

Creative Learning Ecosystems in Early Childhood Education: Integrating Arts, Technology, and Nature Exploration

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ABSTRAK

Creative learning ecosystems in early childhood education have gained increasing attention as an approach to support children's holistic development through diverse and meaningful learning experiences. Integrating arts, technology, and nature exploration in early childhood learning environments can stimulate creativity, critical thinking, and socio-emotional development. However, many early childhood education institutions still implement these elements separately, which limits their potential impact on children's development. Therefore, this study aims to analyze how the integration of arts, technology, and nature exploration contributes to the development of creative learning ecosystems in early childhood education and to formulate an integrative conceptual framework that manages these elements as a unified learning ecosystem. This study employs a qualitative approach using a systematic literature review method. Data were collected from peer-reviewed journal articles published between 2021 and 2025 related to creative learning environments, STEAM education, arts-based learning, and nature-based learning in early childhood education contexts. The data were analyzed through thematic and conceptual synthesis to identify patterns, relationships, and conceptual models related to creative learning ecosystems. The findings indicate that play-based learning, artistic expression, technological exploration, and nature-based learning collectively support children's cognitive, social, emotional, and physical development. The study concludes that an integrative framework combining arts, technology, and nature exploration within holistic learning environments is essential for developing sustainable creative learning ecosystems in early childhood education.

INTRODUCTION

Early childhood education represents a critical stage in human development in which foundational cognitive, emotional, social, and physical capacities are formed. During this period, children demonstrate high levels of curiosity, creativity, and exploratory behavior, which require learning environments that support active engagement and meaningful experiences. Contemporary educational discourse



increasingly emphasizes the importance of creative learning ecosystems that provide children with diverse opportunities to explore, experiment, and express themselves through various forms of learning activities. In early childhood education contexts, a creative learning ecosystem refers to a learning environment that integrates multiple pedagogical elements, including play-based learning, artistic expression, technological exploration, and interaction with the natural environment. Such ecosystems enable children to develop holistic competencies that extend beyond academic knowledge to include creativity, problem-solving abilities, and socio-emotional skills. Therefore, designing creative learning ecosystems in early childhood education institutions has become a strategic priority for educators seeking to foster children's holistic development in an increasingly complex educational landscape (Ekeh & Martin-Ekeh, 2025; Gusmaniarti et al., 2025).

One of the central principles underlying creative learning ecosystems is the emphasis on play-based and child-centered learning. In early childhood education, play functions as a natural medium through which children explore their surroundings, construct knowledge, and develop social relationships. Play-based learning allows children to engage in multisensory experiences that stimulate creativity, cognitive flexibility, and emotional expression. When children are given the autonomy to explore and experiment within supportive environments, they develop problem-solving skills and independent thinking capacities that are essential for lifelong learning. Research indicates that child-centered learning environments characterized by exploration, agency, and experiential learning significantly enhance children's executive function, creativity, and readiness for formal schooling. Such environments encourage children to express ideas freely, collaborate with peers, and develop adaptive learning strategies that strengthen cognitive development (Ekeh & Martin-Ekeh, 2025; Angkur, 2025; Gusmaniarti et al., 2025).

In addition to play-based learning, the concept of holistic-integrative early childhood education has gained increasing attention in educational research. Holistic-integrative approaches emphasize the importance of integrating educational experiences with broader developmental support systems that include health, nutrition, emotional well-being, and family participation. In many countries, holistic early childhood education models are implemented through cross-sectoral collaboration among educational institutions, families, and community organizations. These integrative approaches provide children with enriched developmental experiences that address multiple dimensions of growth simultaneously. Empirical studies demonstrate that holistic-integrative learning environments contribute significantly to children's socio-emotional and physical-motor development while also providing meaningful cognitive stimulation. Such learning ecosystems create supportive environments in which children can develop healthy social relationships, emotional resilience, and physical coordination through diverse interactive experiences (Gea et al., 2025; Nakato et al., 2025; Travelancya, 2022).

