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INTERDISCIPLINARY INTEGRATED EDUCATION IN ART AND DESIGN AT TRANSPORTATION-ORIENTED UNIVERSITIES UNDER THE NEW ENGINEERING FRAMEWORK

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Abstract: Under the New Engineering framework, art and design programs at transportation-oriented universities face persistent problems, including fragmented curricula and weak collaborative mechanisms, which hinder the cultivation of high-quality, application-oriented interdisciplinary professionals. Guided by the interdisciplinary integration of "design + engineering," this study employs structural analysis and comparative case analysis to examine four dimensions: educational objectives, curriculum design, project-based practice, and institutional support. It proposes an integrated teaching pathway consisting of a task chain, a course chain, and an output chain; develops a competency map aligned with the needs of the transportation sector; and introduces a model driven by multi-role collaboration and authentic projects. Through horizontal curriculum integration, dual-track collaborative teaching, and university–enterprise co-development, the study initially establishes a replicable and scalable interdisciplinary education system. The findings indicate that building an interdisciplinary curriculum system together with institutional support mechanisms can strengthen the systematic and engineering-oriented character of design education, providing a key pathway for the transformation of design programs and the improvement of talent quality at transportation-oriented universities.
Keywords: New engineering; Interdisciplinary integration; Art and design education; Transportation-oriented universities; Application-oriented talent cultivation

1 INTRODUCTION

With the deepening of the Fourth Industrial Revolution and China's innovation-driven development strategy, traditional engineering education is undergoing structural transformation. Since February 2017, the Ministry of Education has actively advanced the construction of New Engineering, successively forming the "Fudan Consensus," the "Tianda Action," and the "Beijing Guide," and issuing the Notice on Conducting Research and Practice in New Engineering and the Notice on Recommending New Engineering Research and Practice Projects. These initiatives seek to develop a Chinese model and Chinese experience capable of leading global engineering education and supporting the development of a strong higher education system [1]. Against this background, art and design have been repositioned as a key bridge connecting technology with users and function with experience. Their capacity for systems construction has become increasingly important, particularly in contexts such as smart mobility and urban transportation.

However, in application-oriented transportation universities, art and design remain marginal. Curricula are closed, collaborative mechanisms are weak, and organic integration with engineering education is limited [2]. A homogeneous faculty structure, ineffective platforms, and weak conversion of educational outcomes prevent design education from meeting the New Engineering requirement for systematic talent cultivation. The decorative or supplementary role assigned to design restricts students' ability to understand and intervene in complex engineering problems, resulting in educational outcomes that do not adequately match industry needs [3].

This study focuses on the mechanisms through which art and design education can be integrated with engineering education under the New Engineering framework. It seeks to address curricular barriers, platform separation, and organizational bottlenecks by proposing an interdisciplinary "design + engineering" education pathway suitable for transportation-oriented universities. Combining structural analysis with comparative case analysis, the study examines curriculum reconstruction, collaborative project implementation, and institutional support, with the aim of developing an educational paradigm that is operational, logically coherent, and transferable.

2 CURRENT CHALLENGES IN ART AND DESIGN EDUCATION AT TRANSPORTATION-ORIENTED UNIVERSITIES

2.1 Narrow Content and a Lack of Interfaces with Engineering

Most art and design programs at transportation-oriented universities still follow a conventional art-academy curriculum centered on technical training and formal composition. Teaching content is overly focused on modeling, representation, and visual effect, while systematic connections with core disciplines such as transportation engineering and intelligent manufacturing are neglected. The curriculum therefore remains a closed structure characterized by linear sequencing and limited interdisciplinarity, making it difficult for students' knowledge to match the complex demands of actual industries [4].

Design courses are commonly organized as independent units, with few shared modules, collaborative contents, or common evaluation standards linking them to engineering courses. Cross-school scheduling mechanisms often exist only in name. This parallel mode of operation prevents students from establishing complete problem chains, knowledge chains, and task chains, and is therefore unfavorable to the internal integration of design and engineering logic [5].

