

Research on the Pathways of Talent Cultivation in Design Arts from the Perspective of STEAM Education

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Abstract: *In the era of "Internet Plus" and artificial intelligence, cultivating design arts talents with comprehensive literacy and innovative capabilities has become a key topic in arts education research. This paper explores the implications of STEAM education for talent cultivation in design arts from a theoretical and practical perspective. By analyzing the connotations and core ideas of STEAM education and integrating them with the disciplinary characteristics of design arts, the study identifies interdisciplinary pathways for education provided by the STEAM framework. In terms of cultivation goals, the study emphasizes core literacy-oriented development, focusing on nurturing versatile talents with design thinking, technological application skills, and innovative spirit. For curriculum design, it advocates constructing a course system integrating foundational, core, and advanced courses. In teaching practice, it promotes project-problem-design-based comprehensive practical activities to overcome the isolation of traditional teaching methods, thereby enhancing students' comprehensive abilities and innovation literacy. This research aims to offer reference pathways for talent cultivation in design arts and provide practical support for the theoretical development of STEAM education.*

Keywords: STEAM education, Design arts, Talent cultivation, Interdisciplinary integration, Innovation literacy

1. Introduction

With the rapid advancement of technology and the evolving demands of society, cultivating innovative talents in design arts has become a focal issue in both academic and educational circles. As an interdisciplinary and comprehensive field, design arts not only encompass artistic creativity and aesthetic design but also include technological application and practical innovation. Traditional disciplinary teaching models, while emphasizing theoretical instruction and skill training, often overlook the cultivation of interdisciplinary and innovative abilities, leading to inadequate development of students' comprehensive literacy.

STEAM education is an educational philosophy and practice model centered on interdisciplinary integration. By combining Science, Technology, Engineering, Art, and Mathematics, it aims to develop students' ability to solve complex problems in real-world contexts (Stroud & Baines, 2019). The principles of STEAM education align closely with the educational goals, content, and methodologies of design arts, providing new theoretical support and practical pathways for talent cultivation in the field (Hee Kim & Kim, 2016). Therefore, this paper explores the guiding significance of STEAM education for talent cultivation in design arts and proposes potential pathways for its implementation.

2. The Concept and Core Ideas of STEAM Education

The concept of STEAM education originated from STEM education in the United States during the 1990s. The core of STEM education lies in fostering students' practical abilities and logical thinking through the interdisciplinary integration of Science, Technology, Engineering, and Mathematics. However, as educational needs evolved, STEM education was criticized for its lack of emphasis on creativity development. Consequently, in the early 21st century, Art was formally incorporated, transforming STEM into STEAM education (Land, 2013). The inclusion of Art expanded the scope of education while enriching its cultural and aesthetic dimensions, enabling STEAM education to better address the talent cultivation needs of the 21st century.

The distinctive feature of STEAM education is its emphasis on blurring disciplinary boundaries and solving complex problems in real-world contexts through interdisciplinary integration. This approach is not only applicable to higher education but is also widely implemented in primary and secondary education as well as vocational training. Through STEAM education, students engage in real-world problem-solving processes, integrating multidisciplinary knowledge and enhancing their ability to transfer and innovate knowledge through practical activities. By adopting a problem-driven and practice-oriented methodology, STEAM education fundamentally transforms traditional single-discipline instructional models.

From the perspective of core ideas, STEAM education encompasses five key aspects. First, a student-centered approach forms the foundation of STEAM education. It focuses on students' active participation and experiential learning, encouraging their interest in knowledge exploration and intrinsic motivation through interaction and collaboration. Second, interdisciplinary integration is the core characteristic of its curriculum content (Belbase et al., 2022). Students are required to synthesize knowledge from science, technology, engineering, art, and mathematics to address real-world challenges. Third, project, problem, or design-based learning is the primary methodology in STEAM education. This approach emphasizes combining theoretical knowledge with practical application, allowing students to deepen their understanding and effectively utilize knowledge through hands-on activities (Quigley et al., 2019). Fourth, communication and expression hold a significant place in STEAM education. Students develop their communication and presentation skills through teamwork and project exhibitions, while the process of sharing and discussion helps them further refine their outcomes. Finally, an innovation-oriented outcome is one of the key goals of STEAM education. Through practical activities, students transform their learning process into creative outputs, whether these are innovative ideas, methods, tangible products, or solutions, which serve as tangible evidence of their educational achievements. These core ideas collectively form the framework of STEAM education, providing robust theoretical support for cultivating talents in design arts with comprehensive literacy and innovative capabilities.