Another important dimension of creative learning ecosystems in early childhood education involves the integration of co-curricular activities that complement formal classroom instruction. Activities such as music, drama, sports, gardening, and creative storytelling provide opportunities for children to develop essential life skills through experiential learning. These activities enhance children's literacy and numeracy development while also strengthening executive functions such as self-regulation, attention control, and emotional management. Co-curricular learning environments are

particularly valuable in educational contexts with limited resources because they allow educators to utilize creative teaching strategies that rely on exploration and interaction rather than expensive instructional materials. Studies show that children who participate in diverse experiential learning activities demonstrate improved cognitive flexibility, collaborative skills, and emotional resilience compared to those who experience more rigid learning environments (Nakato et al., 2025; Wright et al., 2023; Li et al., 2024).

Within creative learning ecosystems, three interconnected dimensions play particularly important roles in shaping children's developmental experiences: artistic expression, technological engagement, and nature-based exploration. Artistic activities such as drawing, music, dance, and creative crafts allow children to communicate ideas and emotions through symbolic and imaginative forms of expression. These experiences contribute to the development of fine and gross motor skills while also strengthening language abilities, empathy, and emotional regulation. Artistic learning environments encourage children to explore their identities, develop self-confidence, and cultivate positive character traits such as discipline, responsibility, and perseverance. Research demonstrates that participation in artistic activities enhances children's cognitive and emotional development by providing opportunities for self-expression and creative problem-solving (Ekeh & Martin-Ekeh, 2025; Permatasari et al., 2025; Ardiyanti et al., 2025).

Technological innovation has also become an increasingly important component of contemporary learning environments. The integration of digital technologies in early childhood education provides opportunities for interactive learning experiences that connect theoretical knowledge with real-world applications. Approaches such as STEAM education and makerspace learning encourage children to explore scientific and technological concepts through creative experimentation. Activities involving coding, digital design, and construction using loose parts enable children to develop critical thinking, digital literacy, and collaborative problem-solving skills. These approaches encourage children to view technology not merely as a tool for entertainment but as a medium for creativity and innovation. Research indicates that STEAM-based learning environments can significantly enhance children's creativity, scientific curiosity, and understanding of mathematical and technological concepts when implemented within developmentally appropriate frameworks (Rahma et al., 2023; Khirwadkar et al., 2025; Ng et al., 2022; Gusmaniarti et al., 2025).

Nature-based learning represents another important component of creative learning ecosystems in early childhood education. Direct interaction with natural environments provides children with unique opportunities for sensory exploration, physical activity, and experiential learning. Outdoor learning activities such as gardening, environmental observation, and nature play enable children to develop ecological awareness and emotional connections with the natural world. These experiences promote independence, curiosity, and self-regulation while also supporting physical health and well-being. Nature-based learning environments provide children with opportunities to engage in hands-on learning that integrates cognitive, social, and emotional development. Studies show that children who regularly participate in outdoor and nature-based learning activities demonstrate improved creativity, emotional resilience, and environmental awareness compared to those who primarily learn in indoor classroom settings (Kiviranta et al., 2023; Permatasari et al., 2025; Johnstone et al., 2022).

Despite the growing recognition of the importance of arts, technology, and nature-based learning in early childhood education, many educational institutions still implement these elements separately rather than integrating them within a coherent learning ecosystem. In many cases, artistic activities, digital learning tools, and outdoor exploration are treated as isolated components of the curriculum without systematic coordination. This fragmented approach limits the potential benefits of these learning experiences because children are unable to develop meaningful connections between different domains of knowledge and exploration. As a result, the educational potential of creative learning ecosystems remains underutilized in many early childhood education contexts.

Another challenge identified in the literature relates to the lack of comprehensive conceptual frameworks that guide educators in designing integrated creative learning ecosystems. While numerous studies have examined the benefits of arts-based learning, STEAM education, and nature-based learning individually, relatively few studies have explored how these elements can be systematically integrated within early childhood learning environments. This gap in the literature highlights the need for conceptual models that combine multiple learning dimensions into cohesive educational ecosystems that support holistic child development. Without such frameworks, educators may struggle to design learning environments that effectively integrate diverse pedagogical approaches in meaningful ways (Sriarun et al., 2025; Khirwadkar et al., 2025; Ng et al., 2022).

