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Natural and Recycled Material-Based Educational Play Tools to Stimulate the Imagination and Creativity of Early Childhood Children: A Literature Review

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ABSTRACT

Creativity and imagination are essential developmental capacities in early childhood because they support flexible thinking, symbolic representation, problem solving, and the generation of original ideas. However, early childhood learning still frequently relies on structured activities and ready-made instructional media that may limit children's opportunities for exploration and independent creation. This literature review aimed to synthesize conceptual and empirical evidence concerning the use of educational play tools made from natural and recycled materials to stimulate imagination and creativity in early childhood. The study employed a systematic literature review approach guided by PRISMA 2020 principles. Articles published between 2016 and 2026 were identified through Scopus, Web of Science, ERIC, ScienceDirect, Google Scholar, and SINTA/GARUDA. After screening and eligibility assessment, 15 peer-reviewed studies were included and analyzed through thematic synthesis. The findings revealed four major themes: open-ended material affordances, imagination and symbolic transformation, divergent thinking and creative production, and sustainability supported by teacher scaffolding. Empirically, one classroom-action study reported an increase in children achieving high creative-thinking performance from 55% at baseline to 95% after the second intervention cycle, while another study found that mean creativity scores increased from 7.769 to 13.385 with a statistically significant difference ($p < .001$). Overall, natural and recycled materials were consistently associated with greater exploration, originality, imaginative play, artistic expression, problem solving, and independent creation. The review concludes that these materials represent accessible, flexible, and sustainable pedagogical resources, particularly when combined with appropriate teacher facilitation, safe material selection, adequate play time, and non-directive learning environments.

KEYWORDS: Early Childhood Education; Natural Materials; Recycled Materials; Imagination; Creativity.

INTRODUCTION

Creativity and imagination are fundamental developmental capacities in early childhood because they enable children to generate ideas, transform experiences symbolically, explore alternative possibilities, and construct new meanings through play. Contemporary perspectives on early childhood learning emphasize that creativity does not develop merely through the reproduction of teacher-provided models; rather, it emerges when children are provided with opportunities to investigate, manipulate, combine, redesign, and reinterpret objects in multiple ways. In this respect, pretend and imaginative play creates a symbolic space in which children can transform objects, roles, and ideas beyond their conventional functions. Smits-van der Nat et al. (2024) explain that pretend play involves object substitution, role enactment, attribution of imagined properties, and social interaction, all of which provide important conditions for flexible thinking and symbolic representation. Recent meta-analytic evidence also indicates meaningful relationships between pretend play and cognitive processes associated with executive functioning, although such relationships are influenced by

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play structure and developmental characteristics (Constien et al., 2026). However, learning practices in early childhood settings are still frequently characterized by structured activities, standardized products, worksheets, ready-made toys, and teacher-directed demonstrations. Such practices may narrow opportunities for children to generate original ideas because predetermined materials often suggest predetermined functions. Indonesian studies similarly report that children may hesitate to create independently when learning activities are monotonous or when teachers repeatedly provide examples to be copied (Eriani et al., 2022; Kafolamau & Rahardjo, 2022).

Educational play tools derived from natural and recycled materials provide an alternative pedagogical resource. Leaves, stones, twigs, seeds, shells, cardboard, bottle caps, paper tubes, fabric remnants, and safe discarded containers are relatively inexpensive, accessible, transformable, and open-ended. Their educational value lies not simply in their physical availability but in their capacity to invite multiple interpretations. A stone can become food, a character, a vehicle, or part of a construction; cardboard can become a house, stage, bridge, or imaginary machine. This open-endedness gives children greater control over the meaning and direction of play. Current research increasingly conceptualizes natural and recycled objects through the framework of loose-parts play, in which movable, combinable, redesignable, and non-prescriptive materials facilitate exploratory learning. Cankaya et al. (2023), in a review of preschool loose-parts research, argue that these materials create opportunities for exploration, problem solving, reasoning, divergent thinking, and discovery because children can combine natural and manufactured objects according to self-generated purposes. Askar and Durmusoglu (2023) likewise show that loose parts offer flexible possibilities for preschool play rather than imposing a single predetermined use.

