VTE VOCATION, TECHNOLOGY & EDUCATION

ORIGINAL ARTICLE

Constructing a future-skills talent training mechanism for vocational undergraduate fashion design in the age of digital intelligence

Yupei Cao*

School of Innovation and Creative Design, Shenzhen Polytechnic University, Shenzhen 518040, Guangdong Province, China

ABSTRACT

In the age of digital intelligence, supported by the rapid development of artificial intelligence generated content (AIGC) and intelligent manufacturing, the textile and apparel industries are undergoing a comprehensive transformation, moving from traditional manufacturing to data-driven design and intelligent production. These aspects of production are gradually being implemented throughout the fashion industry's value chain, from spinning to retail. Consequently, there is a growing demand for fashion designers who are highly versatile and possess strong digital and innovative skills. This study aims to construct a training mechanism for vocational undergraduate fashion design education. The challenges facing domestic higher vocational education—such as outdated and rigid curricula, similar competency structures, the decline of practical teaching and school-enterprise cooperation, and one-sided evaluation mechanisms—are analyzed in detail. Based on this analysis, a competency framework oriented toward "digital intelligence + future skills" is proposed, as well as a "five-in-one" approach to cultivating fashion design professionals, including the use of artificial intelligence technology in content and teaching-method development, the development of an interdisciplinary curriculum based on cooperation between art and engineering, the creation of authentic school-enterprise co-creation teaching scenes, the digital construction of faculty teams, and the improvement of outcome-based evaluation and skill-certification systems. This provides a theoretical basis and a practical model for the construction of Chinese-style vocational undergraduate fashion design education, along with a "China solution" for the global popularization and application of vocational education.

Key words: digital intelligence era, fashion design, vocational undergraduate education, future skills, talent training mechanism, China solution

INTRODUCTION

Information technologies such as artificial intelligence (AI), big data, and virtual reality (VR) have developed rapidly in the textile and apparel industry, which has undergone a transformation from physical research and development with offline consumption to virtual research and development driven by intelligence, cross-industry integration, and platform marketing (Figure 1). Technologies such as artificial intelligence generated content (AIGC), virtual three-dimensional fashion design, and intelligent manufacturing are continually emerging as applications in the fashion industry (Bednall, 2022). The Chinese Ministry of Education has emphasized national strategic policies, including the *Education Informatization 2.0 Action Plan*, *the National Vocational Education Reform Implementation Plan*, and *the Vocational Education Industry-Education Integration Empowerment and Enhancement Action Implementation Plan (2023-2025)*. These policies indicate the need to integrate

***Corresponding Author:**
Yupei Cao, School of Innovation and Creative Design, Shenzhen Polytechnic University, No. 3 Zhijiao Street, Xiangmi Campus, Futian District, Shenzhen 518040, Guangdong Province, China. Email: caoyupei@szpu.edu.cn.
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Figure 1. Global digital transformation pathways in the textile and apparel industry. Source: https://lookfashion.ai/; https://www.zhiyitech.cn/home; https://www.theinterline.com/tech-hub/style3d/. AI, artificial intelligence.

AI and other technologies with education as well as to reshape approaches to training individuals and developing programs. The introduction of vocational undergraduate education in China has made training for fashion and apparel design programs at this level a main topic of academic concern.

This study aims to construct a talent training mechanism for vocational undergraduate fashion design education that is adapted to the digital intelligence era, precisely position its talent training direction, and analyze how future skills can empower talent training in fashion design programs, thus matching degree programs with students' digital capabilities, innovative awareness, and industry demands. The research addresses three key questions: (1) How can we construct a talent training mechanism for vocational undergraduate fashion design education that meets the demands of the age of digital intelligence? (2) How can future skills be integrated into vocational undergraduate fashion programs to enhance students' employment competitiveness and innovative capabilities? (3) How can we ensure that fashion design graduates can smoothly adapt to the changes brought about by the AI transformation of the textile and apparel industry?

