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The integrated teaching path of art design and science and technology in the Greater Bay Area under the STEAM education concept

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Abstract: This research builds a framework around the STEAM education concept, comprehensively and deeply analyzing the innovative approaches of integrating art design with science and technology in the Guangdong-Hong Kong-Macao Greater Bay Area. The paper begins by sorting out the theoretical foundation of STEAM interdisciplinary education and its guiding value for the transformation of traditional art design education towards modernization. Then, by analyzing the teaching practices of representative universities in the Greater Bay Area, this paper truly dissected the implementation methods and effects of strategies such as digital tools, AR/VR, and project-based learning in specific teaching from three aspects: technology application, aesthetic cultivation, and curriculum integration. The research presents an optimization plan with the key being the reconstruction of an interdisciplinary curriculum system and the simultaneous advancement of internationalization and regionalization in teaching strategies. It also offers suggestions on policy support and future research directions, providing systematic theoretical references and practical guidance for building an "art and science integration" talent cultivation model with the characteristics of the Greater Bay Area and in line with future demands.

Keywords: STEAM Education Philosophy; Greater Bay Area; Fine Arts and Design; Science and Technology; Teaching Methods

Introduction

Against the backdrop of the global trend of technological innovation and the continuous upgrading of industries, the traditional art design education that divides fields based on skills is facing an increasing number of challenges. The rapid development of technologies such as artificial intelligence and immersive media has revolutionized creative tools and profoundly changed the essence of aesthetic expression, narrative logic, and even design issues The STEAM education concept, which emphasizes the interdisciplinary integration of science, technology, engineering, art and mathematics, provides a key theoretical framework for responding to this transformation. The Guangdong-Hong Kong-Macao Greater Bay Area enjoys a unique geographical advantage that combines an international perspective, a technological highland and rich cultural resources, making it an ideal experimental site for exploring the integrated education model of "art and technology".

1 STEAM Education Philosophy and Art & Design Teaching Theoretical Foundation

1.1 Overview of STEAM Education Philosophy

The STEAM education philosophy embodies a paradigm shift from STEM towards integration with the arts. Its key element is breaking down the boundaries between traditional disciplines, employing interdisciplinary integration to cultivate students' comprehensive qualities and innovative abilities. Originating in the United States in the 1980s to address the demand for multi-skilled talent in global competition, its essence is not a simple addition of five subjects, but a "practice-oriented transdisciplinary education concept." It emphasizes the organic integration and creative application of knowledge in real-world contexts through project-based and problem-solving analysis. The inclusion of art is crucial, adding humanistic care, aesthetic judgment, and emotional thinking to the STEM field, which originally focused on logic and technology. This allows the learning process to stimulate learners' emotional experiences and meaningful reflection, enabling them to cope with the complexities of the real world. The theoretical foundation of STEAM education is built upon constructivism, the learning-by-doing approach, and the theory of multiple intelligences. Ultimately, it aims to cultivate future innovators who can use interdisciplinary knowledge to solve practical problems, possessing both scientific rationality and artistic sensibility.

1.2 Development and Trends of Art and Design Education

Contemporary art and design education is undergoing a profound transformation from simply "imparting professional skills" to "interdisciplinary integration and innovation." This modernization trend aligns perfectly with the STEAM concept. The key to this transformation is addressing the disruptive changes brought about by new technologies such as artificial intelligence, and society's demand for new talents capable of solving complex problems. Educational trends clearly show a two-way integration of "art as engineering" and "engineering as art," advocating for "the combination of art and engineering, and the permeation of arts and sciences," enabling students to master technical implementation and engineering thinking skills while possessing excellent artistic expression. Numerous interdisciplinary teaching cases have emerged both domestically and internationally. For example, in STEM courses, experts skillfully integrate artistic elements, guiding students to think about social and cultural contexts and creative intentions through their works, rather than simply imitating. Universities such as Tongji University and Tianjin University are actively exploring ways to deeply integrate artificial intelligence with design creation in design education. These practices demonstrate that successful art and design education is no longer limited to art studios and workshops, but needs to be closely linked to science laboratories, engineering workshops, and the digital technology field to build a new "new arts" or "art-engineering" training system.

1.3 The Application Value of STEAM Concepts in Art and Design

Applying STEAM concepts to art and design education has the core value of creating an educational model that integrates creative cultivation, technical training, and scientific thinking. This directly addresses the common problem in current design education where "art and technology are simply added together" rather than deeply integrated. Firstly, it restructures the creative cultivation process through "design thinking" and "project-driven learning," ensuring that creativity is not just groundless ideas but a complete cycle from identifying real problems to proposing innovative solutions. Secondly, technical training, such as programming, 3D printing, and digital media, is placed within specific design tasks, becoming essential tools for realizing creativity rather than standalone skills. Thirdly, scientific thinking, such as rational analysis, system modeling, and experimental iteration, is integrated, allowing students to study user needs like scientists and test design prototypes like engineers, improving the logic, feasibility, and innovation of their work. In the Greater Bay Area, this integration trend has already achieved policy consensus and widespread practice at the higher education level.

