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DEVELOPMENTAL OUTCOMES OF STEAM LEARNING IN EARLY CHILDHOOD EDUCATION IN INDONESIA: A SYSTEMATIC LITERATURE REVIEW

I Komang Wisnu Budi Wijaya[1], Ni Wayan Satri Adnyani[2] , I Gusti Lanang Agung Wiranata[3]
[1 2 3]Universitas Hindu Negeri I Gusti Bagus Sugriwa Denpasar
e- mail : wisnu@uhnsugriwa.ac.id[1], satri.adnyani@uhnsugriwa.ac.id[2], agungwiranata@uhnsugriwa.ac.id[3]

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Abstract

This study was motivated by the absence of comprehensive mapping of research on the effects of STEAM on early childhood. This study aims to analyze the effects of the STEAM approach on early children through a systematic literature review (SLR) to produce a research map and identify research gaps. This study employed a systematic literature review using the PRISMA method. Articles were collected from Google Scholar for the period 2021 – 2026. The research stages included formulating the research problem, collecting the literature, selecting literature based on inclusion and exclusion criteria, analyzing the selected literature, presenting the data, and drawing conclusions. A total of 89 articles were retrieved, of which 29 met the inclusion criteria. The data were analyzed descriptively. Of all studies analyzed, the cognitive aspect was the most dominant focus, comprising 16 studies (55.17%), covering creativity, cognitive abilities, and thinking skills. Seven studies (24.13%) examined literacy-related aspects, including scientific literacy, mathematical literacy, numeracy, and Eco-literacy. The affective aspect was identified in five studies (17.24%), focusing on collaboration, independence, and active participation; meanwhile, the psychomotor aspect was found in only one study (3.44%), focusing on fine motor skills.

Keyword* : *STEAM, Early Childhood, Systematic Literature Review (SLR).

INTRODUCTION

Early childhood is widely recognized as a golden period development. During this period, children experience optimal cognitive, affective, and psychomotor development (Sukatin et.al, 2023; Jaoza & Kanda, 2024). Therefore, early childhood learning should be concrete, meaningful, and enjoyable. Young children also have a high level of curiosity. Therefore, learning for young children should provide opportunities for active learning accompanied by activities that encourage the exploration of phenomena. A learning approach that integrates various fields of knowledge through play-based activities and direct experiences is increasingly important for supporting children's holistic development (Hidayah et.al., 2025).

Advances in science and technology also require changes in 21st century learning,

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particularly in science education. One approach that has developed is STEAM-based science learning, an acronym for Science, Technology, Engineering, Arts and Mathematics. The STEAM approach integrates science, technology, engineering, arts, and mathematics into contextual, creative, collaborative, and problem-oriented learning activities (Ramadhan, 2023; Atiasih, 2025). STEAM activities for young children; for example, include constructing simple structures and measuring and describing natural phenomena through artistic activities. Such processes provide children with opportunities to learn through direct experience while developing various abilities in an integrated manner (Alibek & Akhmetova, 2025 ; Hasanah et .at., 2025 ; Veziroglu-Celik et al, 2025).

Various studies have examined the implementation of the STEAM approach in early childhood education. These studies indicate STEAM implementation has positive effects on various aspects of development, including cognitive and socio-emotional development. Thus, STEAM is not solely oriented toward knowledge acquisition but also provides learning experiences that support children's multidimensional development (Setiani, et.al., 2026).

Nevertheless, research findings on the implementation of STEAM in early childhood education show variation in both the developmental aspects addressed and the magnitude of the reported effects. This condition indicates the need for systematic synthesis to obtain a more comprehensive understanding of the effects of the STEAM approach on early childhood. A Systematic Literature Review (SLR) is a relevant method for identifying, evaluating, and synthesizing various research findings on the implementation of STEAM in early childhood education. Through an SLR, previous studies can be mapped according to the effects of STEAM implementation on young children, while research gaps can also be identified to guide future studies.

SLR studies on the implementation of STEAM in early childhood education have previously been conducted. Maulida and Fuadi (2026) examined the effects of STEAM on young children, but their study focused more specifically on cognitive aspects, namely creativity, problem-solving, and critical thinking. The present study examines the effects of STEAM more broadly by covering cognitive, affective, and psychomotor aspects. Suryaningsih et.al. (2025) reported on the effects of STEAM on early childhood literacy skills. The difference between that study and the present SLR is that the current study has a broader scope, encompassing multiple developmental aspects in early childhood.

Based on the discussion above, examining the effects of the STEAM approach on early childhood is important to obtain a comprehensive picture of its effectiveness in supporting children's development. This article aims to synthesize previous research findings on the effect of STEAM implementation in early childhood, particularly about the various developmental aspects and skills targeted through learning. The findings are expected to provide a theoretical contribution to the development of STEAM research in early childhood education and a practical foundation for educators in designing integrative, contextual, and creative learning aligned with children's developmental characteristics.