Furthermore, many early childhood education programs lack structural support systems that facilitate the implementation of creative learning ecosystems. Effective creative learning environments require flexible physical spaces, diverse learning materials, teacher training, and supportive institutional policies. Learning environments should include both indoor and outdoor spaces that allow children to engage in creative exploration using natural materials, loose parts, and digital tools. Teachers also require professional development opportunities that enable them to design innovative learning experiences and integrate interdisciplinary learning strategies. Research suggests that educational institutions that adopt ecosystem-based learning designs demonstrate greater success in promoting creativity and engagement among young learners (Ekeh & Martin-Ekeh, 2025; Rahma et al., 2023; Kiviranta et al., 2023; Muvid, 2023; Casnan et al., 2025).

Based on these considerations, it becomes evident that the development of creative learning ecosystems in early childhood education requires a comprehensive integrative framework that connects arts, technology, and nature exploration within a holistic educational approach. The novelty of this study lies in proposing an integrative conceptual framework that positions creative learning ecosystems as interconnected systems consisting of play-based pedagogy, artistic exploration, technological innovation, and nature-based experiences. This framework also emphasizes the importance of holistic-integrative approaches that involve collaboration among educators, families, and communities in supporting children's developmental needs.

Therefore, the objective of this study is to analyze how the integration of arts, technology, and nature exploration contributes to the development of creative learning ecosystems in early childhood education and to formulate an integrative conceptual framework that can guide educators in designing holistic, innovative, and sustainable learning environments for young children.

METHODOLOGY

This study employs a qualitative research approach using a systematic literature review (SLR) to analyze the integration of arts, technology, and nature exploration in developing creative learning ecosystems in early childhood education. The systematic literature review method was selected because it allows researchers to synthesize and critically evaluate existing empirical and theoretical studies related to creative learning environments, STEAM education, nature-based learning, and holistic early childhood education. The data used in this study consist of secondary data derived from peer-reviewed journal articles, conference proceedings, and scholarly publications that examine creative pedagogical practices in early childhood education contexts. The literature sources were collected from reputable academic databases such as Scopus, Web of Science, and Google Scholar, focusing on publications published between 2021 and 2025 to ensure the relevance and recency of the analysis. The data collection technique involved several stages, including the identification of relevant studies through keyword searches, screening of titles and abstracts, and selection of articles based on predetermined inclusion criteria. The keywords used in the search process included creative learning ecosystem, early childhood education, arts-based learning, STEAM education, nature-based learning, and holistic-integrative learning environments. Only studies that directly addressed the integration of arts, technology, and nature exploration in early childhood learning environments were included in the analysis.

The data analysis was conducted through thematic and conceptual synthesis to identify patterns, relationships, and conceptual frameworks related to creative learning ecosystems in early childhood education. In the first stage, the selected articles were categorized based on their primary research focus, such as studies on play-based learning, artistic activities in early childhood education, technology integration in STEAM learning, and outdoor or nature-based learning approaches. In the second stage, the content of each study was analyzed to identify recurring themes related to learning environments, pedagogical strategies, and the role of educators and communities in supporting children's creative development. These themes were then systematically synthesized to construct an integrative conceptual framework that explains how arts, technology, and nature exploration can function as interconnected components within a creative learning ecosystem. The final stage of the analysis involved interpreting the relationships among these elements to develop a comprehensive model that integrates play-based learning, creative exploration, and multisensory experiences in early childhood education. This analytical approach enables the study to generate theoretical insights that contribute to the development of innovative and holistic learning ecosystems in early childhood education.