The significance of natural materials is also supported by the theory of environmental affordances: children perceive possibilities for action according to the qualities of objects and environments. A systematic review by Prins et al. (2022), synthesizing 28 qualitative studies involving 998 children aged 2–8 years, demonstrated that nature-based environments offer diverse sensory, physical, symbolic, and exploratory affordances that contribute to play quality. Natural loose parts are particularly important because their texture, shape, size, flexibility, and variability enable children to continually redefine how objects may be used. Observational research similarly indicates that natural loose parts are strongly associated with exploratory forms of outdoor play (Dankiw et al., 2022). Empirical evidence from Indonesia supports these theoretical assumptions. Eriani et al. (2022) found that loose-parts experiences positively supported children's creative-thinking abilities, while Kafolamau and Rahardjo (2022) observed that materials such as stones, leaves, twigs, and pinecones encouraged children to explore their imagination more freely. Purwati et al. (2024) further demonstrated experimentally that differentiated learning assisted by loose-parts media significantly enhanced children's creative imagination.

Studies focusing specifically on natural resources provide comparable evidence. Afifah et al. (2024) found that leaf-based printing stimulated creative expression through sensory, motor, and cognitive experiences, whereas Handayani et al. (2026) reported improvement in creativity when children engaged with contextual natural materials. Anasta et al. (2025) additionally identified stones, seeds, banana leaves, and banana stems as potentially valuable resources for creativity, environmental understanding, and fine-motor learning. Recycled materials show a parallel pedagogical potential. Widiari et al. (2026) reported that recycled loose parts could address limitations associated with conventional teacher-centered media and support children's expression of ideas and independent creations. Ansa et al. (2026) similarly documented the use of discarded materials as creative learning resources, while maker activities involving recyclable materials have been associated with both children's creativity and pro-environmental attitudes (Lee & Kim, 2023).

Importantly, this pedagogical approach also connects creativity with sustainability. Systematic evidence on early childhood education for sustainability indicates increasing attention to environmental learning, although intervention-based research remains comparatively limited. Art-based sustainability activities can provide children with opportunities to reinterpret environmental problems creatively rather than merely memorize environmental messages (Kalafati et al., 2025). Natural and sustainable materials have likewise been identified as supporting imagination, hands-on exploration, and environmentally conscious learning (Aksoy, 2026).

Despite these developments, the literature remains fragmented. First, many studies examine loose parts, natural materials, recycled materials, nature play, or creativity separately rather than synthesizing them

within a single conceptual framework. Second, creativity is more frequently examined than imagination, although imagination constitutes an important cognitive mechanism through which children transform ordinary objects into symbolic representations. Third, existing Indonesian studies are predominantly small-scale classroom action, qualitative, or localized intervention studies, making their broader conceptual patterns difficult to identify. Fourth, sustainability-oriented studies frequently prioritize environmental awareness, whereas creativity studies primarily emphasize learning outcomes; the relationship among material reuse, imagination, creative production, and sustainability therefore remains insufficiently integrated. Even recent reviews of natural loose parts suggest that teacher scaffolding, material affordances, methodological quality, and developmental outcomes require stronger synthesis (Yuhana & Nurlinda, 2026).

Accordingly, this literature review aims to critically synthesize recent empirical and conceptual evidence concerning educational play tools made from natural and recycled materials and their role in stimulating imagination and creativity in early childhood. Rather than examining materials merely as economical substitutes for commercial toys, this review conceptualizes them as open-ended pedagogical affordances that enable object transformation, divergent thinking, symbolic representation, exploration, construction, storytelling, and creative problem solving. The novelty of this review lies in integrating four previously dispersed perspectives: (1) natural-material play, (2) recycled-material play, (3) loose-parts/open-ended pedagogy, and (4) imagination–creativity development. It further positions sustainable material use as both a developmental strategy and an early foundation for environmental responsibility. This perspective is consistent with emerging sustainability research emphasizing children's active engagement with reuse, recycling, nature, and meaningful place-based experiences (Kahriman-Pamuk et al., 2026; Fasting et al., 2025).

Taken together, existing evidence suggests that natural and recycled materials possess pedagogical value precisely because they are incomplete, flexible, and capable of acquiring meanings generated by children themselves. Their effectiveness, however, cannot be attributed to the materials alone; it depends on material diversity, safety, accessibility, play freedom, learning context, and appropriate teacher scaffolding. Consequently, a systematic synthesis is needed to clarify how these materials stimulate imagination and creativity, identify effective pedagogical mechanisms, and formulate implications for sustainable early childhood learning. Such synthesis is expected to strengthen the theoretical basis for developing low-cost, contextually relevant, environmentally responsible, and creativity-oriented educational play tools in early childhood education.