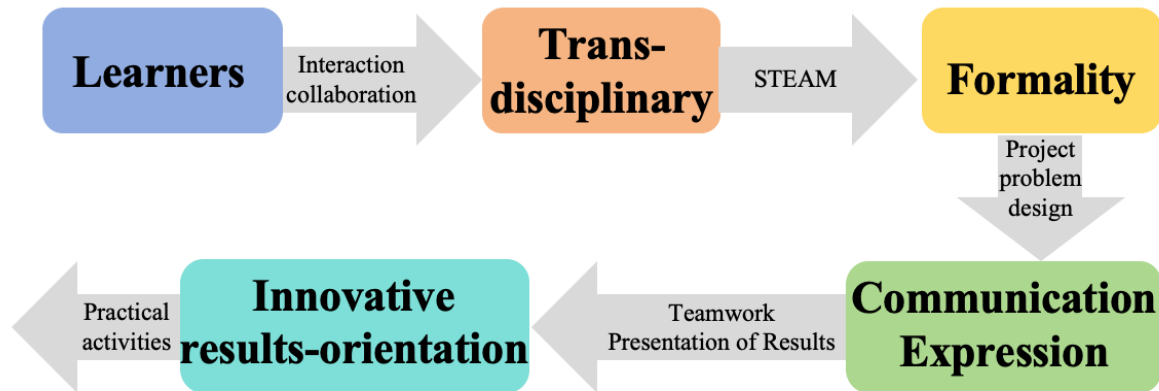


Figure 1: Core Ideas of STEAM Education

3. Analysis of the Alignment Between STEAM Education and Design Arts

STEAM education aligns closely with design arts in terms of educational philosophy, teaching content, and instructional design (Liao, 2016). This alignment not only provides feasible theoretical support for talent cultivation in design arts but also points the way toward innovation in curriculum reform and teaching practices.

Educational Philosophy: Fostering Innovative Design Talents Through Multidisciplinary Integration

At the philosophical level, both STEAM education and design arts emphasize cultivating innovative talents through multidisciplinary integration. STEAM education advocates a student-centered approach, focusing on the combination of knowledge construction and experiential activities. By engaging in learning and practice within real-world contexts, students develop their innovative abilities and comprehensive literacy. This philosophy is particularly suitable for cultivating talents in design arts.

As an interdisciplinary and comprehensive field, design arts focuses on artistic theory and aesthetic cultivation, as well as technological application and design practice. The interdisciplinary integration promoted by STEAM education enables students to apply knowledge from multiple domains—such as art, science, and technology—in creative design processes to solve complex real-world problems (Leavy et al., 2023). For instance, in product design, students must combine technological innovation, aesthetic expression, and engineering practice, which aligns perfectly with STEAM education's real-world problem-solving approach.

Moreover, STEAM education's collaborative and creativity-driven orientation provides design arts students with broader learning perspectives and practical opportunities, enhancing their comprehensive literacy and innovative capabilities through teamwork. Under a diversified and integrated educational ecosystem, introducing STEAM education can help design arts more effectively achieve its goal of cultivating "artistic, technically proficient, and innovative" interdisciplinary talents.

Teaching Content: Integrating Theory and Practice Across Humanities, Sciences, and Engineering

In terms of teaching content, STEAM education and design arts share a high degree of compatibility in integrating interdisciplinary subjects. STEAM education emphasizes the

fusion of disciplines such as science, technology, engineering, art, and mathematics, allowing students to understand interdisciplinary concepts and solve practical problems through their synergistic effects. For example, science provides theoretical knowledge, technology offers tools and methodologies, engineering bridges practice and innovation, art reflects emotion and values, and mathematics supports logical thinking and analytical skills (Bertrand & Namukasa, 2023).

Similarly, the curriculum of design arts exhibits interdisciplinary characteristics, encompassing core courses such as art theory and aesthetic design, as well as technical courses like digital modeling and computer-aided design. Guided by STEAM education principles, the curriculum in design arts can further emphasize the integration of multiple disciplines. For instance, courses might center around themes such as product design, combining aesthetic principles, material science, and technological tools to deliver comprehensive teaching. This enables students to master theoretical knowledge while gaining practical technical experience through hands-on activities.

Furthermore, the integrative learning approach promoted by STEAM education addresses the challenges of isolated course structures in design arts. Traditionally, courses in art design, engineering technology, and mathematical analysis are often taught separately. However, under the STEAM framework, interdisciplinary course clusters can be created to organically integrate these subjects, thereby enhancing students' comprehensive practical abilities.

Instructional Design: Comprehensive Practice Based on Problems, Projects, and Designs

In instructional design, STEAM education advocates for problem-based learning (PBL), project-based learning (PjBL), and design-based learning (DBL). These approaches align closely with the emphasis in design arts on hands-on practice, creative expression, and solving real-world problems.

