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INTEGRATING STEM AND ART IN SCIENCE TEACHING AT PRIMARY SCHOOLS

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Abstract:
The article discusses integrating art into STEM education to create the STEAM model, which aims to enhance comprehensive skills in elementary school students. It presents four methods for incorporating art in science teaching, including designing artistic and scientific products, using art in presentations, fostering creativity through experiments, and merging art with technology in STEAM projects. Additionally, the article highlights the significance of environmental education through recycled materials, thereby promoting environmental awareness alongside students' creative development. Ultimately, the author emphasizes that implementing the STEAM model improves learning outcomes and encourages exploration and innovation, requiring support from educators, resources, and infrastructure for successful development.

Keywords: STEAM education, integration, creativity, environmental awareness, elementary school

1. Introduction

STEM (Science, Technology, Engineering, and Mathematics) is an interdisciplinary educational model that promotes students' scientific and technical capabilities (Aguilera & Ortiz-Revilla, 2021; Tiep & Huong, 2023). With the development of the modern world, STEM has gradually become widespread in many countries to meet the demand for a workforce in high-tech industries (Bircan & Çalışıcı, 2022; Kurup *et al.*, 2019). To enhance

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students' creative skills, STEM has evolved to include an Art (A) component, creating **STEAM** (Aguilera & Ortiz-Revilla, 2021; Bassachs *et al.*, 2020; Henriksen, 2014; Land, 2013; Maeda, 2013; Nguyen Thi Thu *et al.*, 2023; Shukshina *et al.*, 2021; Song *et al.*, 2019). STEAM education not only develops scientific and technical thinking skills but also encourages creativity and critical thinking through artistic elements (Aguilera & Ortiz-Revilla, 2021; Henriksen, 2014; Maeda, 2013) within STEM lessons and topics.

Art plays a significant role in fostering creative thinking and personal development. When combined with STEM, art helps students not only deepen their understanding of scientific concepts but also apply them in real life through creativity and artistic expression. This makes STEAM a more comprehensive educational model, helping students develop academic knowledge and practical application skills (Uştu *et al.*, 2022).

To date, numerous studies have been published around the concepts of STEM and STEAM. Some studies present contradictions between theory and practice; others use the same term (STEM or STEAM education) but attach different meanings to each term. There are three different concepts of STEAM education: (1) STEAM as an instructional method integrating art and technology; (2) STEAM as the integration of art and science; and (3) STEAM as the integration of five subject areas. Among these, the most popular interpretation of STEAM is the teaching approach of the five disciplines by applying a multidimensional interactive educational method. STEAM integrates STEM (including Science, Technology, Engineering, and Mathematics) with Art and is implemented in the educational environment (Aguilera & Ortiz-Revilla, 2021; Anabousy & Daher, 2022; Henriksen *et al.*, 2019; Land, 2013; Maeda, 2013; Uştu *et al.*, 2022).

STEAM education is considered an evolving educational model where traditional subjects such as Science, Technology, Engineering, Art, and Mathematics are integrated into a cohesive educational program. STEM/STEAM education is an interdisciplinary approach to learning, where academic knowledge is combined with practical lessons, allowing students to apply scientific, technological, engineering, mathematical, and artistic knowledge to specific contexts, thereby bridging schools, communities, and businesses. This helps learners develop STEM/STEAM-related skills and enhances their competitiveness in the modern economy (Baptista *et al.*, 2020; Henriksen *et al.*, 2019; Land, 2013; Loukatos *et al.*, 2020; Maeda, 2013; Uştu *et al.*, 2022).

2. Research Question

This study provides an overview of STEAM in the context of primary education in Vietnam. In this paper, we aim to address the following research questions:

- What is the STEAM educational model, and how is it applied to teaching Science in Vietnam?
- How can art be integrated into STEM education to create STEAM and comprehensively develop primary school students' skills in learning Science?

3. Literature Review

3.1. Integrating Art into STEM Education

STEAM is built upon the foundation of STEM but with the addition of art to foster students' creative thinking. According to Yakman and Lee, STEAM not only focuses on providing academic knowledge but also encourages creativity and critical thinking through artistic activities (Yakman & Lee, 2012). This approach helps students develop the ability to solve complex problems by combining knowledge from multiple fields.