METHOD

This study employed a systematic literature review approach to synthesize empirical and conceptual evidence regarding educational play tools made from natural and recycled materials for stimulating imagination and creativity in early childhood. A literature review was selected because it enables researchers to consolidate fragmented findings, identify recurring theoretical patterns, and clarify research gaps across heterogeneous studies (Snyder, 2019). In addition, Xiao and Watson (2019) emphasize that a systematic literature review requires a transparent search strategy, explicit selection criteria, structured data extraction, and an analytical synthesis that extends beyond a descriptive summary of previous studies. Accordingly, the review procedure was organized around the principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) to strengthen transparency and reproducibility (Page et al., 2021).

The literature search focused on peer-reviewed journal articles published during the 2016–2026 period. Relevant studies were identified through major academic databases and indexing platforms, including Scopus, Web of Science, ERIC, ScienceDirect, Google Scholar, and SINTA/GARUDA. Search terms were developed from the central concepts of the study and combined using Boolean operators. The principal keywords included “educational play tools,” “natural materials,” “recycled materials,” “loose parts,” “early childhood education,” “creativity,” “creative thinking,” “imagination,” “imaginative play,” and “open-ended play.” Such a multi-keyword strategy was intended to capture different terminologies used to describe material-based play in early childhood settings. This approach is consistent with Prins et al. (2022), who demonstrated the importance of combining multiple terms related to play, natural environments, and early childhood when conducting evidence synthesis in this field.

Studies were included when they met the following criteria: (1) published in a peer-reviewed journal; (2) published between 2016 and 2026; (3) involved children in early childhood or preschool settings; (4) investigated educational play involving natural materials, recycled materials, loose parts, or other open-ended materials; (5) reported outcomes related to imagination, creativity, divergent thinking, symbolic play, exploration, or creative production; and (6) provided sufficient methodological and empirical information. Articles were excluded when they were non-peer-reviewed publications, conference abstracts without complete empirical data, studies focusing exclusively on older children, studies unrelated to play-based learning, duplicate publications, or articles without adequate methodological information. Following title and abstract screening and subsequent full-text eligibility assessment, 15 articles were retained as the final objects of analysis.

Methodological quality was evaluated according to the characteristics of each research design. Particular attention was given to clarity of research questions, appropriateness of participant selection, validity of data collection procedures, transparency of analysis, and consistency between evidence and conclusions. This principle is compatible with the Mixed Methods Appraisal Tool, which allows critical assessment across qualitative, quantitative, non-randomized, descriptive, and mixed-method studies (Hong et al., 2018).

Data from the 15 studies were subsequently extracted into a structured review matrix containing author and publication year, country, participant characteristics, research design, type of material, learning activity, indicators of imagination and creativity, major findings, and pedagogical implications. The findings were then analyzed through thematic synthesis, involving repeated reading, initial coding, grouping related findings, developing analytical categories, and interpreting overarching themes. The analytical procedure was informed by contemporary thematic-analysis principles emphasizing systematic identification and interpretation of meaningful patterns across a dataset (Braun & Clarke, 2019; Byrne, 2022). The synthesis particularly examined patterns concerning material affordances, open-ended exploration, symbolic and imaginative transformation, divergent thinking, teacher scaffolding, creative product formation, and environmental awareness. This strategy enabled the review to move beyond a simple description of the selected articles and develop an integrated explanation of how natural and recycled educational play materials contribute to imagination and creativity in early childhood.