In design arts education, project-based learning has become a vital method for developing students' practical skills (Oo et al., 2024). However, traditional project-based learning often focuses on single disciplines or skill training, lacking interdisciplinary integration. By introducing STEAM education, more interdisciplinary problems can be incorporated into instructional design, creating learning tasks with greater challenges and complexity. For example, instructors could assign a "public facility design" project requiring students to consider engineering materials, aesthetic design, user needs, and budget constraints. Such project-based learning not only stimulates students' innovative thinking but also develops their multidimensional comprehensive abilities.

Additionally, STEAM education emphasizes strengthening interaction among teachers and students, as well as among peers during the learning process (Herro & Quigley, 2017). In design arts classrooms, this could involve group collaboration, design critiques, and staged outcome presentations to foster teamwork and competitive awareness among students. During presentations, students not only showcase their design concepts through their works but also articulate their ideas through verbal and visual communication, thus improving their communication skills and presentation techniques.

By integrating the instructional design principles of STEAM education, the curriculum in design arts can shift from single-skill training to cultivating comprehensive literacy, better meeting the demands of the modern era for design professionals.

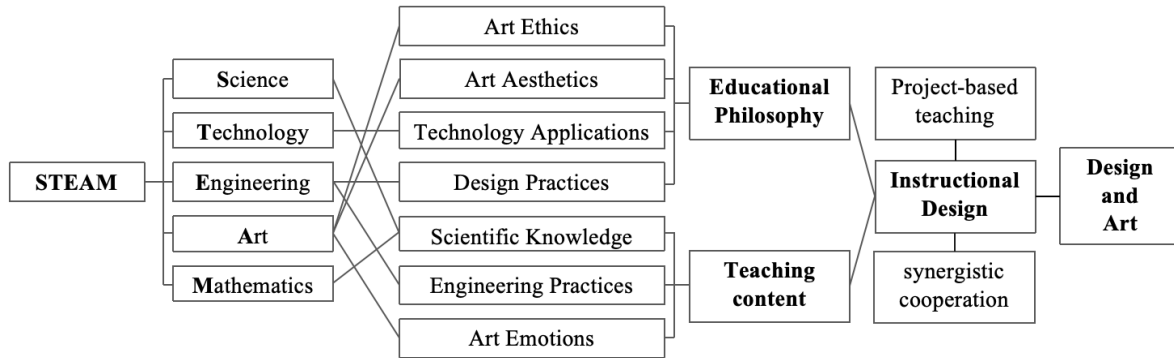


Figure 2: Integration of STEAM Education Perspectives and Design Artistry

4. Insights from STEAM Education for Talent Cultivation in Design Arts

The interdisciplinary integration philosophy of STEAM education provides new perspectives and practical frameworks for talent cultivation in design arts. In the context of rapid development in the “Internet Plus” era and artificial intelligence, incorporating core ideas of STEAM education enables innovation in talent cultivation goals, curriculum design, and instructional approaches in design arts. This helps to produce versatile design professionals who meet the demands of contemporary society.

Talent Cultivation Goals: Focusing on Core Competencies to Develop Multidisciplinary Innovators

The talent cultivation goals in design arts should center around the core competencies advocated by STEAM education, emphasizing students' innovation abilities, technological proficiency, and artistic creativity. Specifically, design arts programs should aim to nurture multidisciplinary talents capable of solving real-world problems in an interdisciplinary context. Such talents must possess a deep understanding of artistic theories, as well as the ability to utilize modern technological tools and lead collaborative innovations across multiple fields.

The student-centered approach of STEAM education provides valuable insights for setting these goals. Design arts education must transition from “knowledge transmission” to “capability cultivation,” emphasizing not only the acquisition of professional knowledge but also the enhancement of comprehensive skills and practical abilities. By integrating artistic creativity, scientific reasoning, and engineering practices, students can develop the full-spectrum skills required to navigate the process from problem identification to resolution in real-world projects, thus adapting to the fast-changing demands of society (Henriksen et al., 2019).

Moreover, talent cultivation goals should also prioritize global perspectives and social responsibility. By incorporating topics like sustainable design and cultural preservation into the curriculum, students can be encouraged to embed social values and cultural heritage into their design practices, contributing humanistic care to the development of an innovative society.

Talent Development Plans: Building an Interdisciplinary Curriculum System

In the design of talent development plans, design arts education should draw on the interdisciplinary integration philosophy of STEAM education to build a multi-tiered and diversified curriculum system. This system should consist of foundational, core, and advanced courses, each aimed at cultivating students' core competencies.

Foundational courses should focus on general education, providing students with essential knowledge and skills (Nelson Laird & Garver, 2010). For example, courses like the history of design arts, science and society, and introductory computer applications can equip students with both an understanding of artistic background and basic technological literacy.

Core courses should target the primary professional content of design arts, such as digital design, interaction design, and visual communication. By combining theory with practice, these courses help students develop professional skills and innovative thinking.