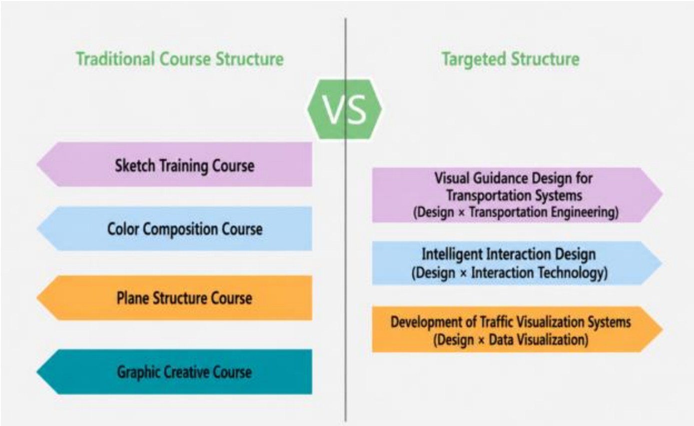

Figure 1 The Closed Curriculum Structure of Art and Design Programs at Transportation-Oriented Universities

The left side of Figure 1 shows the Traditional Course Structure, which emphasizes isolated technical and compositional training. Connections among modules and interdisciplinary interfaces are weak, resulting in a linear structure and limited outputs. The right side of Figure 1 presents the Targeted Structure based on New Engineering principles. Through the integration of engineering courses, task-chain continuity, and progressive competency development, it establishes a systematic and interdisciplinary curriculum pathway aligned with the educational needs of the intelligent transportation sector.

2.2 Strategic Marginalization and Weak Resource Allocation

Within the disciplinary planning and resource allocation systems of transportation-oriented universities, art and design programs are often treated as auxiliary disciplines and struggle to obtain the same level of academic voice and institutional protection as core engineering disciplines. Their shares of research funding, experimental space, and financial allocation are markedly limited [6].

In advancing New Engineering reforms, some universities focus primarily on technical fields such as artificial intelligence, intelligent manufacturing, and the Internet of Vehicles, while neglecting the contribution of design thinking to human-centered and sustainable engineering systems. Because design programs are not incorporated into the strategic blueprint for innovation-driven collaborative education, they remain absent from the main arena of interdisciplinary talent cultivation [7].

2.3 Lack of Interdisciplinary Faculty Backgrounds and Collaborative Mechanisms

Faculty members in art and design programs commonly come from conventional backgrounds such as fine arts and visual communication. Many lack experience in engineering projects and the ability to co-teach engineering-related courses, while teachers with genuinely interdisciplinary backgrounds remain scarce. As a result, course content is often confined to an "art–visual communication–exhibition" sequence and is difficult to extend into the dimensions of technology, function, and systems [8-10].

There are also few mechanisms for joint lesson preparation and collaborative teaching across disciplines. Design courses therefore have difficulty entering engineering practice platforms. Although some engineering instructors understand project requirements, they have not been trained in design pedagogy and often lack the capacity to guide user-centered thinking, further intensifying the fragmented use of teaching resources [11].

2.4 Formalized Platforms and Insufficient Project Depth

Although many universities have established design training bases and maker spaces, most projects remain oriented toward the display of finished works and lack capacity for systems construction, technical implementation, and industrial embedding. Students participate for short periods and at a superficial level, and their outputs are often disconnected from authentic engineering practice [12].

Practice platforms generally lack task-chain designs driven by authentic transportation problems. Students participate only decoratively and do not experience the complete process of user research, requirements modeling, solution iteration, and feasibility validation. This detached mode of design is unable to develop students' abilities in systems collaboration and critical construction.