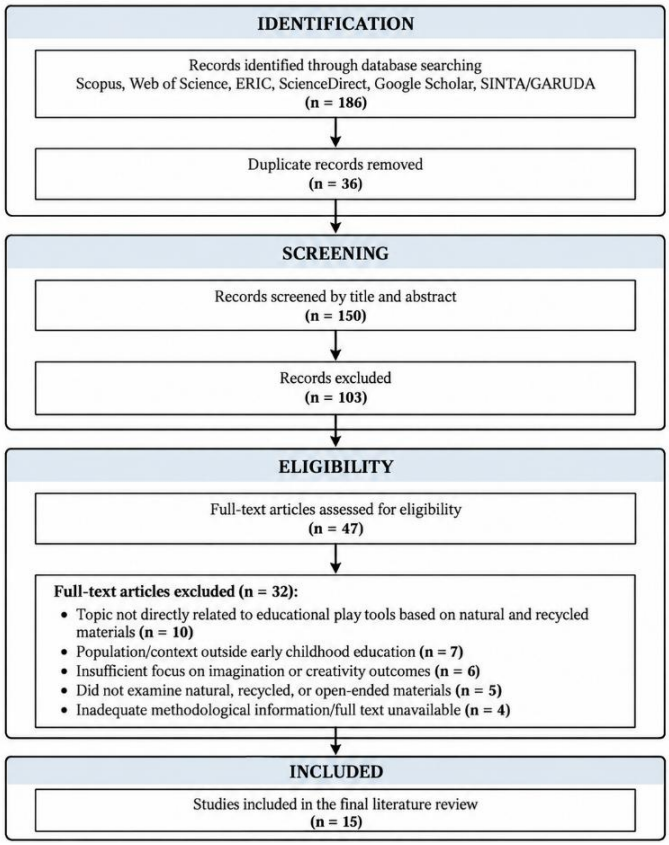


Figure 1. Prisma 2020 Flow Diagram of study selection

RESEARCH RESULTS AND DISCUSSION

Research Results

Characteristics of the Selected Studies

The literature selection process resulted in 15 articles that met the inclusion criteria and were considered relevant to explaining the role of natural, recycled, and open-ended educational play materials in stimulating imagination and creativity in early childhood. The selected literature represented a combination of systematic/scoping reviews, quantitative and quasi-experimental studies, classroom action research, and qualitative studies. This methodological diversity provided both conceptual explanations of why open-ended materials support children's development and empirical evidence regarding changes in creativity, imagination, divergent thinking, exploratory behaviour, and aesthetic expression.

Across the reviewed literature, natural materials included leaves, stones, twigs, pinecones, seeds, vegetables, banana stems and fronds, sand, and other objects obtained from children's immediate environment. Recycled or manufactured loose parts included cardboard, bottle caps, plastic containers, paper tubes, fabric scraps, boxes, and other reusable materials. Their common characteristic was open-endedness: unlike fixed-function commercial toys, these objects could be moved, combined, separated, redesigned, reconstructed, and symbolically transformed according to children's ideas.

Table 1. Characteristics and Main Findings of the 15 Reviewed Studies

Authors/ Year	Design / Participants	Materials or Learning Context	Main Outcome	Major Findings
Houser et al. (2016)	Scoping review; 16 articles	Loose parts and unstructured play materials	Active and exploratory play	Loose parts supported child-led interaction with environments and offered multiple possibilities for manipulation and play, although implementation varied considerably across studies.
Gibson et al. (2017)	Systematic review	Loose-parts play interventions	Cognitive, social, and emotional development	The review indicated developmental potential of movable play materials, while also emphasizing the limited number and methodological variability of rigorous studies.
Dankiw et al. (2020)	Systematic review; 16 studies	Unstructured nature play	Imagination, creativity, cognitive play	Nature play consistently supported cognitive play behaviours. One included creativity study showed significant gains in fluency, originality, and imagination compared with traditional play environments.
Eriani et al. (2022)	One-group pretest–posttest quantitative study	Loose parts	Creative thinking	A paired-sample analysis showed a substantial effect of loose-parts play on creative thinking (t = 21.05, exceeding the reported critical value), supporting its effectiveness for stimulating children's ability to generate ideas.
Kafolamau & Rahardjo (2022)	Descriptive qualitative; children aged 4–5 years	Stones, leaves, twigs, and pinecones	Creativity and imagination	Children demonstrated richer exploration and imaginative use of objects. Teacher prompts and provocative questions were important in extending children's ideas.
Prins et al. (2022)	Systematic review/meta-ethnography; 28 studies, N = 998, ages 2–8	Nature-based play environments	Play quality and cognitive development	Three overarching dimensions emerged: qualities of children's play, environmental affordances supporting play, and teacher–child interaction. Natural environments facilitated varied and meaningful play experiences.
Andriani & Rakimahwati (2023)	Literature review/thematic analysis	Natural-material learning media	Early childhood creativity	Four themes were identified: natural materials supporting creativity, learning activities, teacher roles, and limitations. Natural materials were considered accessible resources for stimulating creative thinking.

