



Exploring Core STEAM Principles and Their Integration into Early Childhood Education

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ARTICLE INFO	ABSTRACT
Published Online: 25 July 2025	In early childhood education, the integration of Science, Technology, Engineering, Arts, and Mathematics (STEAM) is more than a passing trend—it signifies a critical pedagogical shift. This integrative approach aims to foster the foundational skills young children need to navigate an increasingly complex and interconnected world. However, the effective implementation of STEAM in early learning settings depends on the presence of well-trained and professionally competent educators. To prepare such educators, it is imperative that early childhood teachers acquire a deep understanding of the core principles of STEAM education, along with developmentally appropriate pedagogical strategies for its meaningful application. Accordingly, this paper examines the foundational principles of STEAM education and investigates how they can be effectively integrated into early childhood teaching practices. Strategies for integrating
Corresponding Author: Yi-Huang Shih	STEAM into early childhood education are as follows: (1) interdisciplinary integration; (2) inquiry-based and experiential learning; (3) creativity and innovation.
KEYWORDS: Early Childhood Education, STEAM, Young Children	

1. INTRODUCTION

In today's rapidly evolving world, the demand for skills in science, technology, engineering, and mathematics (STEM) continues to grow. STEM education aims to equip students with the knowledge and skills necessary to tackle complex problems, innovate, and thrive in a technology-driven society. However, in recent years, there has been a push to incorporate the arts into STEM education, giving rise to the STEAM movement (STEAM Academies, 2025). In fact, integrated STEAM education has been recognized as a relevant and effective pedagogical approach for addressing the complex challenges of

contemporary society. However, its successful implementation in early childhood classrooms requires well-trained and professionally competent teachers (Silva-Hormazábal & Alsina, 2023). To cultivate such educators, it is essential for early childhood teachers to develop a deep understanding of the core principles of STEAM education, as well as pedagogical strategies for its meaningful integration into early learning environments. Therefore, this paper primarily explores the core principles of STEAM education and their integration into early childhood teaching practices.

2. STEAM EDUCATION

2.1 The Rise of STEAM: Integrating the Arts

In recent years, STEM education—an acronym formed from the first letters of Science, Technology, Engineering, and Mathematics—has garnered considerable attention in the global educational community. It originally emerged in the United States in response to concerns over students’ underperformance in international assessments, particularly in mathematics. In an effort to address this issue, the U.S. government invested substantial resources and funding to develop STEM education. Notably, *the U.S. Department of Education released STEM 2026: A Vision for Innovation in STEM Education* (2016), which extended STEM education into the early childhood stage, including infants and toddlers. This vision has been implemented in early childhood education settings, even in infant centers such as the renowned Children’s Center at Caltech, which serves children aged 0 to 6. Following this trend, many countries have also actively promoted STEM education policies to respond to the new era of artificial intelligence and to enhance national competitiveness (Chou, 2025).

In recent years, STEAM, an acronym for Science, Technology, Engineering, Arts, and Mathematics, has garnered global interest from both educational and practical perspectives. STEAM education, which originated from STEM, is a movement that emerged in the early 1990s. It is an educational learning approach that employs an integrated method to impart relative knowledge in science, technology, engineering, arts, and mathematics. It utilises these five subjects as entry points to foster learners’ creativity, scientific inquiry, dialogue, critical thinking, and problem solving, all while connecting them with everyday life (Wang & Lin, 2025). STEAM education builds upon the foundation of STEM by adding the arts into the mix. The “A” in STEAM represents disciplines such as visual arts, music, theater, and design. By integrating the arts into STEM education, STEAM programs aim to foster creativity, innovation, and interdisciplinary thinking. Students engage in activities that blend scientific inquiry with artistic expression, allowing them to explore connections between different

disciplines and approach challenges from multiple perspectives (STEAM Academies, 2025).

2.2 Significance of STEAM Education in Early Childhood Development

At an early age, all children have the capacity and propensity to observe, explore, and discover the world around them. These are basic abilities for science learning, including the capacity and propensity to observe, explore, and discover the world that can and should be encouraged and supported among children in the earliest years of their lives. Through STEAM-oriented exploration and creative project-based activities, children gradually develop problem awareness and the ability to generate diverse solutions. Hands-on material manipulation and design practices not only strengthen their practical skills but also foster the development of innovative thinking. Furthermore, collaboration and discussion enhance their language expression, listening comprehension, and social interaction skills such as teamwork. The dynamic and practical nature of STEAM education effectively stimulates children’s motivation and enthusiasm for learning, encouraging them to become active and engaged learners (Lin & Tsai, 2021; Shih, 2025a, 2025b).