3 REFRAMING EDUCATIONAL OBJECTIVES UNDER A "DESIGN + ENGINEERING" ORIENTATION

3.1 Paradigm Shift from Product Orientation to Systems Orientation

For a long time, art and design programs have focused their educational objectives on finished works and visual aesthetics. Evaluation systems have emphasized static exhibition, visual novelty, and formal technique, while overlooking the systemic nature of design as a process of problem solving. In transportation-oriented application universities in particular, design education is often limited to representation tasks rather than collaborative construction, making it unable to meet the New Engineering requirement for the formation of systems-oriented professionals [13-15].

In complex contexts such as intelligent transportation, urban mobility, and smart interactive interfaces, design is no longer merely decoration and representation. It is a systemic activity linked to data structures, technology platforms, and user behavior. Art and design education must therefore move beyond visual centrism and reconstruct its objectives around systems collaboration, achieving a paradigm shift from product thinking to structural thinking [16].

3.2 Constructing a Competency Map for the Transportation Sector

Within an interdisciplinary education system, art and design students should act as collaborators in systems construction. Educational objectives should be aligned with actual occupational needs in the transportation sector and organized around a competency map that progresses from problem identification and scenario reconstruction to prototype design and functional validation. Design courses should provide not only training in style and aesthetics but also practical dimensions such as route planning, user modeling, interaction strategies, and engineering tolerances [17-20].

To cultivate interdisciplinary designers, students must also master the language of engineering, including interface specifications, transportation behavior data analysis, technical feasibility assessment, and cross-disciplinary communication. Educational objectives should therefore shift from cultivating visual creators to developing participants in systems construction, enabling students to form a three-dimensional capability structure comprising analytical thinking, coordination, and interaction in engineering contexts [21].

3.3 Embedding Multi-Role Collaboration, Problem Orientation, and Authentic Task Models

New Engineering emphasizes multi-role collaboration. Design courses should not operate independently but should organize teaching tasks from the multiple perspectives of users, designers, and engineers. Students should repeatedly shift roles, build shared understanding, and advance projects collaboratively [22]. This role-based design of teaching tasks helps move beyond the traditional linear teaching chain and creates a process integrating the task chain, scenario chain, and collaboration chain.

The reframing of educational objectives also requires the deep embedding of problem-based learning. Authentic transportation problems, such as optimizing visual guidance in metro stations and upgrading transportation signage for older users, can serve as core projects that tightly connect course objectives, competency training, and industry needs, allowing authentic problems to generate authentic capabilities [23-26].

4 STRATEGIES FOR RECONSTRUCTING AN INTERDISCIPLINARY CURRICULUM SYSTEM

4.1 Establishing Horizontal Cross-Module Pathways

In traditional curriculum systems, art and design courses and engineering courses are administered by different schools, with little horizontal connectivity. Students are constrained by disciplinary boundaries and cannot combine knowledge across fields or produce integrated competencies. This curriculum-island structure is incompatible with the cross-boundary collaborative education required by New Engineering [27].

Curricula should be oriented toward authentic industry scenarios and reorganize design, engineering, and interaction into modular units. These units can form task-based course packages shared by students from multiple majors, such as Smart Transportation Interface Design, Transportation Space Experience Construction, and Interactive Product Prototype Design. Problem-centered horizontal modules can help students develop systems understanding through multidisciplinary co-construction [28].

Table 1 Cross-Curricular Matrix

Design Courses / Engineering Courses	Introduction to Transportation Engineering	Intelligent Transportation Systems	Urban Rail Transit Design	Human Factors Engineering	Data Visualization and Analysis
Information Visualization Design	High-Density Transportation Mapping (Offered)	Intelligent Public Transit Visualization System (Pilot)	—	Transportation Cognitive Mapping (Proposed)	Travel Behavior Visualization Design (Offered)
Guidance Systems and Spatial Narrative	—	Intelligent Station Hall Guidance System (Pilot)	Urban Rail Space Experience Construction (Offered)	Route Perception Optimization System (Proposed)	—

Interactive Prototyping and User Interface Design	Multi-Terminal Interface Consistency Design (Proposed)	Intelligent Interaction Prototype Construction (Offered)	—	Passenger Interaction Feedback Interface (Pilot)	Data-Driven Interface Style Optimization (Offered)

Table 1 presents horizontal integration pathways between transportation engineering courses and design courses. The columns represent transportation-related course modules, while the rows represent design-related course modules. Each intersecting cell identifies an integrated course and its development status: green indicates that the course is offered, yellow indicates a pilot course, and gray indicates a proposed course. The matrix reveals both the current level of integration and the development potential of multidisciplinary curricula, providing a pathway for constructing a systematic curriculum collaboration framework.