Aisyiah & Pamungkas (2023)	Descriptive qualitative study	Leaves, banana fronds, vegetables, and other natural materials	Artistic creativity	Printing, stamping, batik, and other art activities allowed natural objects to become creative media and expanded children's artistic experiences.
Purwati et al. (2024)	Quasi-experimental, post-test-only control-group design; N = 40	Differentiated learning assisted by loose parts	Creative imagination	Loose-parts-assisted differentiated learning significantly influenced creative imagination. An interaction was also reported between the learning approach and children's social skills.
Qiromah et al. (2024)	Classroom action research; N = 20	Nature-based loose parts	Creative thinking and imagination	Children reaching high creative-thinking achievement increased from 11 children at pre-cycle to 15 in Cycle I and 19 in Cycle II, with improvements in curiosity, imagination, production of forms, and responsibility.
Fajrie et al. (2024)	Quasi-experimental/non-equivalent control group; N = 33	Natural-material-based art learning	Aesthetic and creative experience	Significant pre–post improvements were found in experimental groups, while changes in the control group were less substantial, indicating the effectiveness of nature-based art activities.
Yuliani & Kristiana (2024)	Qualitative; 18 children aged 5–6 years and teacher	Natural loose parts	Creativity	Flexible natural objects supported children's freedom to construct different products and representations and encouraged individual creative expression.
Cankaya et al. (2025)	Systematic review; 25 studies selected from 5,721 records	Indoor loose parts and comparable open-ended materials	Cognitive development, problem solving, divergent thinking	Most relevant evidence suggested relationships between flexible play materials and creativity, problem solving, academic skills, and convergent/divergent thinking, although methodological heterogeneity remained substantial.
Wulandari et al. (2026)	Quasi-experimental one-group pretest–posttest; N = 13	Loose parts in open play	Creativity	Mean creativity increased from 7.769 to 13.385, with a mean difference of 5.615 and p = .000, indicating significant improvement after loose-parts activities.
Ansa et al. (2026)	Descriptive qualitative; teacher and 18 Group B children	Recycled materials	Creativity and sustainable learning	Recycled objects were reported as useful creative learning media that enabled children to transform discarded materials into new products while simultaneously introducing reuse and environmental responsibility.

Synthesis of the Empirical Findings

The analysis produced four interconnected themes: (1) open-ended material affordances and exploratory play; (2) imagination and symbolic transformation; (3) divergent thinking and creative production; and (4) sustainability and teacher scaffolding.

Open-Ended Material Affordances and Exploratory Play

The first and most consistent finding concerned the affordances of open-ended materials. Natural and recycled materials differed from conventional single-purpose toys because their functions were not predetermined. Children could move, rotate, stack, connect, sort, dismantle, and reconstruct the materials according to emerging play objectives. Eriani et al. (2022), for example, emphasized that loose parts can be separated, recombined, transported, and redesigned in numerous ways. The broader evidence supports this mechanism. Prins et al. (2022), based on 28 qualitative studies involving 998 children, identified characteristics of the natural environment itself as one of three central determinants of nature-play quality. The variety and manipulability of environmental elements created possibilities for physical, exploratory, cognitive, and imaginative engagement. Similarly, Cankaya et al. (2025) concluded that flexible play materials

were associated in several studies with problem solving, divergent thinking, and broader cognitive development, although the evidence base remained methodologically heterogeneous. These findings suggest the following conceptual mechanism: Material flexibility → exploration → experimentation → reconstruction → generation of new ideas. Thus, the educational value of natural and recycled objects appears to arise less from what an object *is* than from what children are able to *do and imagine with it*.

Imagination and Symbolic Transformation

The second theme concerned creative imagination. Natural and recycled materials frequently lack a fixed representational identity. Consequently, children must assign meaning to them during play. A twig can become a fishing rod, a spoon, a road divider, or a character; a stone may represent food, money, an animal, or a component of a building. Such symbolic substitutions constitute a central mechanism through which open-ended play stimulates imagination. Kafolamau and Rahardjo (2022) observed that stones, leaves, wooden twigs, and pinecones encouraged children to explore ideas and imagination in flexible ways. More direct quantitative evidence was provided by Purwati et al. (2024), whose quasi-experimental study demonstrated that differentiated learning supported by loose-parts media significantly influenced children's creative imagination. Nature-play evidence showed a similar pattern. The systematic review conducted by Dankiw et al. (2020) found consistently positive effects on cognitive play behaviours, including imaginative and dramatic play. Importantly, the review reported that the study directly assessing creativity found statistically significant improvements in fluency, originality, and imagination among children exposed to nature play.