ANALYSIS OF CURRENT CHALLENGES IN VOCATIONAL FASHION DESIGN TRAINING

Comparative analysis of domestic and foreign training models

Currently, different talent training models in fashion and apparel design are being developed in various countries—including academic, applied, and interdisciplinary models. In Europe and the United States, fashion design education focuses on achieving a balance between academic research and artistic creation, while some schools see cultivating avant-garde artistic creation as the main goal of education. Because Western fashion education was the first to develop, a comprehensive system has already been established, with schools in different regions adopting distinct approaches. For instance, Central Saint Martins in London and Parsons School of Design in New York prioritize creative research, experimental fashion, and interdisciplinary integration. Their teaching is arranged in a "studio-based + project-driven" mode, and their students are highly experimental and avant-garde (Figure 2). In contrast, the Swedish School of Textiles and the Politecnico di Milano in Italy value a balance between creativity and commercialization, fashion interdisciplinary integration, fashion management and sustainability, industrial innovation, and social responsibility. Japan tends to adopt a technical application model based on crafts and industry. Bunka Fashion College, for example, values a combination of garment structure, pattern making, and industrial production, emphasizing technicality and entry into the job market. Famous teachers who graduated from this school include Yohji Yamamoto, Kenzo Takada, and Junya Watanabe, who are renowned for their unique tailoring techniques and structural designs.

The talent training models employed for fashion programs in Chinese higher vocational colleges frequently demonstrate a current state characterized by emphasizing skills while neglecting comprehensive literacy, with a pronounced disconnection between theoretical knowledge and practical application (Shi,

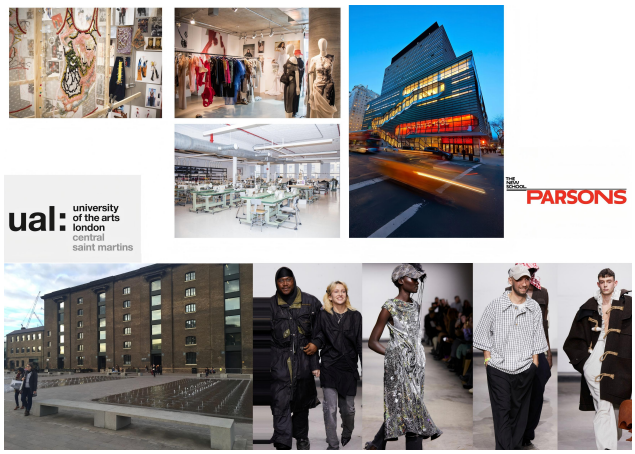

Figure 2. Graduation projects and campus scenes at the Parsons School of Design and Central Saint Martins. Source: https://www.newschool.edu/parsons/mfa-fashion-design-society/; https://www.arts.ac.uk/colleges/central-saint-martins/stories/ma-fashion-show-2025.

2023). This approach results in graduates who lack robust professional problem-solving capabilities and innovative characteristics. Many institutions continue to adopt relatively traditional "skill-oriented" curriculum frameworks. In contrast to the "problem-solving" pedagogical models employed by internationally acclaimed fashion institutions—which promote learning through project-based practice—domestic fashion programs place insufficient emphasis on industrial demands and future technological innovation within their curriculum architectures. In this regard, Hangzhou Vocational and Technical College's Dali Women's Fashion Institute in Zhejiang Province and Suzhou Arts and Crafts Technology Institute in Jiangsu Province stand at the forefront of comparable higher vocational institutions in China regarding fashion design talent cultivation (Zhuo & Li, 2025). These institutions have capitalized strategically on locally advantageous industrial clusters by establishing distinctive industrial colleges and specialized program subdivisions that address the urgent needs of local industries. They have designed project-based practical training curricula that authentically align with industry requirements. Hangzhou Vocational and Technical College's Dali Women's Fashion Institute has entered a partnership with Dali Silk (Zhejiang) Co., Ltd. to vigorously develop comprehensive training facilities equipped with diverse equipment and full-category garment production workshops while actively inviting frontline industry designers and technical personnel to deliver on-campus instruction. Similarly, the Suzhou Arts and Crafts Technology Institute has established specialized program subdivisions—including knitwear, menswear, and embroidery design—by strategically leveraging partnerships with advanced garment manufacturing and knitting enterprises located in Changshu and Suzhou, as well as Tongxiang and Haining in Zhejiang Province.