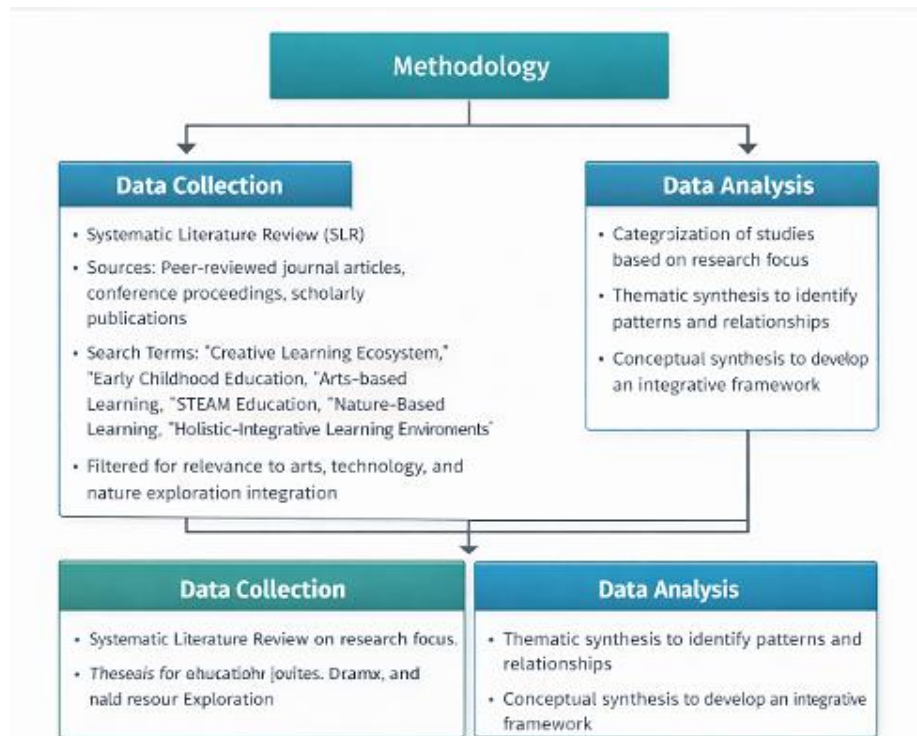


Figure 1. Diagram Conceptual Research

RESULTS AND DISCUSSION

Based on the systematic literature review conducted in this study, several key patterns were identified regarding the role of arts, technology, and nature exploration in shaping creative learning ecosystems in early childhood education. The reviewed studies consistently highlight that creative learning environments that combine multisensory play, artistic expression, technological exploration, and interaction with natural environments contribute significantly to children's holistic development. These elements collectively support the development of cognitive flexibility, creativity, social-emotional competence, and physical-motor abilities. In addition, the literature emphasizes that creative learning ecosystems are most effective when implemented within holistic-integrative frameworks that involve collaboration among educators, families, and communities. The synthesis of findings from the reviewed studies is summarized in Table 1.

Table 1. Synthesis of Creative Learning Ecosystem Components in Early Childhood Education.

Key Component	Learning Activities	Contribution to Child Development	Supporting References
Play-Based and Multisensory Learning	Exploration activities, role play, interactive games	Enhances creativity, executive function, problem-solving skills, and school readiness	Ekeh & Martin-Ekeh (2025); Gusmaniarti et al. (2025); Angkur (2025); Nakato et al. (2025)
Holistic-	Cross-sector	Strong contribution	Gea et al. (2025);

Integrative Learning Environment	collaboration, integrated services, family involvement	to socio-emotional and physical-motor development, moderate contribution to cognitive development	Travelancya (2022); Nakato et al. (2025)
Arts-Based Learning	Drawing, music, dance, crafts, storytelling	Supports emotional expression, language development, creativity, and character formation	Ekeh & Martin-Ekeh (2025); Permatasari et al. (2025); Ardiyanti et al. (2025)
Technology and STEAM Learning	Coding activities, digital learning tools, makerspaces, loose parts construction	Enhances digital literacy, critical thinking, creativity, and integration of science and mathematics concepts	Rahma et al. (2023); Khirwadkar et al. (2025); Ng et al. (2022); Gusmaniarti et al. (2025)
Nature-Based Learning	Outdoor exploration, gardening, environmental observation	Improves creativity, independence, self-regulation, physical health, and environmental awareness	Kiviranta et al. (2023); Permatasari et al. (2025); Johnstone et al. (2022)
Community and Family Collaboration	Parent involvement, community learning activities	Strengthens sustainability of learning programs and children's engagement in learning	Gea et al. (2025); Nakato et al. (2025); Travelancya (2022)