Divergent Thinking and Creative Production

The third theme concerns the transformation of imagination into observable creative performance. Across the studies, creativity was expressed through multiple indicators, including idea generation, originality, curiosity, experimentation, construction, production of new forms, artistic expression, and children's ability to use one object in different ways. Among the clearest empirical findings, Eriani et al. (2022) reported a strong pre–post difference in children's creative thinking after loose-parts activities ($t = 21.05$). Qiromah et al. (2024) similarly documented a progressive classroom-action pattern: the number of children reaching high creative-thinking performance increased from 11 of 20 children in the pre-cycle (55%), to 15 children in Cycle I (75%), and finally 19 children in Cycle II (95%). This corresponds to an increase of 40 percentage points from baseline to the second intervention cycle. The most recent quantitative evidence in the reviewed set further reinforced this pattern. Wulandari et al. (2026) reported an increase in mean creativity from 7.769 at pretest to 13.385 at posttest, representing an absolute mean gain of approximately 5.616 points, with the paired analysis reaching statistical significance ($p < .001$). Natural-material art activities also generated positive developmental outcomes. Fajrie et al. (2024) found significant improvement in children's aesthetic experience following natural-material-based art learning in a sample of 33 kindergarten children. This finding complements the qualitative observation of Aisyiah and Pamungkas (2023) that leaves, banana fronds, carrots, and other environmental materials can be transformed through printing, stamping, and batik activities, thereby expanding possibilities for individual artistic production.

Table 2. Thematic Synthesis of the Literature

Major Theme	Developmental Mechanism	Observable Indicators	Overall Evidence
Open-ended exploration	Children manipulate, combine, separate, rearrange, and reconstruct materials	Curiosity, experimentation, sustained exploration, problem solving	Strong and consistently reported across loose-parts and nature-play studies
Imagination and symbolic transformation	Objects acquire meanings that differ from their original physical functions	Pretend use, storytelling, object substitution, fantasy construction	Strong conceptual evidence; growing quantitative support
Divergent thinking	Multiple material possibilities stimulate multiple solutions or ideas	Fluency, flexibility, originality, alternative uses	Moderate-to-strong empirical support
Creative production	Ideas are transformed into constructions, art, models, and new forms	Unique products, independent design, construction, artistic expression	Strong qualitative and classroom-based evidence
Sensory and aesthetic experience	Texture, shape, colour, smell, and physical characteristics provide sensory variation	Artistic exploration, colour/pattern experimentation, aesthetic responses	Moderate empirical evidence, particularly for natural materials

Problem solving	Construction failures or material limitations require children to revise strategies	Trial and error, planning, redesign, solution generation	Consistently identified in broader loose-parts literature
Environmental awareness	Natural and discarded objects are repositioned as useful learning resources	Reuse, recycling, care for materials and environment	Promising but less frequently measured as a primary outcome
Teacher scaffolding	Teachers extend rather than prescribe play through questions and provocations	More complex stories, extended exploration, articulation of ideas	Consistent qualitative evidence

Natural Materials versus Recycled Materials

A further pattern emerged when the studies were examined according to material type. Natural materials appeared particularly useful for sensory exploration, imagination, aesthetic experiences, and contextual learning. Their irregular shapes, textures, colours, weights, and sizes create variability that standardized commercial toys cannot easily reproduce. Nature-based research also suggests that such variability produces richer opportunities for imaginative and dramatic play.

Recycled materials, by contrast, provided a similar open-ended structure but introduced an additional pedagogical element: children could transform an object perceived as waste into an object with a new function. Cardboard packaging, plastic containers, bottle caps, fabric pieces, and other discarded materials therefore supported both creative reconstruction and early sustainability learning. Evidence specifically isolating recycled materials, however, was smaller than the evidence base for natural or general loose-parts play. This means that claims concerning environmental responsibility should be interpreted as promising pedagogical outcomes rather than as effects established with the same empirical strength as creativity.

The Role of Teacher Scaffolding

The synthesis also demonstrated that creative outcomes were not produced solely by providing materials. Teacher mediation emerged as a significant contextual mechanism. Kafolamau and Rahardjo (2022) noted that teachers could extend children's imagination through provocative questions and supporting stories rather than supplying a model that children had to reproduce. Prins et al. (2022) reached a comparable conclusion at a broader evidence level, identifying teacher–child interactions as one of the three major themes explaining the quality of children's nature play. The synthesis therefore indicates a pedagogical sequence: Accessible materials → child-led exploration → teacher provocation → imaginative transformation → experimentation → creative product/problem solution. This process implies that excessively directive instruction may reduce the defining advantage of open-ended materials. The teacher's role is better conceptualized as facilitator, observer, questioner, and provider of conditions for exploration, rather than as the designer of a single correct final product.