Through a comprehensive comparative analysis, it becomes evident that fashion programs across different geographical regions must cultivate distinctive regional industrial characteristics in their talent-training approaches. Leading international institutions such as Central Saint Martins and Parsons School of Design effectively leverage their strategic positions within the world's premier fashion capitals of London and New York. They achieve this by focusing on the seamless integration of innovation and technology, comprehensive interdisciplinary education, and profound project-based alignment with regional industries. These exemplary approaches provide invaluable insights and promising exploratory directions for the future development and enhancement of China's vocational undergraduate fashion design programs, as illustrated in Table 1.

Major challenges in talent training for vocational education in fashion and apparel design in China

At Chinese vocational colleges, talent training in fashion and apparel design has traditionally focused on "direct employment and development", whereby fashion and apparel design programs emphasize "performance and use". Since the very beginning, the ultimate goal of these colleges has been to prepare skilled talent for the fashion industry so that they can apply basic design and production knowledge and work on the front line as assistants or designers in the fashion industry. Graduates from these colleges normally work as fashion design assistants, pattern- or sample makers, technicians in garment production and management, or in visual merchandising and marketing.

However, according to an employment survey, most graduates in fashion and apparel design prefer career paths with tracks as creative designers, starting from an assistant position and providing creative support (Feng *et al.*, 2024). Thus, there is high consistency in final employment and employment tracks following graduation from undergraduate programs in general education, higher vocational colleges, and vocational undergraduate programs. This weakens the characteristics of the three types of education but also reflects problems in the talent training system, such as insufficient differentiation in training models and poor matching with market needs.

Deep curriculum homogenization and unclear talent training objectives and hierarchical positioning

Currently, the majority of institutions that provide

Table 1: Comparative analysis of talent cultivation models in domestic and international fashion design institutions and their implications for China's vocational undergraduate teaching models

Region	International institution/case study	Training model classification	Distinctive talent training characteristics	Strategic implications for Chinese vocational undergraduate models
Europe	Central Saint Martins	Academic-oriented	Creative research excellence, avant-garde fashion leadership, comprehensive interdisciplinary integration	Emphasizes the critical balance between creative practice and rigorous academic research, actively promoting interdisciplinary integration in comprehensive training approaches
	Politecnico di Milano	Hybrid	Innovation- and technology-driven methodologies, sustainable design principles, and comprehensive social responsibility cultivation	Concentrates on developing designers' social responsibility awareness and industrial innovation capabilities, promoting a strategic combination of sustainable development principles with practical commercial applications
	The Swedish School of Textiles	Hybrid	Seamless integration of design, technology, and management; comprehensive industry-education collaborative integration	Systematically strengthens "skills + creativity + management" compound capability development while comprehensively embedding sustainable development concepts throughout the entire teaching system
Japan/Korea	Bunka Fashion College	Technology-application oriented	Advanced craft technology and comprehensive industrial practice; technology-driven innovation methodologies	Emphasizes meticulous and refined training in traditional crafts and cutting-edge technology, systematically cultivating designers who demonstrate mastery in cutting techniques and sophisticated garment construction
United States	Parsons School of Design	Academic-oriented	Digital skills-based innovative research methodologies; comprehensive project-based training that strategically leverages the geographical advantages of global fashion centers	Systematically strengthens project-driven learning models while significantly enhancing students' proactive innovation capabilities and comprehensive industrial adaptability
	FIT	Technology-application oriented	Integrated a "technical skills + liberal arts foundation" approach; close industrial practice alignment; robust vocational orientation	Systematically strengthens comprehensive skills training and strategic industry alignment within vocational undergraduate education frameworks, implementing a modular combination of training methodologies
China	Hangzhou Vocational and Technical College Dali Women's Fashion Institute	Technology-application oriented	Strategic reliance on distinctive industrial colleges for comprehensive practical training infrastructure development; actively invites frontline industry designers and technical personnel for instructional delivery	Emphasizes profound integration with industry stakeholders, systematically establishing comprehensive university-enterprise joint curriculum programs
	Suzhou Arts and Crafts Technology Institute	Technology-application oriented	Strategic leverage of regional garment manufacturing cluster advantages to establish highly specialized program directions	Actively promotes comprehensive curricular refinement and advanced specialized development initiatives