4.2 Cross-Education between Design and Engineering Students

The curriculum may adopt a dual-track integration model. On one track, design students take embedded courses containing engineering logic and methods, such as transportation simulation visualization and user behavior modeling. On the other track, engineering students take creativity-enhancement courses centered on visual design and interaction thinking. This arrangement enables reciprocal knowledge transfer and complements the cognitive structures of both groups [29].

At the organizational level, teaching should move beyond fixed class affiliation and establish mixed cohorts across schools. Engineering and design instructors should co-teach, and each project task should be completed by multidisciplinary teams. Students can thereby experience complete task construction, division of labor, collaboration, and output communication. This teaching format can substantially improve their cross-disciplinary understanding and collaborative problem-solving ability.

4.3 Integrated Teaching Cases and the Logic of Course-Cluster Design

Some universities have already experimented with curriculum integration around New Engineering and art and design. Changsha University of Science and Technology, for example, has offered a Transportation Information Design course that combines visualization technology, route-planning algorithms, and visual graphic expression. Zhejiang Institute of Communications has offered a practical course in intelligent interaction prototype development, in which enterprise mentors provide project contexts and university teams organize the decomposition and implementation of teaching tasks, producing notable results.

Table 2 Comparison of Collaborative Curriculum Practices at Three Universities

Item	Changsha University of Science and Technology	Zhejiang Institute of Communications	Tianjin Art Vocational College
Integrated Course / Project	Environmental Art Design (Transportation Guidance System Construction Project)	Fundamentals of Interaction Design; Digital Media Project Practice	Guidance System Design; Exhibition Space Design
Collaboration Model	The School of Art and Design and the School of Transportation Engineering jointly carry out a design project based on optimizing the Changsha Metro guidance system.	The university and an enterprise jointly develop a practical training project; enterprise mentors participate throughout the process to develop an intelligent interaction prototype interface.	The spatial design and digital media teaching groups jointly organize course tasks centered on improving the campus spatial experience.
Course Objective	Develop students' ability to construct visual guidance systems in authentic transportation environments.	Strengthen prototype thinking and the construction of practical engineering interaction logic.	Improve students' comprehensive ability to design urban guidance experiences and transportation-space circulation.
Student Feedback	Students generally consider the course highly relevant to practice, engaging, and logically structured.	Students report a heavy workload but substantial gains and clear improvement in skills.	Students find the course engaging but note insufficient support from data analysis.
Outcome Conversion	Outstanding student proposals were adopted by Changsha Metro Group and used in actual station visual-optimization work.	Prototype proposals were adopted by the enterprise and iterated into an operational application interface.	Results were used to update the college guidance system, and selected works were exhibited in a joint graduation design exhibition in Tianjin.

Table 2 compares three types of institutions in terms of collaboration mechanisms, educational objectives, implementation feedback, and pathways for converting outcomes. It demonstrates concrete operational approaches and points of effectiveness for interdisciplinary collaborative education across different institutional types, providing practical references for optimizing curriculum integration models.

Integrated course clusters should not remain at the stage of isolated experimental courses. They should form a progressive pathway consisting of introductory study, intermediate development, project integration, and incubation practice. For example, Fundamentals of Transportation System Aesthetics, Transportation Interface Behavior Design, and System Interaction Prototype Development can be arranged as sequential modules that guide students from theoretical understanding to engineering implementation.