METHODOLOGY

This study employed a systematic literature review (SLR) using the PRISMA method. The study began with the formulation of the research problem: What are the effects of STEAM implementation on early childhood? This was followed by the literature collection stage. The literature used as the data source consisted of journal articles published and indexed in Google Scholar during 2021-2026. The literature search used the keywords "effect", "STEAM", and "early childhood". A total of 89 articles were identified through the search.

The third stage was article selection. The collected articles were selected using inclusion and exclusion criteria. The inclusion and exclusion criteria are presented in Table 1.

Table 1. Inclusion and Exclusion Criteria

Inklusi	Ekslusi
Article published as a journal article or conference proceeding	Article is not a journal article or conference proceeding
Article published in an ISSN-bearing journal	Article is not published in an ISSN-bearing journal
Full paper accessible	Full paper is inaccessible
Article reports empirical research	Article is a literature review

After the articles were selected according to the inclusion and exclusion criteria, 29 articles met the inclusion criteria. The selected articles were then subjected to content analysis to answer the research question. The findings of the analysis were presented in tables, supplemented by an argumentative narrative, and concluded with a synthesis of the findings. The research stages are presented in Figure 1.

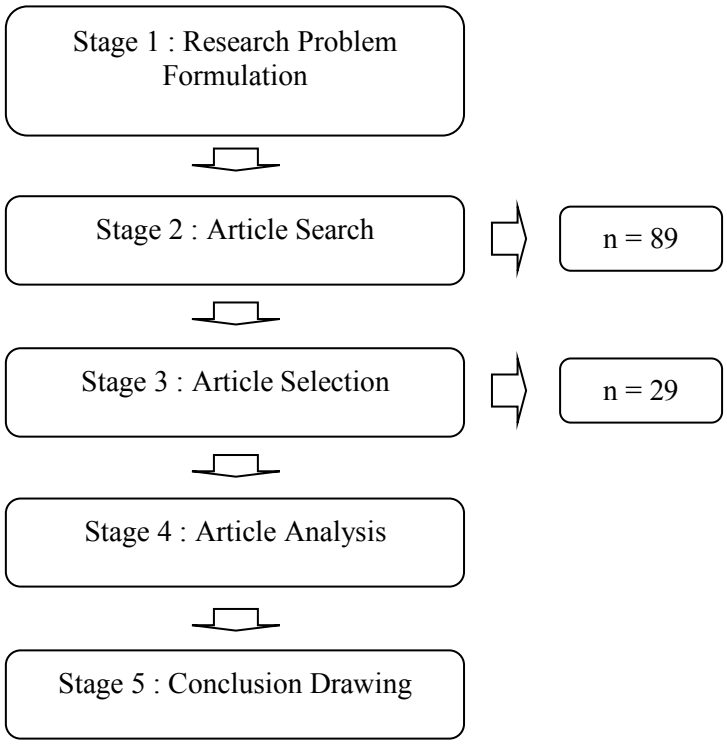


Figure 1. SLR Research Stages

RESULTS AND DISCUSSION

The results of the analysis of the articles that met the inclusion criteria are presented in Table 2.

Table 2. Results of the Analysis of Articles on the Effects of STEAM on Early Childhood

No	Author (s)	Year	Findings
1	Hasanah et al	2021	Improved creativity in young children
2	Riawati et al	2022	Increased active participation
3	Jaya et al	2024	Critical thinking skills
4	Kurniawati et al	2022	Cognitive development in young children
5	Faujiah et al	2022	Improved creativity
6	Septiani & Kasih	2021	Increased independence
7	Lestari & Handayani	2024	Improved creativity
8	Putri et al	2021	Improved 21st-century skills
9	Sudarti & Diana	2023	Improved collaboration
10	Sudarti et al	2024	Improved creativity
11	Sativa & Buahana	2024	Improved critical thinking skills
12	Amseke et al	2025	Improved cognitive abilities
13	Aliyah & Nurjanah	2022	Development of cognitive aspects
14	Aisyah et al	2025	Early mathematical abilities
15	Azizah et al	2022	Critical thinking skills
16	Miharini et al	2025	Improved scientific literacy
17	Rizki et al	2026	Improved creativity
18	Hidayati et al	2025	Improved eco-literacy
19	Yuniarti et al	2024	Improved problem-solving abilities
20	Naba & Nirwana	2021	Improved cognitive abilities
21	Hasanah et al	2026	Improved mathematical abilities
22	Sari et al	2025	Improved fine motor skills
23	Wahyuni et al	2021	Improved creativity
24	Rahma et al	2023	Improved literacy
25	Sulastri et al	2025	Improved creativity
26	Shaka et al	2024	Improved numeracy abilities
27	Munawir et al	2024	Improved science skills
28	Najamudin et al	2022	Improved problem-solving abilities
29	Fauziah et al	2024	Improved creativity and collaboration