2 Teaching Practices Integrating Art, Design, and Science & Technology in the Greater Bay Area

2.1 Teaching Practices from a Technological Perspective

At the technological level, teaching practices in universities in the Greater Bay Area have evolved from basic software instruction to a deeply integrated stage driven by cutting-edge digital technologies and oriented towards solving complex problems. The focus of teaching is no longer limited to the operation of tools like Photoshop and Illustrator, but has broadly introduced immersive and intelligent technologies such as AR/VR/MR, 3D printing, digital twins, and AI-generated content. For example, Shenzhen Technology University, in collaboration with Shenzhen Media Group, developed a campus digital twin model based on 3D Gaussian splash technology. Students can use VR devices for immersive roaming and interaction. This project itself forms a comprehensive technical training topic. Shenzhen University, in its design achievement exhibition, guided students to use MR technology to create urban and campus landscape experiences that transcend the boundaries between virtual and real, and also explored the application of 3D printing technology in virtual IP creation. These practices place technical training within specific real-world project scenarios such as "smart campuses," "future cities," and "cultural heritage," allowing students to deeply understand the core logic of technology serving creativity and humanistic connotations while mastering advanced tools.

2.2 Cultivating the Aesthetic Dimension of Art

In terms of aesthetic appreciation, the training strategies of universities in the Greater Bay Area focus on reshaping students' visual creativity, design thinking, and cultural cognition within a cross-cultural context and against the backdrop of cutting-edge technology. The key

is to integrate visual creative training with profound cultural and artistic literacy and critical design thinking. A typical approach is to guide students in contemporary translation of local traditional culture. For example, a team from the Hong Kong University of Education led students in the "Greater Bay Area Intangible Cultural Heritage Virtual Museum" project. Students conducted field research, video recording, and content design on Hakka walled villages and folk customs, balancing "cultural authenticity" and "technological innovation" in a 720-degree panoramic virtual space. This requires students to master visual storytelling skills and deeply understand the historical and social significance behind cultural symbols. Shenzhen University's design discipline, through the "Dialogue of Civilizations" section, explores the modern design translation of Dunhuang art and Silk Road patterns. The Faculty of Humanities and Arts at Macau University of Science and Technology, through its collaboration with the Shenzhen Guan Shanyue Art Museum's "Greater Bay Area Seed Project," transforms the museum's academic resources and digital collections into a "living classroom," enabling students to improve their aesthetic judgment and academic level through cross-disciplinary research in art and technology.

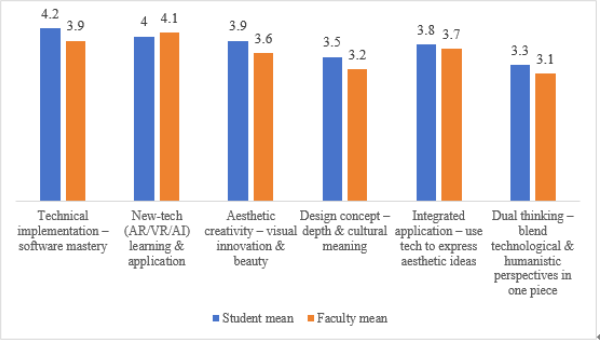

Figure 1.Student self-ratings vs. faculty ratings after project-based learning (1–5 scale)

2.3 Teaching Integration Strategies and Practical Results

A key strategy for promoting the integration of "fine arts and design + technology" in the Greater Bay Area is to systematically build an interdisciplinary, inter-institutional, and project-based teaching ecosystem. In terms of curriculum, this manifests as the development of deeply integrated "dual-narrative" courses. For example, courses on "digital art" and "intelligent interaction" technology are designed together with humanities topics such as "contemporary translation of traditional cultural context." In implementation, "museum-school cooperation" and "university-enterprise collaboration" models are widely used. For instance, the "Greater Bay Area Seed Project" collaborates with the Guan Shanyue Art Museum and numerous universities such as Macau University of Science and Technology and Southern University of Science and Technology to jointly build laboratories and research and teaching bases, introducing real cultural projects and industry needs into the classroom. Teaching evaluations show that this integrated teaching based on complex projects can effectively promote the simultaneous and coordinated development of students' technical and aesthetic abilities. Compared with traditional subject-based teaching, students can better feel the indispensability of both abilities in the process of solving practical problems, stimulating intrinsic learning motivation and achieving a higher overall sense of accomplishment and learning satisfaction.

