as instructional objects but as creative affordances that enable multiple forms of action and meaning-making.

One of the most prominent findings was the dominance of loose parts and other open-ended manipulable materials, which accounted for 8 of the 13 studies reviewed. This pattern has important theoretical implications. Loose parts can be moved, combined, separated, rotated, redesigned, and assigned new meanings, allowing children to transform an object according to their own ideas rather than reproduce a teacher-determined product. Eriani et al. (2022) found that such characteristics stimulated creative thinking, while Wardhani et al. (2021) identified imagination, independence, cooperation, responsibility, and confidence during loose-parts activities. Similar conclusions were reported by Spencer et al. (2019), Rahardjo (2019), Dewi et al. (2023), Sukardjo et al. (2023), Rahma et al. (2023), and Hernawati et al. (2025). Collectively, these studies indicate that the pedagogical strength of loose parts derives from their low structural determination but high possibility for transformation.

The empirical findings further reinforce this interpretation. Nurjanah and Muthmainah (2023) reported significantly greater creativity among children learning with loose parts compared with those using conventional worksheets or magazines ($Z = -2.183$, $p = .029$). More recent research by Utami and Sujarwo (2025) similarly showed that children exposed to loose-parts media demonstrated better creativity and speaking skills than comparison groups using picture-based media. Indonesian findings from Arifianti et al. (2025), Zulfiha et al. (2026), and Umamah et al. (2026) also indicate that open-ended materials promote exploration, flexibility of thought, problem solving, and self-evaluation. Thus, the present synthesis strengthens the argument that learning environments dominated by predetermined worksheets may restrict opportunities for divergent responses, whereas manipulable materials create greater space for children to produce multiple legitimate solutions.

However, the findings also demonstrate that materials alone do not produce creativity. Their educational effectiveness depends substantially on pedagogical implementation. Contemporary guided-play theory positions effective learning between two extremes: completely unstructured free play and highly directive teacher instruction. Skene et al. (2022), in a systematic review of 39 studies involving children aged one to eight years, showed that guided play could outperform direct instruction or free play for several developmental

outcomes. This supports the current review, in which successful implementation was characterized by child autonomy combined with teacher scaffolding, open-ended questioning, observation, encouragement, and contextual prompts. Anggraini et al. (2025) similarly found that teachers could promote fluency and flexibility even when the availability of educational game tools was limited, provided that facilitation was responsive and exploratory.

This teacher–child interaction is especially important because creativity develops through processes rather than through products alone. When teachers prescribe a single model and expect children to imitate it, educational play may become another form of direct instruction. Conversely, questions such as “What else could you make?”, “What happens if these materials are combined?”, or “Is there another way to solve this problem?” preserve children's ownership while extending reasoning. Rahma et al. (2023) found that children using loose parts within a Merdeka Belajar environment produced varied creations and remained active in asking questions, while Ratna et al. (2023), Maarang et al. (2023), Hayat (2023), and Dewi et al. (2024) highlighted the compatibility of loose parts with STEAM-oriented inquiry. These studies collectively position the teacher as a designer of learning possibilities rather than a controller of children's products.

The integration of STEAM provides an additional explanation for these outcomes. Loose parts allow children to observe material properties (science), use or understand tools (technology), construct and redesign structures (engineering), explore patterns, quantity, and spatial relations (mathematics), and communicate ideas visually (arts). Rahardjo (2019) specifically identified freedom of creation and problem solving as central contributions of loose parts to STEAM, while Sukardjo et al. (2023) demonstrated their potential for stimulating creativity, critical thinking, communication, and collaboration. Qoumariah et al. (2025), through a systematic narrative review, similarly concluded that STEAM–loose-parts integration offers meaningful conditions for creativity development. These findings explain why the effect of educational play tools may extend beyond originality to broader twenty-first-century competencies.