5 COLLABORATIVE MECHANISMS FOR PRACTICE PLATFORMS AND PROJECT-BASED TEACHING

5.1 Embedding Authentic Scenarios in Project-Based Courses

Project-based teaching under the New Engineering framework emphasizes the deep integration of knowledge systems, competency structures, and actual engineering needs. If design courses are detached from authentic transportation scenarios, they cannot effectively cultivate students' abilities in problem identification and systems construction. Practice platforms should therefore be built around three authentic dimensions: authentic users, authentic tasks, and authentic evaluation, allowing teaching to move from simulation to practical effectiveness.

Project topics should originate in concrete problems of transportation and mobility, such as adapting urban public transportation guidance systems for older users, designing human–machine interaction for intelligent vehicles, and constructing interface consistency across multi-terminal transportation applications. These problems involve not only visual language but also data processing, system logic, and user experience, making them natural contexts for integrating design and engineering.

5.2 Constructing the Teaching Task Chain: From Transportation Scenarios to User Solutions

Traditional teaching tasks are often closed assignments in which students complete course assessments through partial representations and have little opportunity to construct a complete system. A task chain should therefore divide a project into five stages: research, modeling, prototyping, testing, and improvement. Each stage embeds knowledge from different disciplines and enables students to cross disciplinary boundaries naturally as the project progresses.

Course arrangements should be flexibly configured according to the rhythm of project development. Modules in transportation simulation, interactive behavior, and interface prototyping can be interwoven with core design courses, forming a dynamic teaching model in which course content advances with the task. This model can strengthen students' awareness of application and their capacity for project time management.

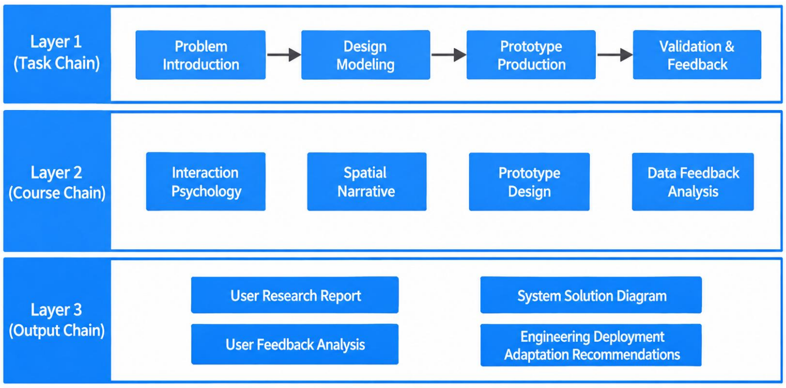

Figure 2 Integrated Pathway of the Task Chain, Course Chain, and Output Chain

Figure 2 presents a teaching task chain driven by authentic problems, together with the corresponding interdisciplinary course content and output pathway. Four task nodes—Problem Introduction, Design Modeling, Prototype Production, and Validation & Feedback—are horizontally supported by course content. The pathway ultimately produces multiple outcomes, including a User Research Report, User Feedback Analysis, a System Solution Diagram, and Engineering Deployment Adaptation Recommendations, thereby forming a closed loop that connects teaching tasks, knowledge construction, and outcome conversion.

5.3 University–Enterprise Collaboration: Integrated Development of Design and Engineering Tasks

Enterprises should not merely release projects; they should also co-construct the teaching process and promote the conversion of outcomes. Universities can invite transportation design institutes, intelligent transportation companies, and visual technology companies to act as course partners and jointly formulate project processes, technical standards, and evaluation milestones, thereby improving the industry relevance of teaching.

Team configuration should adopt a multi-party model comprising a design mentor, an engineering mentor, and an enterprise consultant. Students can learn to communicate across professional contexts through guidance from multiple perspectives. After project completion, enterprise specialists should participate in evaluation through a dual process combining simulated user testing with engineering implementation assessment, strengthening the practical orientation and conversion potential of teaching.