FIT, Fashion Institute of Technology.

education in fashion and related design areas in China show significant problems with how programs are organized and positioned (Feng *et al.*, 2024). Their programs demonstrate considerable similarity to those in regular universities and in higher-level practice-oriented programs. Institutions do not develop different specializations that relate to particular industrial features in regions or that relate to different segments of market demand. Such specialized areas include high-quality custom clothing, athletic wear, production management, and fashion design for men. Some institutions use curricula and training approaches from research universities as models, which causes confusion regarding training objectives and how programs should be positioned in relation to different levels of education (Feng *et al.*, 2024). The homogenization that occurs in these contexts leads to a series of problems in program development and curriculum implementation, including misaligned model comparisons, inefficient imitation, and imbalanced evaluation. Institutions adopt studio approaches from research universities that emphasize concepts and exhibitions but provide limited skill development. These approaches are transplanted into educational contexts oriented toward employment. This transplantation weakens the depth of skill development that students receive and does not establish clear positioning in relation to different educational levels (McGrath & Ramsarup, 2024). Students in professional courses pursue broad coverage and large quantities of curriculum content. However, they neglect the depth and practical orientation required for alignment with actual job requirements. This unclear positioning undermines the main value that education in these areas should provide. The positioning also diminishes the particular value that this education should provide in serving local economic conditions and connecting with emerging industries.

Lagging teaching resources and hardware facilities, with limited digital curriculum supply oriented toward future industries

With the rapid development of the global fashion industry and digital transformation, industry require-

ments for talent have undergone profound changes. Various application scenarios, such as virtual fitting, unmanned garment production factories, and digitalized production management systems, continuously disrupt traditional fashion design working models. However, the current limitations of many vocational colleges in terms of teaching resources and hardware facilities have resulted in an obvious disconnect between curriculum content, capability structures, and actual industry needs. Fashion design creative studios, sample garment production workshops, and cutting facilities at some institutions still rely primarily on traditional manual operations and lack support from advanced technologies, such as digital 3D design, VR virtual simulation, and intelligent manufacturing. A lack of digital equipment in classrooms makes it difficult for students to adapt to advanced technological applications in the modern fashion industry, while also limiting their operational capabilities once they are employed. Surveys have shown that although most domestic fashion programs have established digital-related courses, such as 3D fashion design, virtual fitting, and AI fashion design, these courses are mostly positioned as supplementary or elective subjects with relatively basic content that cannot simulate the mainstream working scenarios currently prevalent in the fashion industry (Nam *et al.*, 2025). After graduation, students are often unable to apply these tools directly to solve actual industry problems. To date, the fashion design curricula at most domestic vocational colleges have not fully aligned with this objective, and the content and teaching methods of digital courses have not met the industry's requirements for high-level digital skills.