Advanced courses should address cutting-edge technologies and fields, such as artificial intelligence in design, sustainable design, and cultural heritage innovation, broadening students' perspectives while enhancing their practical and research abilities.

Additionally, the curriculum should emphasize the intrinsic logical connections between courses to avoid fragmentation. For example, a thematic course cluster or module can integrate related courses under a unified theme, enabling students to explore the relationships between disciplines during their studies. A digital media design module, for instance, could combine visual arts, programming, and user experience design to develop students' interdisciplinary abilities through integrated learning.

Instructional Design: Project-Based Approaches to Strengthen Comprehensive Practical Skills

In terms of instructional design, design arts programs can adopt the project-based learning philosophy of STEAM education, focusing on core problems and key skills while designing comprehensive practice activities (Pérez Torres et al., 2023). This approach not only deepens students' understanding of knowledge but also enhances their ability to apply it comprehensively through practice.

First, learning tasks should be guided by real-world problem-solving. For instance, teachers could set a project theme like "Green City Design," requiring students to conduct research and create designs addressing dimensions such as environmental protection, public art, and urban transportation. In tackling such tasks, students would combine scientific calculations, technological tools, and artistic creativity to propose functional and aesthetically pleasing solutions.

Second, the organization of learning activities should encourage collaboration and interaction. STEAM education emphasizes teamwork and showcasing results, which can be mirrored in design arts education through group design projects and phased reviews (Tenaglia, 2017). For example, students could divide responsibilities within teams to complete different aspects of a design project and present their work in class for feedback. This enhances teamwork and communication skills while fostering a collaborative learning environment.

Lastly, the presentation and evaluation of innovative outcomes should be a central focus of instructional design. Toward the end of the course, instructors can organize exhibitions and assessments of students' design works. Through expert reviews, peer evaluations, and self-reflection, students can identify areas for improvement, refine their designs, and enhance the practicality and societal impact of their innovative outcomes.

By integrating STEAM education principles into instructional design, design arts courses can shift from focusing on isolated skill training to cultivating comprehensive competencies, better equipping students to meet the evolving needs of the design industry.

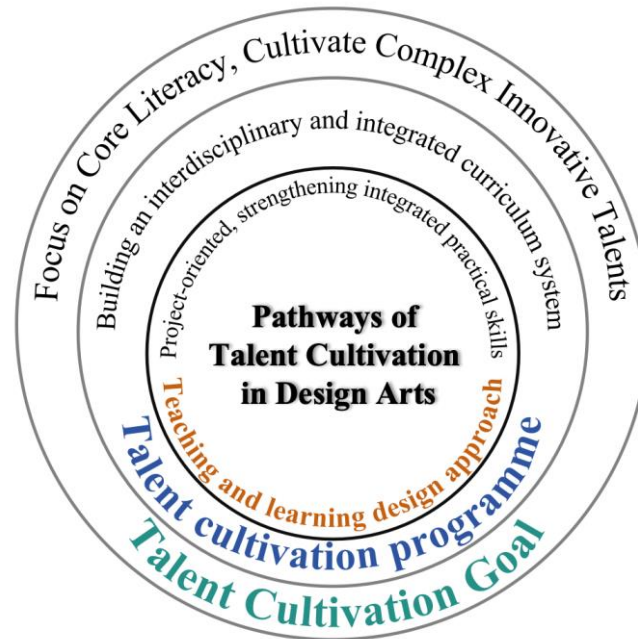


Figure 3: Pathways for Design Artistry Talent Development in STEAM Education

5. Conclusion

STEAM education, with its interdisciplinary integration and student-centered approach, provides new theoretical support and practical pathways for talent cultivation in design arts. In terms of cultivation goals, STEAM education emphasizes the development of core competencies, which aligns closely with the objectives of design arts to nurture multidisciplinary talents who combine artistic creativity, technological skills, and innovative thinking. Regarding curriculum design, STEAM education advocates for the seamless integration of multidisciplinary content, offering valuable insights for optimizing and innovating design arts curricula. In teaching practice, the project-based and problem-oriented learning methods of STEAM education help to enhance students' comprehensive practical abilities and innovative competencies, making it highly relevant to the demands of design arts education.

Nevertheless, effectively aligning STEAM education principles with the specific teaching needs of design arts requires further exploration. Future efforts could focus on three key areas: first, deepening the theoretical integration between STEAM education and design arts to develop practice models tailored to the discipline's characteristics; second, fostering interdisciplinary collaboration in curriculum design to promote deeper integration of teaching content; and third, adopting diverse evaluation systems to comprehensively measure students' learning outcomes and innovation capabilities. Through the dual advancement of theory and practice, design arts can fully leverage the advantages of STEAM education to cultivate high-quality, innovative design professionals who meet the evolving needs of society.

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