Technology and engineering play an important role in STEAM education. Research by Barnes *et al.* indicates that using robots in STEAM lessons helps students develop scientific and technological skills while also encouraging them to create products with artistic value. The combination of technology and art enables students to master technical knowledge and apply it to creative projects (Barnes *et al.*, 2019).

Art in STEAM education is not just an additional factor; it plays a core role in developing students' creativity. According to Maeda, art helps combine convergent thinking (from STEM) and divergent thinking (from art), resulting in creative and practically valuable products. When students are encouraged to use art in STEM projects, they can perceive and address problems from multiple perspectives (Maeda, 2013). For instance, when students design a technological product such as a mini projector or a thermal bottle, art helps them focus not only on technical features but also on aesthetic factors and user experience.

The term "Arts" in STEAM education is diverse, encompassing various forms of art, including social sciences, humanities, or any subject area that possesses artistic elements (Kang, 2019; Maeda, 2013; Taylor & Andrews, 2012; Uştu *et al.*, 2022). The integration of arts into STEM education aims to promote creative thinking and critical thinking in problem-solving, especially helping learners acquire the 4Cs skills (Critical Thinking, Creativity, Communication, Collaboration) (Ananiadou & Claro, 2009; Edens, 2000; Pellegrino *et al.*, 2013).

"Arts" increasingly demonstrates its positive role in STEAM education, contributing to holistic education and lifelong education—essential demands of the 21st century characterized by extensive knowledge and the ability to adapt and think across disciplines. Life skills are typical products facilitated by the development of social and humanistic arts fields. Arts subjects should not be taught in isolation but should be integrated into the themes and teaching activities of various academic disciplines (Taylor & Andrews, 2012).

Integrating art into STEM education can be achieved through various approaches. Some studies have proposed methods such as project-based learning, the use of technology in creative and design contexts, and a multidimensional approach to questioning complex issues (Kim & Kim, 2016; Mutakinati *et al.*, 2018). These methods help students approach problems from different aspects and encourage creativity in the learning process.

3.2. STEAM Education Models in Teaching Science in Primary Schools in Vietnam

In STEAM education for Science in primary schools, several popular STEAM education models exist:

- **Engineering Design Process (EDP) STEAM Education Model:** This is a systematic and creative process that students apply to solve practical problems in STEAM education. EDP includes basic steps such as identifying the problem, researching, proposing ideas, planning, designing, creating, testing, and refining the product. This process not only helps students develop technical skills but also fosters creative thinking and problem-solving through continuous improvement and refinement of designs. In STEAM, EDP also integrates artistic elements, helping students develop aesthetics and creativity when designing interdisciplinary products or projects (Mutakinati *et al.*, 2018).
- **Project-Based Learning (PBL) STEAM Education Model:** PBL is one of the popular STEAM education models where students must carry out interdisciplinary projects to address real-world issues (Mutakinati *et al.*, 2018). Henriksen emphasizes that PBL not only helps students develop theoretical knowledge but also provides opportunities for them to apply knowledge to real-life situations through creative projects (Henriksen, 2014; Henriksen *et al.*, 2019) . For example, in a project on energy conservation and efficiency in Science, fourth-grade students may be asked to design a solar cooker model, integrating knowledge about light science, engineering (designing a solar energy cooker), and art (architectural aesthetics).
- **Research-Based Learning STEAM Education Model:** Research is an effective method for students to develop critical thinking and problem-solving skills. Anabousy & Daher emphasize that research-based learning in STEAM helps students self-discover and gain a deeper understanding of scientific and engineering concepts through practical research processes (Anabousy & Daher, 2022).

3.3. Ways to Integrate Art into STEM Education to Form STEAM in Teaching Science Aimed at Developing Comprehensive Competencies for Students

Integrating art into STEM education to form STEAM aims to develop students holistically. STEAM not only helps students gain a deeper understanding of science, technology, engineering, and mathematics but also develops creative thinking, aesthetic skills, and problem-solving abilities through art. When teaching Science, integrating art helps students develop creativity, critical thinking, communication skills, and teamwork, while also allowing them to view scientific knowledge from multiple perspectives. To integrate art into STEM education to create STEAM in teaching Science aimed at developing comprehensive competencies for primary school students in Vietnam, teachers can implement the following approaches:

1) **Integrate Art Through Designing and Creating Scientific Products in STEAM Lessons:** When students engage in projects and scientific themes, encouraging them to design and create products with artistic elements enhances their creative

thinking and problem-solving skills. Art in STEAM helps students not only focus on scientific accuracy but also develop aesthetic qualities, allowing them to apply creative techniques in their learning.