The results presented in Table 1 demonstrate that creative learning ecosystems in early childhood education consist of interconnected learning components that collectively support children's holistic development. Play-based and multisensory learning environments serve as the foundation of creative ecosystems by encouraging exploration and imaginative thinking. Through such environments, children are able to develop cognitive flexibility and executive functioning skills that are essential for problem-solving and future academic success. Furthermore, the integration of arts-based learning activities enhances children's emotional expression and creativity, while technological learning environments such as STEAM and makerspaces stimulate critical thinking and digital literacy. These two learning domains complement each other by enabling children to express ideas creatively while also developing analytical skills. At the same time, nature-based learning provides opportunities for hands-on exploration that strengthens children's connection with the natural environment and promotes physical well-being.

The synthesis also highlights the importance of holistic-integrative learning

environments that combine educational experiences with family and community participation. Such collaborative ecosystems allow children to experience consistent developmental support across multiple contexts, thereby strengthening the sustainability and effectiveness of creative learning programs. Overall, the findings indicate that the integration of arts, technology, and nature exploration within a holistic–integrative framework creates a balanced creative learning ecosystem that supports the cognitive, emotional, social, and physical development of young children. These results underscore the importance of designing early childhood learning environments that encourage interdisciplinary exploration and experiential learning.

Discussion

The objective of this study is to analyze how the integration of arts, technology, and nature exploration contributes to the development of creative learning ecosystems in early childhood education and to formulate an integrative conceptual framework that allows these elements to function as a unified ecosystem. Based on the findings summarized in the results section, the literature consistently indicates that creative learning ecosystems provide an effective environment for supporting holistic child development. Such ecosystems combine play-based learning, artistic exploration, technological innovation, and nature-based experiences within learning environments that emphasize creativity, exploration, and child agency. The discussion elaborates on three key dimensions identified in the literature synthesis, namely the importance of creative learning ecosystems in early childhood education, the role of arts, technology, and nature exploration as complementary learning components, and the need for an integrative framework that manages these elements as a cohesive educational ecosystem.

Creative learning ecosystems in early childhood education are fundamentally grounded in play-based and child-centered pedagogical principles. In early childhood contexts, play functions as a primary medium through which children explore their environment, develop social relationships, and construct knowledge through direct experience. When children are provided with learning environments that encourage exploration, creativity, and autonomy, they develop cognitive flexibility and problem-solving abilities that are essential for lifelong learning. Research demonstrates that learning environments characterized by play-based and multisensory activities significantly enhance children's executive function, creativity, and self-expression. These learning environments allow children to experiment with ideas, interact with peers, and engage in exploratory learning processes that strengthen their cognitive and emotional development (Ekeh & Martin-Ekeh, 2025; Gusmaniarti et al., 2025; Angkur, 2025).

The concept of a creative learning ecosystem extends beyond individual learning activities to include broader systemic interactions between educational institutions, families, and communities. Holistic–integrative early childhood education models emphasize the importance of integrating educational experiences with other developmental support systems such as health services, nutrition programs, and family engagement. Such integrative approaches provide children with enriched developmental experiences that support multiple aspects of growth simultaneously. Empirical evidence indicates that holistic learning ecosystems have particularly strong effects on children's socio-emotional and physical-motor development, while also contributing to cognitive development. When children are exposed to rich multisensory interactions within supportive environments, they develop stronger emotional resilience, improved physical coordination, and enhanced social communication skills (Gea et al., 2025; Nakato et al.,

2025; Travelancya, 2022).