Insufficient industry-education integration mechanisms, lacking high-quality school-enterprise project-based practical training

Vocational education in fashion and apparel design universally exhibits "form over substance" in terms of industry-education integration (Liu, 2025). Regional school-enterprise cooperation models predominantly emphasize simple collaborative activities, such as short-term internships, enterprise visits, and campus lectures by enterprise mentors, and lack high-intensity systematized project courses and practical training systems that connect with authentic market demands and overall industrial chain components. For example, in the Guangdong-Hong Kong-Macao Greater Bay Area, with Shenzhen at its core, fashion design enterprises demonstrate high clustering density with substantial demand for creative design talent.

However, despite deep cooperation between regional vocational colleges and leading fashion enterprises, companies are more inclined to have vocational college students engage in low-value-added segments, such as marketing, production, sampling, and processing, while participation in high-end segments, such as product creative design and brand planning, remains limited. This not only weakens students' design innovation capability development during internships but also solidifies the stereotype of "vocational education = low-end employment" among industry perceptions (Ramsarup *et al.*, 2024). Therefore, to achieve high-quality development in fashion-design vocational undergraduate programs, overcoming this "low-end lock-in effect" at the vocational undergraduate stage by strengthening high-level creative practice, increasing joint school-enterprise original-design project courses, and introducing market-oriented graduation design evaluation mechanisms to reshape vocational education graduates' low-end employment status has become a critical issue.

Insufficient career orientation awareness and development, lacking guidance for diversified career development paths

In China, many professional institutions that provide vocational education for fashion and apparel design majors demonstrate significant advantages in cultivating students' professional skills and technical abilities, but they offer insufficient guidance regarding students' career positioning and career development paths. Constantly declining wages in traditional garment industries have led graduates to become unwilling to engage in garment manufacturing-related professions. At a vocational college in Anhui, fashion major graduates earn starting salaries of only 3500 yuan, which is lower than the average income of food delivery workers, resulting in a sharp decline in the employment match rate for graduates. According to surveys, the employment match rate for 2024 graduates from Shenzhen Polytechnic University's fashion design program was below 15%, reflecting fashion major students' unwillingness to compromise on low-quality employment opportunities (CFW Apparel Manager, 2025). According to statistics from the China Fashion Talents Network, in 2024, only 32% of fashion design graduates entered the industry, while 50% moved into positions such as Douyin fashion live streamers or Xiaohongshu styling bloggers. Under these circumstances, strengthening career awareness and guiding diversified career development paths for graduates is becoming particularly important (Xu, 2015).

TYPOLOGICAL POSITIONING AND TALENT TRAINING CHARACTERISTICS OF VOCATIONAL UNDERGRADUATE FASHION DESIGN EDUCATION

Typological positioning of vocational undergraduate fashion design programs

In 2014, the Chinese Ministry of Education and other departments first proposed the *Decision on Accelerating the*

Development of Modern Vocational Education (State Council of the People's Republic of China, 2014), which recommends exploring the types of talent training for vocational education at the undergraduate level. In 2019, the State Council formally included vocational undergraduate education in the typological education system in the *Implementation Plan for National Vocational Education Reform* (typically called 20 Articles on Vocational Education in China; State Council of the People's Republic of China, 2019). In the 1990s, Chen Yu proposed the vocational belt theory, Chen (2006) believing that skilled professionals can be divided into three major categories: Skilled, technical, and engineering. Vocational undergraduate education is a component of applied undergraduate education. Within this system, fashion design majors at this level are expected to receive training that builds their technical and advanced technical-application abilities—namely, strong professional skills, project implementation capacity, and applied innovation capability (Jin & Wang, 2025).

However, in actual practice, not all engineering and technology universities in China play a key role in implementing the above types of training in fashion design programs. For example, the fashion design programs of the Shanghai University of Engineering Science and Shenzhen Technology University focus on technical applications, but the curriculum system designs of these two schools do not differ from the fashion design programs in regular universities; that is, they remain within the framework of traditional general-undergraduate talent training.