5.4 Establishing Mechanisms for Project Exhibition and Outcome Conversion

Project outcomes should extend beyond classroom assessment and enter public review, school-level exhibitions, or industry competitions, thereby forming a dynamic loop of course development, exhibition, evaluation, and iteration. Universities may establish a “Transportation × Design Achievement Exhibition” to provide a platform for students to present outcomes, share experience, and receive further feedback.

Promising projects may be recommended to university entrepreneurship centers, joint laboratories, or industrial technology-transfer platforms for incubation. Universities and enterprises can jointly establish a Creative Transformation Fund to support prototype production, engineering assessment, user feedback, and copyright applications for original student projects, thereby connecting course tasks with industrial prototypes.

6 INSTITUTIONAL SUPPORT AND MECHANISMS FOR ADVANCING INTEGRATED TEACHING

6.1 Establishing an Integrated Curriculum Platform

Most transportation-oriented universities still manage courses at the school level, which makes it difficult to support horizontal collaboration between design and engineering courses. To advance integrated teaching effectively, universities should establish an Integrated Course Platform or an Interdisciplinary Curriculum Center that coordinates course co-development, faculty allocation, task release, and outcome evaluation through a university-level governance mechanism.

Integrated courses should not exist merely as optional supplements but should be incorporated into the core curriculum. A certification system for cross-disciplinary course modules should define minimum requirements for students from different majors, while cross-school credit recognition should be established to eliminate institutional curriculum barriers.

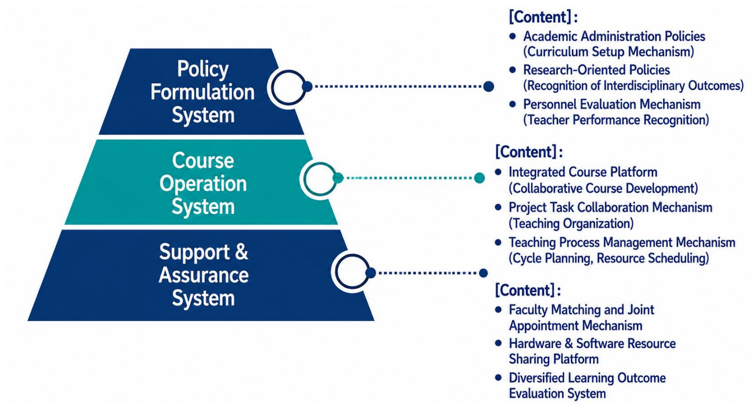

Figure 3 Support System for Integrated Education in Universities

Figure 3 illustrates a three-level collaborative mechanism for interdisciplinary education: top-level design through the Policy Formulation System, middle-level coordination through the Course Operation System, and foundational support through the Support & Assurance System. The three modules interact to create a support framework with both vertical governance and horizontal collaboration, providing stable institutional support for the routine operation of “design + engineering” education.

6.2 Incentivizing Participation in Interdisciplinary Teaching

The Guidelines for New Engineering Research and Practice Projects state that engineering talent cultivation should establish a multidisciplinary integration model, break disciplinary boundaries, and form an education system that reflects interdisciplinary characteristics.

Universities should optimize organizational models by establishing interdisciplinary institutions that support cross-school and cross-major cultivation of New Engineering professionals; reform curriculum systems by offering interdisciplinary courses and exploring teaching models for complex engineering problems; build interdisciplinary teaching teams and project platforms to promote collaborative learning; develop evaluation standards and assessment methods for interdisciplinary competence and establish a quality-monitoring system; and advance the development of professional clusters that highlight institutional characteristics.

When faculty participate in integrated course development, their teaching workload is often not formally recognized and ownership of teaching outcomes remains unclear, reducing motivation. Universities should issue Measures for Recognizing Contributions to Cross-School Teaching, clearly defining workload conversion ratios for co-teaching, authorship order for outcomes, and the allocation of assessment credits.

Faculty evaluation should emphasize actual educational contributions in project-based collaborative teaching, joint task design, and industry review activities, rather than relying primarily on classroom teaching hours. Dedicated bonus items for interdisciplinary teaching outcomes should also be introduced to encourage long-term participation in integrated curriculum development.