Another important characteristic of creative learning ecosystems is the inclusion of diverse co-curricular activities that complement traditional classroom instruction. Activities such as music, drama, sports, gardening, and storytelling provide opportunities for children to learn through experiential engagement rather than passive instruction. These activities support the development of literacy and numeracy while also strengthening executive functions such as attention control, self-regulation, and emotional management. In educational settings with limited resources, co-curricular activities often become powerful tools for enhancing children's learning experiences because they rely on creativity and interaction rather than expensive learning materials. Research indicates that experiential learning activities contribute to the development of critical thinking and collaborative skills, which are essential competencies for children's long-term academic and social success (Nakato et al., 2025; Wright et al., 2023; Li et al., 2024).

Within creative learning ecosystems, artistic learning activities represent a particularly significant dimension of children's development. Artistic experiences such as drawing, music, dance, and creative crafts provide children with opportunities to express emotions, communicate ideas, and develop imaginative thinking. These activities stimulate both fine and gross motor skills while also supporting language development and emotional regulation. Artistic learning environments encourage children to explore symbolic representation and storytelling, which enhances their capacity for creative expression and cognitive development. Research indicates that participation in artistic activities contributes to children's social-emotional development by fostering empathy, confidence, and cooperation. Moreover, artistic engagement helps children develop positive character traits such as discipline, perseverance, and responsibility, which are essential for holistic development during early childhood (Ekeh & Martin-Ekeh, 2025; Permatasari et al., 2025; Ardiyanti et al., 2025).

Technological innovation represents another key component of contemporary creative learning ecosystems. Digital technologies have increasingly become part of children's daily learning environments, offering new opportunities for interactive and exploratory learning experiences. When used appropriately, technological tools such as digital learning platforms, coding activities, and makerspaces can stimulate creativity and critical thinking among young learners. STEAM education approaches integrate science, technology, engineering, arts, and mathematics within interdisciplinary learning environments that encourage experimentation and problem-solving. In makerspace learning environments, children can explore creative construction activities using materials such as loose parts, digital tools, and three-dimensional models. These experiences allow children to connect abstract scientific and mathematical concepts with real-world applications. Research suggests that STEAM-based learning environments significantly enhance children's digital literacy, creativity, and problem-solving abilities when implemented within developmentally appropriate pedagogical frameworks (Rahma et al., 2023; Khirwadkar et al., 2025; Ng et al., 2022; Gusmaniarti et al., 2025).

Nature-based learning also plays a critical role in supporting creative learning ecosystems in early childhood education. Interaction with natural environments provides children with rich opportunities for sensory exploration and physical activity. Outdoor learning experiences such as gardening, environmental observation, and nature play allow children to engage in hands-on exploration that stimulates curiosity and creativity. These activities strengthen children's connection with nature while promoting independence

and self-regulation. Nature-based learning environments also contribute to children's physical health and well-being by encouraging active movement and outdoor play. Studies indicate that children who regularly participate in outdoor learning activities demonstrate improved emotional resilience, social cooperation, and environmental awareness compared to those who primarily learn in indoor classroom environments (Kiviranta et al., 2023; Permatasari et al., 2025; Johnstone et al., 2022).

Although arts, technology, and nature exploration each provide valuable contributions to children's development, the literature indicates that these learning components are often implemented separately within early childhood education programs. In many educational institutions, artistic activities, technological learning tools, and outdoor exploration are treated as independent components of the curriculum rather than as interconnected elements of a unified learning ecosystem. This fragmented approach limits the potential benefits of creative learning environments because children may not experience meaningful connections between different learning domains. As a result, the opportunities for interdisciplinary exploration and holistic development become constrained.