Therefore, to correctly position the talent training goals of fashion design programs at the vocational undergraduate level, we must first clearly define the future job distribution of graduates from different levels of education and their corresponding capability requirements.

Drawing on Barbara Minto's pyramid principle, we constructed a model to illustrate the relationship between the distribution of talent in the fashion industry and corresponding levels of education (Figure 3). It can be seen from Figure 3 that the research positions in high-end fashion design and innovative design applications (A, B, C) account for approximately 25% (the percentage of positions provided by fashion companies in relation to the total), and the main source of recruitment is graduates and undergraduates. Design collaborations and brand operations at the middle level (D) account for approximately 15%, with the main source of recruitment being vocational graduates. The remaining 60% comprises basic production and sales positions (E), mainly from graduates of diploma-level vocational education and short-term vocational training.

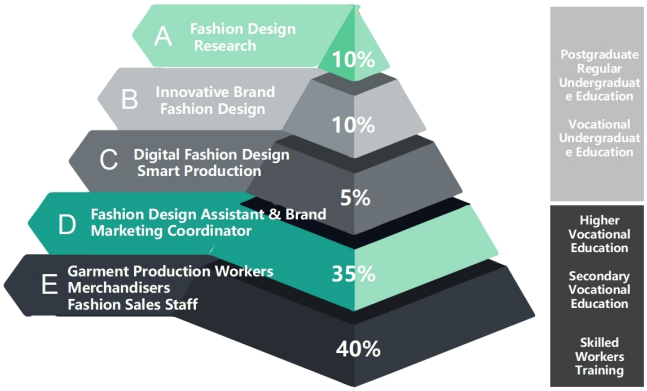

Figure 3. Talent training and job distribution pyramid in fashion design under digital intelligence.

In Figure 3, A, B, and C represent individuals with strong innovative thinking and the ability to manage innovation design, corresponding to graduates at the general undergraduate level. This does not mean that fashion design students at the vocational undergraduate level cannot perform similar tasks. This study took 10 fashion companies in the Greater Bay Area, with Shenzhen at the center, as the main research object and interviewed the enterprises' design supervisors. Through interviews and questionnaires, we found that the enterprises expected vocational undergraduate fashion design graduates to possess mature product innovation design skills and strong cognitive-transformation abilities; that is, graduates required creativity to transform ideas into commercial products according to brand requirements and brand development strategies to ensure effective implementation. The results showed that the ability to design from an international perspective and respond flexibly to the industry were the main criteria for these fashion enterprises to evaluate recruits.

By understanding the levels of education for recruitment across various positions, a clearer understanding can be gained that the goals of vocational fashion design education should focus on training undergraduates to adapt to industrial demand and international perspectives, and space should be allocated in curricula for students' upward academic advancement.

Talent training characteristics of vocational undergraduate fashion design education

In traditional vocational colleges, talent training in fashion design is often limited by fixed, isolated curriculum bands. Following the principle of "technical first, then standardized competency", many vocational colleges clearly separate technical and design courses in their curricula. These standardized models blur the

connections between creativity and craftsmanship, technology, and business, making it difficult to develop the integrated competencies required by the industry.

In the digital intelligence age, from a regional and international perspective, vocational undergraduate fashion design training should establish a job-oriented talent training model that integrates creativity, technology, and business and is empowered by digital intelligence.

Job orientation and multicompetency structures

The logic underlying the training of fashion design undergraduates in vocational education is job oriented and characterized by different competencies. Based on the fashion industry's value-chain logic, this training logic not only covers conventional occupations—such as fashion designer, patternmaker, and visual merchandiser—but also new occupations that have emerged in the fashion industry, such as digital fashion designer, virtual fashion content designer, and sustainable materials designer. Through modular training and a diverse training plan, students can develop a competency structure that encompasses occupational creative R & D, technical execution, and brand operation. This enables them to clarify their roles and the competitive advantages of their chosen career paths.