6.3 Project Funding Mechanisms and University–Enterprise Co-Development

Integrated curriculum development often involves hidden costs, including case acquisition, enterprise coordination, and data processing. Universities should establish a Special Fund for Interdisciplinary Curriculum Development, using project-based applications and dynamic management to support prototype development, enterprise collaboration, and mentor remuneration.

Enterprises should be encouraged to co-develop course resources by providing teaching cases, jointly building training platforms, and opening project data. Enterprises with sustained participation may be prioritized for inclusion in the university's database of practice-teaching partners and receive corresponding support in policy, funding, and resource allocation.

Universities should also mobilize social resources and develop multi-party collaborative education involving enterprises, research institutes, other universities, and local governments. Such efforts can form a New Engineering talent cultivation system characterized by multiple participants and industry–university–research integration, promote organizational innovation in universities, and explore new institutional models such as industry-oriented colleges.

6.4 A Multidimensional Evaluation System for Interdisciplinary Educational Outcomes

Student evaluation should shift from the aesthetic quality of isolated works to the systemic value of project outcomes. A comprehensive evaluation framework should include problem-identification ability, systems-construction ability, collaborative execution ability, and responsiveness to user feedback. Evaluation should involve university teachers, engineering specialists, and industry users to ensure that outcomes combine aesthetic quality, practical value, and engineering compatibility.

Course outcomes should be archived in a unified manner. Outstanding projects should be included in a digital teaching-outcome repository for later teaching reference, exhibition, and competition recommendation. A post-course evaluation mechanism should also be introduced to review deficiencies in mechanisms, barriers to collaboration, and difficulties in converting outcomes, thereby supporting ongoing institutional revision.

7 CONCLUSIONS AND PROSPECTS

Taking the developmental challenges of art and design programs at transportation-oriented application universities under the New Engineering framework as its point of departure, this study systematically examines the necessity and practical pathways of interdisciplinary integrated education. It argues that breaking disciplinary barriers and advancing "design + engineering" collaboration are essential to the structural transformation of design education and the improvement of talent quality.

Future research should compare the implementation effectiveness of integrated education mechanisms across different types of universities and examine students' behavioral patterns and evaluation systems in project-based collaboration. It should also investigate the potential of intelligent technologies such as artificial intelligence and big data to support curriculum collaboration and teaching feedback, enabling integrated education to continue evolving through digitally and intelligently driven development.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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REFERENCE

[1] Guo P X. Interdisciplinary pathways for cultivating New Engineering talent: Exploration in theory and practice. Writers' World, 2025(11): 54–57.

[2] Sun Y, Xu W, Dong S R, et al. Research on the New Engineering talent cultivation model in application-oriented undergraduate universities under the integration of specialty education and innovation–entrepreneurship education. University, 2025(10): 125–128.

[3] Li Y, Shi Q Q, Wei X R. Reform and practice of teaching models for art and design courses from the perspective of digital intelligence. Qin Zhi, 2025(5): 86–88.

[4] Zhou J C, Mai F Y, Sun J J, et al. Pathways for constructing a talent-cultivation ecosystem in application-oriented undergraduate universities: A case study of the fashion and apparel design program at Guangling College of Yangzhou University. Leather Science and Engineering, 2025(3): 126–132.

[5] Rong D S, Fang H L, Zhou L Z, et al. Research on the practical teaching system of application-oriented universities under the New Engineering framework. Education and Teaching Forum, 2025(9): 97–100.

[6] Ma X. Exploration of talent-cultivation models for art and design majors in higher vocational colleges under the New Engineering concept. Western China Quality Education, 2024, 10(15): 90–93.

[7] Tian B Y. Constructing integrated thinking: Interdisciplinary cooperation in employment-oriented art and design education. Footwear Technology and Design, 2024, 4(23): 117–119.

[8] Ren J Y, Ren P. Reform and innovation of design-thinking courses from an interdisciplinary perspective. Screen Printing Industry, 2025(4): 121–123.