Overall Pattern of Evidence

Overall, the 15 reviewed articles demonstrate a predominantly positive relationship between natural/recycled open-ended play materials and the development of early childhood imagination and creativity. The most convincing empirical evidence derives from intervention and classroom-action studies that reported measurable changes after children engaged with loose parts or nature-based materials. For example, Qiromah et al. (2024) reported an increase from 55% to 95% in the proportion of children demonstrating high creative-thinking achievement, while Wulandari et al. (2026) documented an increase in mean creativity scores from 7.769 to 13.385. Systematic reviews additionally indicate positive patterns for imaginative play, cognitive play, problem solving, and divergent thinking, while simultaneously cautioning that differences in definitions, interventions, instruments, and study quality limit direct comparison across studies.

Consequently, the reviewed evidence supports a conceptual model in which material openness is the central mechanism connecting educational play tools with creativity. Natural and recycled materials provide multiple affordances; these affordances encourage exploration and symbolic transformation; exploration produces trial-and-error and divergent idea generation; and these processes ultimately facilitate imaginative narratives, creative problem solving, and original products. The evidence further indicates that this process is strengthened when educators provide adequate time, varied materials, physical freedom, safety, and non-directive scaffolding.

In summary, natural and recycled educational play tools should not be viewed merely as inexpensive alternatives to manufactured toys. The reviewed studies indicate that their primary developmental significance lies in their ambiguity, transformability, sensory richness, and capacity to invite child-generated meanings. These features establish a learning environment in which imagination operates as the cognitive bridge between material exploration and observable creativity.

Discussion

The findings of this literature review demonstrate that educational play tools based on natural and recycled materials have substantial potential to stimulate imagination and creativity in early childhood. Across the 15 reviewed studies, the most consistent pattern was that children became more exploratory, flexible, imaginative, and productive when learning materials were open-ended rather than functionally predetermined. This finding supports the broader literature on loose-parts play, which emphasizes that movable and transformable objects allow children to construct their own purposes, combine materials in multiple ways, and generate alternative solutions during play (Cankaya et al., 2023). A more recent systematic review similarly found that loose-parts play is associated with several cognitive outcomes, including divergent thinking, problem solving, exploration, symbolic play, and constructive play, although methodological heterogeneity remains an important limitation in the evidence base.

The empirical results identified in this review reinforce this conceptual mechanism. Eriani et al. reported marked improvement in children's creative thinking following loose-parts activities, while Purwati et al. (2024) found that differentiated learning supported by loose parts significantly enhanced creative imagination. In the latter study, the instructional model interacted with children's social skills, suggesting that creativity does not arise from the materials alone but from the relationship between learning design, learner characteristics, and opportunities for exploration. This interpretation is consistent with Anwar's (2026) meta-analysis of 15 studies, which reported a mean standardized effect size of 0.85, indicating a large overall effect of loose-parts media on early childhood creativity, particularly divergent thinking, fluency, and originality.

Natural materials appear especially powerful because they provide rich and irregular sensory affordances. Leaves, seeds, stones, branches, bark, and other environmental objects vary naturally in colour, texture, weight, size, shape, and resistance. Such variation encourages children to compare, classify, manipulate, reconstruct, and attribute new meanings to objects. Prins et al. (2022) found that nature-based environments provide diverse affordances supporting explorative, imaginative, physical, and social forms of play, with teacher–child interaction functioning as an important mediator of play quality. Yuhana and Nurlinda (2026) similarly concluded that natural loose parts such as seeds and leaves support multiple developmental domains, including cognition, fine motor competence, language, social-emotional development, creativity, and ecological awareness. Their review also emphasized that the pedagogical value of natural materials depends substantially on teacher scaffolding.

These findings provide an important explanation for why natural materials are particularly relevant to imaginative development. Imagination requires children to detach an object from its literal function and assign it an alternative symbolic meaning. A stick may become a sword, spoon, bridge, animal, or writing tool; a leaf may function as food, currency, a roof, or part of an artistic composition. Thus, ambiguous materials invite symbolic transformation. This process corresponds with findings that natural-material activities create opportunities for children to channel imagination while engaging simultaneously in sensory, cognitive, and motor stimulation. Afifah et al. (2024), for example, showed that leaf-printing activities encouraged children to explore creatively and express ideas within an enjoyable learning context.