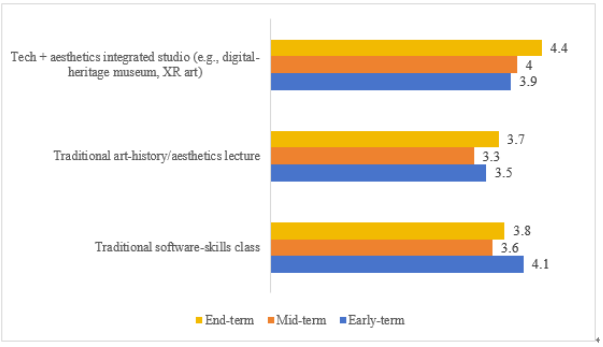

Figure 2.Student-satisfaction trajectories by course type (hypothetical data, 1–5 scale)

3 Optimization and Development Strategies of STEAM Integrated Teaching Paths

3.1 Interdisciplinary Curriculum System Design

The key to optimizing the curriculum system is to break away from the traditional mechanical parallelism of "technology" and "aesthetics" courses, and instead construct a double-helix progressive organic structure. In the lower grades, a "basic integrated module" can be offered, such as teaching courses like *Digital Media Fundamentals* and *Introduction to Visual Culture* simultaneously. This ensures that students develop the cognitive concept that "technology serves beauty" from the very beginning of their exposure to tools. In the higher grades, the focus shifts entirely to "project-based learning" and "research-based learning." Project-based learning, such as the "Digital Revitalization of Cultural Heritage in the Greater Bay Area" project, requires students to form teams to complete the entire process from field research and conceptual design to technology development. Research-based learning encourages students to conduct in-depth academic analysis on cutting-edge topics such as "artificial intelligence aesthetics" and "sensory engineering," writing research papers or creating experimental works. This design elevates learning from skills acquisition to knowledge creation, cultivating students' meta-ability to define problems, integrate resources, and innovate solutions in complex situations.

3.2 Internationalization and Regionalization Teaching Strategies

Teaching strategies need to simultaneously deepen "local practice" and broaden "international perspectives." At the regionalization level, teaching should closely revolve around the dual characteristics of the Greater Bay Area—"technology + culture"—developing a teaching case library centered on real local issues. For example, using topics such as the "Shenzhen-Hong Kong Biennale," "Revitalization of Guangzhou's Traditional Cultural Blocks," or "Brand Upgrading of Greater Bay Area Enterprises" as prompts, students can be guided to use STEAM thinking to propose innovative solutions. At the internationalization level, a systematic, multi-level exchange network should be built: encouraging students to participate in international short-term workshops and competitions, promoting joint degree or credit recognition programs with top overseas institutions, and regularly conducting international scholar residency programs and online collaborative courses. Crucially, international experience should be critically absorbed and localized, rather than simply transplanted, to cultivate designers who can solve local problems and participate in global dialogue.

Table 1. Comparative models of art-design & technology integration in selected Greater Bay Area universities

University	Core integration model & positioning	Flagship courses / projects
The Hong Kong Polytechnic University	Design-thinking-led, tech-enabled: user-centred research merged with advanced engineering.	MDes in Intelligent Products & Services, Interaction Design
The Education University of Hong Kong	Culture & education-oriented tech fusion: digital humanities, heritage preservation, innovative education.	GBA Intangible-Cultural-Heritage Digital-Museum Project
Macau University of Science & Technology	Cross-institutional collaboration & art-tech frontier: joint work with museums & industry.	"Bay Area Seed Project" (with Guan Shanyue Art Museum, etc.)
Shenzhen University	Comprehensive innovation under "new liberal arts": leverages full university ecosystem for theory + practice.	Digital-media arts, 3-D printing & virtual-IP design, MR urban-landscape studio
Guangzhou Academy of Fine Arts	"Art-science fusion" serving local industry: fine-arts foundation driving tech innovation for cultural & creative industries.	

4 Conclusion

This study, through theoretical construction and practical analysis, comprehensively demonstrates the necessity and feasibility of promoting the deep integration of art design and science and technology in the Greater Bay Area under the STEAM education concept. The core conclusion shows that the successful integration path relies on a set of systematic reforms, involving the design of the "double helix" curricu-

lum system and the teaching process driven by real projects. Until a strategy that combines internationalization with localization. This system reform can effectively enhance students' compound abilities such as technological application and aesthetic innovation, and it is also a strategic measure to respond to the fundamental requirements of the digital age for design talents. The limitation of this study mainly focuses on the construction of macro paths at the higher education level. Future research can delve into areas such as the connection mechanisms among different educational stages, the quantitative evaluation of the effects of specific courses, and cross-cultural comparisons.

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