Importantly, the review also shows that effective APE is not limited to loose parts. Tangram, wooden blocks, structured educational games, and digital applications can stimulate creativity when they preserve exploration and multiple solution pathways. Behnamnia et al. (2020) found that digital game-based learning can foster young children's creativity when applications incorporate interaction, problem solving, feedback, exploration, and meaningful challenges. Their systematic review of digital creativity research likewise emphasized that technology is most valuable when children act as active participants rather than passive recipients. This interpretation is reinforced by Alotaibi's (2024) meta-analysis of 136 studies, which found significant effects of game-based learning on cognitive development ($g = 0.46$), engagement ($g = 0.44$), motivation ($g = 0.40$), social development ($g = 0.38$), and emotional development ($g = 0.35$). Therefore, the critical distinction is not simply digital versus non-digital, but passive versus generative learning design.

Another important implication concerns the multidimensional measurement of creativity. Across the reviewed studies, creativity was manifested through fluency, flexibility, originality, elaboration, imagination, curiosity, and problem-solving behaviors. Such findings caution against evaluating APE effectiveness only through the attractiveness of children's final products. A child who repeatedly revises a construction, changes strategies after failure, combines unusual objects, explains different solutions, or collaborates to create a new structure is demonstrating important creative processes. Cankaya et al. (2023) similarly associate loose-parts play with exploration, reasoning, problem solving, and divergent thinking, while Dankiw et al. (2020) found that unstructured nature play consistently supported imaginative and dramatic play. Selvi (2022) consequently argues that effective educational play tools should integrate functionality, quality, safety, comfort, reliability, distinctive features, and attractive design.

Taken together, these findings support the proposed Design–Implementation–Effectiveness framework. Design determines the creative possibilities afforded by the tool; implementation determines whether those possibilities are activated through autonomy, exploration, dialogue, and scaffolding; and effectiveness reflects changes in creative thinking and related developmental outcomes. This framework also explains why identical materials may produce different outcomes across classrooms. Material variety without appropriate teacher facilitation may result only in unstructured activity, whereas excessive teacher direction may eliminate the very openness that makes APE creativity-enhancing.

Overall, the synthesis extends previous research by demonstrating that successful educational play tools require a dynamic interaction among open-ended design, child agency, guided facilitation, meaningful

challenges, repeated exploration, and multidimensional creativity assessment. The evidence from both international research and Indonesian PAUD settings suggests that low-cost natural or recycled materials can be pedagogically as meaningful as sophisticated digital technologies when they offer rich creative affordances. Consequently, future APE development should shift from asking whether a particular toy or medium is effective toward examining which design characteristics, teacher practices, contextual conditions, and child–material interactions make it effective. This shift provides a stronger conceptual and empirical foundation for developing educational play tools that are culturally contextual, scalable, developmentally appropriate, and genuinely capable of cultivating creativity in early childhood.

CONCLUSION

This literature review concludes that educational play tools can significantly support the development of creativity in early childhood when their design, implementation, and evaluation are integrated within a child-centered learning framework. Across the 13 reviewed studies, eight studies (61.5%) focused primarily on loose parts or other open-ended manipulable materials, while the remaining studies examined digital games, blocks, general educational game models, and tangram-based activities. Conceptually, the most effective tools were characterized by open-endedness, manipulability, safety, attractiveness, flexibility, developmental appropriateness, and the possibility of producing multiple solutions rather than one predetermined outcome. Empirically, the reviewed studies consistently reported positive changes in creativity and related learning outcomes. Nurjanah and Muthmainah (2023) found significantly higher creativity among children using loose parts than among those using conventional worksheets or magazines ($Z = -2.183$, $p = 0.029$). Lismayani et al. (2023) reported an increase in mean creativity scores from approximately 16.38 to 22.63, while Wulandari et al. (2026) reported an increase from 7.769 to 13.385 ($p < 0.001$). Developed educational games also demonstrated high feasibility and effectiveness, including 92% feasibility in Puspita et al. (2026) and 93% effectiveness for tangram-based media in Hardila and Rakimahwati (2026). Overall, effective educational play depends not merely on the material itself, but on the interaction between creative affordances, child autonomy, teacher scaffolding, meaningful exploration, and appropriate assessment of fluency, flexibility, originality, elaboration, imagination, and problem solving.

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