The reviewed findings also reveal that recycled materials extend creativity into the domain of sustainable learning. Cardboard, bottle caps, fabric scraps, paper rolls, packaging, and safe plastic containers are not merely inexpensive replacements for manufactured toys; their pedagogical significance lies in the possibility of converting discarded objects into objects with new functions. Widiari et al. (2026) reported that recycled loose-parts media address limitations associated with conventional, teacher-centred learning by increasing opportunities for children to express ideas, use imagination, and create products independently. This transformation from “waste” into a meaningful play object potentially integrates creativity with early environmental responsibility.

The relationship between open-ended materials and creative autonomy is also evident in Indonesian early childhood settings. Rahma et al. (2023) found that loose-parts-based learning within the Merdeka Belajar framework enabled children to produce diverse creations, remain active, ask questions, express themselves freely, and engage in problem solving with teacher support. Likewise, recent literature on the Merdeka Curriculum positions loose parts as particularly compatible with child-centred, contextual, and creativity-oriented pedagogy because children are given greater freedom to explore rather than reproduce predetermined products. This has important pedagogical implications: creativity is more likely to emerge when educators reduce overly prescriptive instruction and provide meaningful choices.

However, the results also suggest that materials should not be regarded as an independent causal mechanism. The quality of teacher facilitation, duration of play, material diversity, safety, environmental arrangement, and freedom of action influence whether loose-parts experiences genuinely become creative learning experiences. Natural-material reviews consistently identify scaffolding as a crucial factor, particularly through open-ended questions, invitations to explore, and non-directive guidance. Recent Indonesian evidence similarly stresses that teachers should function as facilitators rather than designers of a single expected product. A further contribution of the present review is the integration of imagination, creativity, and sustainability into one explanatory framework. Previous research often examines creativity, environmental education, or loose-parts pedagogy separately. Yet the findings suggest a developmental sequence in which children first encounter flexible material affordances, then explore and reinterpret those materials, generate alternative meanings and solutions, and finally produce novel constructions or artistic products. The process can be summarized as material affordance → exploration → symbolic transformation → divergent thinking → creative production. This sequence is consistent with recent reviews emphasizing that natural loose parts contribute not only to creativity but also to broader cognitive and ecological learning.

Nevertheless, caution is required when interpreting the overall evidence. Many studies involve small samples, short interventions, qualitative observations, or classroom action designs. Standardized measures of imagination and creativity are not consistently employed, and longitudinal evidence remains limited. Recent systematic reviews have therefore emphasized measurement validity, methodological heterogeneity, and the scarcity of rigorous causal studies as continuing research gaps. Consequently, future research should employ stronger quasi-experimental or experimental designs, validated creativity instruments, larger samples, and longer follow-up periods.

Overall, the literature supports the pedagogical value of educational play tools made from natural and recycled materials. Their strength lies not simply in accessibility or low cost but in their open-endedness, sensory richness, transformability, symbolic ambiguity, and sustainability potential. When accompanied by appropriate teacher scaffolding, these materials can create learning environments in which children independently explore possibilities, construct meanings, solve problems, and produce original ideas. Such characteristics make natural and recycled educational play tools particularly relevant for contemporary early childhood education that seeks to integrate creativity, learner autonomy, contextual learning, and environmental awareness.

CONCLUSION

This literature review concludes that educational play tools based on natural and recycled materials have meaningful potential to stimulate imagination and creativity in early childhood. Across the 15 reviewed studies, the most consistent evidence showed that open-ended materials such as leaves, stones, twigs, seeds, cardboard, bottle caps, fabric scraps, and reusable containers encourage children to explore, combine, reconstruct, and symbolically transform objects according to their own ideas. Conceptually, these materials support a developmental sequence of material affordance, exploration, symbolic transformation, divergent thinking, and creative production. Empirically, several studies reported measurable improvements in creativity and imagination. For example, one classroom-action study showed that the proportion of children reaching high creative-thinking achievement increased from 55% at baseline to 95% after the second intervention cycle. Another quasi-experimental study reported an increase in mean creativity scores from 7.769 to 13.385, with a statistically significant difference ($p < .001$). Other studies also demonstrated improvements in originality, fluency, imaginative play, artistic expression, problem solving, and independent creation.

The findings further indicate that recycled materials provide an additional sustainability dimension by introducing reuse and environmental responsibility. However, the effectiveness of these materials depends on appropriate teacher scaffolding, material diversity, safety, sufficient play time, and freedom from overly prescriptive instruction. Overall, natural and recycled educational play tools represent an accessible, contextual, and pedagogically relevant strategy for creativity-oriented early childhood education.

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