[9] Zhang Y, Meng C R. Reform and innovation of talent-cultivation models for art and design programs in universities. Education and Teaching Forum, 2020(40): 137–138.

[10] Lian H B. Construction of a quality-evaluation system for talent cultivation in application-oriented universities under science–education integration. Journal of Yuzhang Normal University, 2025, 40(2): 14–19.

[11] Li P H, Dai S Q, Lin F R. Innovation in product design courses based on interdisciplinary integration. Industrial Design, 2023(9): 89–92.

[12] Xu Y X. An interdisciplinary and cross-enterprise industry–education integration model based on design thinking and artificial intelligence. Computer Education, 2023(S1): 84–87.

[13] Hu K Y, Yang Q Q, Lu L. Research on interdisciplinary cultivation models for New Engineering talent. Computer Knowledge and Technology, 2025, 21(2): 130–133.

[14] Yin L L. Integration of art design and landscape design under the New Engineering framework. Building Structure, 2023, 53(13): 172.

[15] Tian Y P. Research on an innovation and entrepreneurship capability-cultivation system for application-oriented talent at industry-characteristic universities. Scientific Management Research, 2021, 39(3): 138–142.

[16] Tai W W. Development strategies for general education in design thinking in the digital-intelligence era. Art Education Research, 2024(5): 152–154.

[17] Jiang T J, Jin X H. Strategies for cultivating art and design professionals through interdisciplinary integration. University, 2021(2): 72–73.

[18] Lü Y, Li H L, Ma X J, et al. Collaborative education: Cross-boundary cooperation and innovative practice under the New Engineering framework. New Curriculum Teaching (Electronic Edition), 2024(19): 179–181.

[19] Dai X, Zhang J. Exploration of an interdisciplinary "art + engineering" design-talent cultivation model. Heilongjiang Education (Theory and Practice), 2021(9): 38–41.

[20] Huang H M, Chen Y N. Research on a talent-cultivation model for art and design programs based on interdisciplinary integration. Art Education Research, 2020(6): 125–128.

[21] Ding S H, Chen X P, Dong J H, et al. Exploration of an integrated innovation and entrepreneurship education model for civil engineering programs under the New Engineering framework. Educational Informatization Forum, 2024(7): 93–95.

[22] Tang J G, Wang J H. Research on software-talent cultivation models in universities under the New Engineering framework. Jiangsu Science and Technology Information, 2020, 37(28): 75–77.

[23] Liu K. Governance of New Engineering education: Framework, system, and model. Doctoral dissertation, Tianjin University, 2020.

[24] Wang L, Liu X P. Exploration of talent demand and cultivation models for postal engineering under the New Engineering framework. Education and Teaching Forum, 2020(4): 254–256.

[25] Fu L, Yang F X, Tang G H, et al. Cultivating internationally first-class thermal-fluid talent with foundations in the humanities, mathematics, and information science: Practice and exploration of the New Engineering talent-cultivation model at Xi'an Jiaotong University. Research in Higher Education of Engineering, 2019(S1): 1–5.

[26] Sun H N, Ding W F, Zhao J X. Teaching reform in communication-related programs based on industry–university–research collaborative innovation. China Modern Educational Equipment, 2019(1): 88–91.

[27] Li J X, Cao X L, Shao T T, et al. Construction and practice of a multi-party collaborative education model for electronic information programs under the New Engineering framework. In Proceedings of the 2019 7th ICASS International Conference on Management, Business and Technology Education (ICMBT 2019), Advances in Education Research, 2019, 126: 574–580.

[28] Huang W, Li W. University–enterprise collaborative cultivation of New Engineering talent in an industrial ecosystem. China Modern Educational Equipment, 2018(21): 85–87.

[29] Wang X M, Hu D, Fang J, et al. Exploratory practice in innovation education by engineering training centers using multidisciplinary advantages. Experimental Technology and Management, 2018, 35(2): 6–9.