For example: In a lesson about the role of the environment, students may be asked to design a model of "The Environment Around Me" (Ministry of Education and Training, 2018) using recycled materials. Students will not only focus on accurately recreating the elements of their living environment (natural and social environment) but also consider how to make the model aesthetically pleasing and creative, vividly reflecting the activities and lives of people around their living area. Combining crafts and art techniques such as painting and 3D modeling helps students develop artistic skills while learning fundamental scientific concepts.

2) **Use Art in Presentations and Scientific Demonstrations:** Art can be integrated into scientific presentations and demonstrations to help students convey knowledge in a lively and creative manner. By using artistic mediums such as painting, music, or acting, students can express scientific knowledge in fresh ways, thereby developing communication skills and critical thinking.

   For example: When learning about the water cycle in nature (Ministry of Education and Training, 2018), after creating a model of the water cycle, students can perform a skit to introduce their group's model through the journey of a water droplet from evaporation to condensation and falling to the ground, and then back to the ocean. Students may use costumes, paint illustrations of water cycle processes, or even use music to express their ideas. Through this process, students learn scientific knowledge while developing artistic and communication skills.

3) **Encourage Artistic Creativity Through Scientific Experiments:** Integrating art into scientific experiments can help students express their scientific knowledge visually or through tangible products. Art plays a crucial role in helping students gain a deeper understanding of complex scientific concepts through visual representations or handcrafted products.

   For example: When studying sound, sound sources, and how sound propagates (Ministry of Education and Training, 2018), teachers can encourage students to conduct experiments demonstrating sound-emitting objects vibrating based on scientific phenomena. Students will apply knowledge about sound sources and propagation to create simple musical instruments and orchestras from materials like water cups, bowls, wooden boxes, or toys, while incorporating aesthetic elements in color coordination and shaping, thereby enhancing their understanding of physics concepts while developing artistic and creative abilities and a music appreciation.

4) **Combine Art and Technology in STEAM Projects:** Technology and art can be integrated into science projects to create complete STEAM products. When students use modern technology, such as 3D printing, robotics programming, or digital graphic software in science projects, they develop technical thinking and artistic creativity simultaneously.

For example: When studying the needs for light, air, water, temperature, and minerals for living organisms (Ministry of Education and Training, 2018), students can use design software to create videos illustrating the essential factors for the survival and growth of living organisms in response to changes in light, air, water, minerals, and temperature. In this way, students can combine technical and artistic elements to create visual scientific products while developing digital design skills and creativity.

5) **Use Recycled Materials to Integrate Art into STEAM Lessons for Environmental Education:** Environmental education is an area where art can easily be integrated into STEAM education (Thi *et al.*, n.d.). Scientific topics related to using recycled materials to create models and STEAM products help students develop awareness of environmental protection and natural resources through artistic and practical products.

   For example: When organizing a STEAM lesson on the topic "Good and Poor Thermal Conductors; Applications in Everyday Life" (Ministry of Education and Training, 2018)Teachers can guide students in brainstorming design ideas for simple thermal bottles or containers that they can use and present to their peers. Students can complete this scientific task by using recycled materials such as plastic bottles, foam boxes, cardboard boxes, old fabrics, and cardboard to create practical and artistic thermal products. These STEAM tasks not only help students gain a deeper understanding of scientific issues but also integrate environmental awareness and develop their skills in craftsmanship, creativity, and innovation.

4. Conclusion

Integrating art into STEM education to form STEAM not only helps students develop skills in science, technology, and engineering but also encourages aesthetic, creativity thinking, and self-expression through art. This enables elementary students to develop comprehensively, from critical thinking and creativity skills to communication and collaboration skills. Applying the STEAM model in teaching Science not only enhances learning effectiveness but also encourages students to explore and innovate during the learning process. The integration of art into STEM helps students understand scientific and technical concepts more deeply while also fostering creativity and critical thinking. For STEAM to develop more robustly, support is needed from teachers, educational materials, and infrastructure.

Conflict of Interest Statement

We confirm that there are no conflicts of interest in this study. All data and results are presented accurately and honestly, without manipulation or distortion of information. This study was solely for academic purposes and does not involve any commercial intent or personal gain.

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