2.3 The Core Principles of STEAM Education

There is growing interest among forward-looking public officials, educators, and professionals in enhancing educational platforms to better prepare students for both analytical and creative thinking. Traditional STEM (Science, Technology, Engineering, and Mathematics) education has primarily emphasized convergent thinking—problem-solving that leads to a single correct answer—whereas the arts cultivate divergent thinking, which encourages the generation of multiple solutions and perspectives. The ability to harness both modes of thinking at scale positions a nation more competitively in a globalized, innovation-driven economy. STEAM education—integrating Science, Technology, Engineering, the Arts, and Mathematics—represents an evolution of the STEM model and has recently garnered significant scholarly attention. By incorporating the arts into STEM, STEAM expands the curriculum beyond technical proficiency to include creativity, cultural awareness, and humanistic perspectives. This enriched

pedagogical model fosters deeper engagement and holistic learning experiences. The ‘A’ in STEAM is interpreted in diverse ways across academic literature, often encompassing disciplines such as visual arts, music, theater, dance, literature, and history. Despite this variability, a unifying theme persists: the inclusion of the arts broadens the educational framework to emphasize creativity, expression, and human-centered design—elements crucial for addressing complex, real-world challenges. At its core, STEAM education promotes interdisciplinary learning that not only reinforces foundational content knowledge but also cultivates essential 21st-century skills such as creativity, critical thinking, collaboration, and communication. It underscores the importance of integrative approaches in preparing students to navigate and innovate within a rapidly changing world (Henriksen, 2014; Land, 2013; Spyropoulou & Kameas, 2024).

3. CONCLUDING REMARKS: APPLICATION of STEAM in EARLY CHILDHOOD EDUCATION

STEAM is a method of teaching that encourages students to become lifelong learners who are always on the lookout for new and innovative ways to solve challenges they encounter in the real world (Dahal, 2022). In early childhood education, integrating Science, Technology, Engineering, Arts, and Mathematics (STEAM) is more than a passing trend—it represents a vital pedagogical evolution. Its goal is to cultivate young children’s foundational skills necessary for navigating a world characterized by complexity and interconnectedness (Muhammad Rafiq-Uz-Zaman, 2025). Strategies for integrating STEAM into early childhood education are as follows: (1) interdisciplinary integration: A core principle of STEAM is interdisciplinary integration, where traditional subject boundaries are blurred to promote a more connected understanding of knowledge. For instance, a project on building a miniature garden may integrate science (plant life cycles), technology (using simple watering timers), engineering (designing raised beds), art (creating plant markers), and mathematics (measuring growth); (2) inquiry-based and experiential learning: This integrated approach supports inquiry-based and experiential learning, encouraging

children to explore the world through hands-on activities and sensory experiences. (3) creativity and innovation: Additionally, the inclusion of the arts element amplifies children’s creativity and innovation, allowing them to express understanding through drawing, building, movement, or storytelling. In a preschool classroom in Taiwan, for example, children worked together to create a bridge from recycled materials, combining basic engineering with artistic design and mathematical measurements. Through this, they developed problem-solving skills in real-world contexts and learned to collaborate and communicate effectively with peers. The role of the teacher is crucial in this process—not as a knowledge transmitter, but as a facilitator who poses open-ended questions, documents learning progress, and supports children’s emergent thinking (Vasquez et al., 2013). Overall, integrating STEAM in early childhood not only promotes foundational academic skills but also nurtures the cognitive, emotional, and social domains essential for lifelong learning (Henriksen, 2014; Muhammad Rafiq-Uz-Zaman, 2025; Shih, 2022; Vasquez, Comer & Sneider, 2013; Yakman & Lee, 2012). Relevant studies include, for example, Chen & Wu (2024) studied the teacher and the children discuss the importance of millet and red quinoa in traditional Rukai daily life and for disaster prevention. Then, they explore the differences between areas with and without sunlight and their effects on plant growth. This helps the children understand the following concept: “Sunlight warms the Earth’s surface, creating an environment suitable for the growth of millet and red quinoa”. They also addressed the engineering, technology, and science application standard by asking questions, making observations, and gathering information that supports the growth of millet and red quinoa.

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