Based on the data in Table 2, STEAM learning in early childhood affects cognitive, affective and psychomotor, and literacy-related aspects. Research on cognitive aspects, including creativity, cognitive abilities, and thinking skills, was the most dominant, accounting for 16 studies (55.17%). Literacy-related abilities, including scientific literacy, mathematical literacy, numeracy, and eco-literacy were examined in seven studies (24,13%). Affective aspects, including collaboration, independence, and active participation, were addressed in five studies (17,24%), while the psychomotor aspect, represented by fine motor skills, was examined in only one study (3.44%).

The data analysis demonstrates that the STEAM approach has positive effects on young children in cognitive, affective, and psychomotor domains. The integration of multiple disciplines in STEAM enables young children to engage in diverse learning experiences, such as observation, exploration, problem-solving, play and other activities through which they construct knowledge. Therefore, STEAM is a holistic learning approach with the potential to accommodate the developmental characteristics of young children during their golden period (Istiqlaliyah et.al. 2026).

The most dominant aspect identified in this study was the cognitive aspect. In STEAM learning, young children are provided with stimuli in the form of phenomena that encourage them to think and seek solutions. In the process of finding solution, children engage in various activities, such as simple experiments or creating products, and interacting with objects (Gamcut 2024; Salam et.al., 2026). When these activities are implemented consistently and continuously, they may contribute to children's cognitive development. Among the cognitive aspects, creativity was the most frequently identified. This may be explained by the inclusion of Arts in STEAM. The integration of the arts provides children with opportunities to express ideas, produce divers designs, use their imagination and develop interactive solutions to problems (Rahmawati et.al., 2026). For example, when children are asked to design a simple structure, they can apply concepts of shape and size from mathematics, understand material characteristics through science, use technology or simple tools, apply an engineering process, and add aesthetic elements through the arts (Novitasari & Zaida, 2022).

The studies also indicate that STEAM affects literacy skills. Literacy is not limited to mastering concepts but also involves connecting multiple concepts to explain a phenomenon or solve a problem. STEAM integrates five disciplines into learning activities. This integration can develop various literacy skills in young children, including scientific literacy, mathematical literacy, numeracy, and other forms of literacy (Brantasari et al., 2025). For example creating simple gardens can involve scientific literacy through observing plant growth, numeracy through measuring and counting, technology using simple tools, engineering through designing a planting medium and the arts through drawing or decorating the garden.

The STEAM approach also affects the affective development of young children. STEAM is a student-centered learning approach that encourages children to be actively involved in the learning process (Widyastika, et.al., 2025). When children are given opportunity to participate actively in learning, their independence in learning can also develop. STEAM also provides opportunities for children to share ideas, use tools and materials in turn, and complete tasks or projects collaboratively (Susanti et.al., 2026). Such conditions can support the development of collaboration and social communication skills.

The findings indicate that the STEAM approach affects the psychomotor development of young children, although this aspect represents the smallest proportion of the studies reviewed. This may be because assessing psychomotor development in young children requires relatively complex instruments and procedures, and consequently, fewer studies have examined psychomotor development as a research variable. STEAM learning inherently involves many hands-on activities, such as designing, arranging, drawing, cutting, pasting, building, manipulating objects, and producing simple products. Theoretically, these activities have considerable potential to stimulate children's fine motor development (Aisyi & Herianingtyas, 2025).

The STEAM approach has positive effects on the cognitive, effective, and psychomotor development of young children. Therefore, STEAM can be recommended as an alternative learning approach for early childhood education that balances minds-on, hands-on, and social – emotional learning. Future research on STEAM is expected to examine its effects on the psychomotor development of young children more extensively. Future studies may also explore the integration of STEAM with local cultural and environmental contexts so that children's learning experiences become more contextual and meaningful.

CONCLUSION

The results of this SLR indicate that the STEAM approach has positive effects on cognitive, affective, and psychomotor aspects. The cognitive aspect was dominant,

represented by 16 studies (55.17%) covering creativity, cognitive abilities, and thinking skills. The relatively low proportion of studies addressing affective and particularly, psychomotor aspects indicate a research gap that requires attention in future studies. Therefore, future research should develop and test STEAM learning designs that integrate cognitive, literacy, socio-emotional, and psychomotor aspects in a balanced manner while considering the developmental characteristics of young children.

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