Another challenge identified in the literature relates to the absence of comprehensive conceptual frameworks that guide educators in designing integrated creative learning ecosystems. While numerous studies have examined arts-based learning, STEAM education, and nature-based learning individually, relatively few studies have explored how these elements can be systematically combined within cohesive pedagogical models. This research gap highlights the need for integrative conceptual frameworks that connect these learning dimensions within unified educational ecosystems. Such frameworks would enable educators to design learning environments that encourage interdisciplinary exploration and experiential learning (Sriarun et al., 2025; Khirwadkar et al., 2025; Ng et al., 2022).

The integrative framework proposed in this study builds upon existing theoretical perspectives such as experiential learning, systems thinking, and the Reggio Emilia approach. These perspectives emphasize the importance of viewing learning environments as interconnected systems that support children's creativity and exploration. In such ecosystems, artistic expression, technological innovation, and nature-based exploration function as complementary components that enrich children's learning experiences. Through experiential learning, children engage directly with materials and environments that stimulate curiosity and creativity. Systems thinking perspectives encourage educators to design learning environments that integrate diverse pedagogical elements within coherent educational ecosystems (Sriarun et al., 2025; Casnan et al., 2025; Li et al., 2024).

Holistic-integrative early childhood education models further strengthen the implementation of creative learning ecosystems by connecting educational practices with broader developmental support systems. These approaches emphasize the integration of education, health, nutrition, character development, and community participation within unified frameworks. By involving families and communities in educational processes, early childhood institutions can create supportive learning environments that extend beyond classroom settings. Research indicates that collaborative ecosystems involving educators, families, and communities significantly enhance the sustainability and effectiveness of early childhood learning programs (Gea et al., 2025; Nakato et al., 2025; Travelancya, 2022).

In addition to conceptual integration, the implementation of creative learning

ecosystems requires supportive educational infrastructure and institutional policies. Flexible physical learning spaces that combine indoor and outdoor environments allow children to explore diverse learning activities. Learning materials such as loose parts, natural objects, and digital tools provide children with opportunities for creative experimentation. Teacher professional development programs are also essential for equipping educators with the skills necessary to design innovative learning environments. Educational policies that support creative pedagogy and interdisciplinary learning approaches further strengthen the sustainability of creative learning ecosystems in early childhood education (Ekeh & Martin-Ekeh, 2025; Rahma et al., 2023; Kiviranta et al., 2023; Muvid, 2023; Casnan et al., 2025).

Overall, the findings of this study demonstrate that the integration of arts, technology, and nature exploration within creative learning ecosystems provides a powerful framework for supporting holistic child development. When these elements are combined within holistic-integrative educational environments, they create dynamic learning ecosystems that encourage creativity, exploration, and interdisciplinary learning. However, the successful implementation of such ecosystems requires the development of integrative conceptual frameworks that guide educators in designing cohesive learning environments. By integrating artistic expression, technological innovation, and nature-based exploration within unified educational ecosystems, early childhood education institutions can create learning environments that nurture children's creativity, resilience, and lifelong learning capacities.

CONCLUSION

This study concludes that creative learning ecosystems in early childhood education that integrate arts, technology, and nature exploration play a significant role in supporting the holistic development of young children. The findings indicate that play-based and child-centered learning environments provide a strong foundation for developing creativity, cognitive flexibility, and problem-solving abilities, while artistic activities foster emotional expression, character formation, and language development. At the same time, technological learning approaches such as STEAM and makerspaces stimulate critical thinking, digital literacy, and innovative problem-solving, whereas nature-based learning promotes independence, environmental awareness, physical well-being, and socio-emotional resilience. However, the literature also reveals that these learning components are often implemented separately, which limits their potential impact on children's development. Therefore, the study emphasizes the importance of developing an integrative framework that manages arts, technology, and nature exploration as interconnected elements within a unified creative learning ecosystem. Such a framework should adopt holistic integrative approaches that combine experiential learning, flexible learning environments, interdisciplinary teaching strategies, and collaboration among educators, families, and communities. Through this integrative approach, early childhood education institutions can create sustainable learning ecosystems that effectively nurture children's creativity, well-being, and lifelong learning capacities.

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