Integrated fusion of creativity-technology-business

Past and present experiences of fashion education show that fashion courses do not always relate to what is happening in the commercial world. Student creativity is restricted in campus exhibitions. There is little effective connection between market demand and the industry supply chain. Design outputs cannot make a "value leap" from creativity to commercialization. Therefore, vocational undergraduate fashion design programs propose a combined training model that gives equal weight to creativity, technology, and business (Choudhury *et al.*, 2025). Students are trained in digital fashion design, intelligent manufacturing technology, and virtual simulation-based design validation, covering clothing products and systematic creative abilities from fashion concept generation to visual expression. Training in creativity is not limited to fashion design itself but also covers the translation of fashion design ideas into feasible commercial products and brand stories. An H-shaped talent structure reflects the organic unity of "technical strength and cross-disciplinary knowledge" (Xue *et al.*, 2025). This is realized through fashion design programs that connect students' achievements in fashion design, fashion technology, and fashion marketing with an overall process of market research, brand planning, and sustainability strategies.

Dual positioning of regional embedding and international expansion

Undergraduate fashion design education should follow a two-way training path of regional embedding and international expansion. Regional embedding refers to making full use of industrial clusters and embedding co-creation studios, project-based industry-education integration platforms, and other practice bases into the regional fashion industry chain and value network. Students cultivate practical professional abilities by undertaking actual projects and promoting the development of the local economy. International expansion refers to engaging in overseas workshops and joint transnational curriculum construction and training in transcultural cooperation and international competitiveness while participating in the global fashion industry chain.

RESTRUCTURING THE FUTURE-SKILLS COMPETENCY FRAMEWORK FOR VOCATIONAL FASHION DESIGN UNDERGRADUATES IN THE ERA OF DIGITAL INTELLIGENCE

In the face of a global technological revolution and industrial transformation, fashion design professionals' competencies are gradually changing from being mainly composed of traditional skills to incorporating digital-intelligence empowerment, cross-disciplinary integration, and sustainable innovation. In advanced modern vocational education, undergraduates are guided not only by external drivers, such as national strategies and industrial upgrading, but also by external drivers, such as vocational education typology. The level of study is extended, the level of competence is elevated, and the range of competencies is expanded. Therefore, systematic training logic is employed to produce high-quality and technically skilled fashion design professionals (Veltman *et al.*, 2024). As shown in Yu's (2021) theory of technical adaptability in vocational undergraduate education, the most basic training logic of vocational education is to train students who can learn, apply, and develop technology across clusters of occupational roles and maintain skill-based competitive advantages in future jobs. According to the Organisation for Economic Co-operation and Development's (OECD) future skills framework (OECD, 2019) and United Nations Educational, Scientific and Cultural Organization's (UNESCO's) Recommendations for the Development of Vocational Education, future vocational skills can generally be classified into three levels—core literacy, technical skills, and interdisciplinary abilities—which are consistent with the training logic of fashion design professionals in vocational undergraduate education in terms of technology and skills (World Economic Forum, 2023).

Enhancing digital-intelligence literacy and the integration of technological competence

In a future skills-based fashion design training system,

digital-intelligent technology changes from having a traditional subordinate tool to being a main driving force that deeply influences the creative generation, design optimization, and production collaboration process. Future digital-intelligent literacy encompasses not only advanced technology capabilities but also overall quality, including digital thinking, data cognition, and cross-disciplinary innovation (Théric *et al.*, 2025).

In the digital-intelligence era, the competencies of design graduates in the textile and apparel industry have gradually advanced from lower to higher levels, evolving through three stages: From a solid technical foundation, to digital intelligence-empowered core capabilities, and, finally, to innovation-driven advanced capabilities (Ling, 2024).

Based on Bloom's (1956) cognitive domain theory and Senge's systems thinking theory, we constructed and analyzed a three-tier progressive model of undergraduates' future professional fashion design literacy (Figure 4).

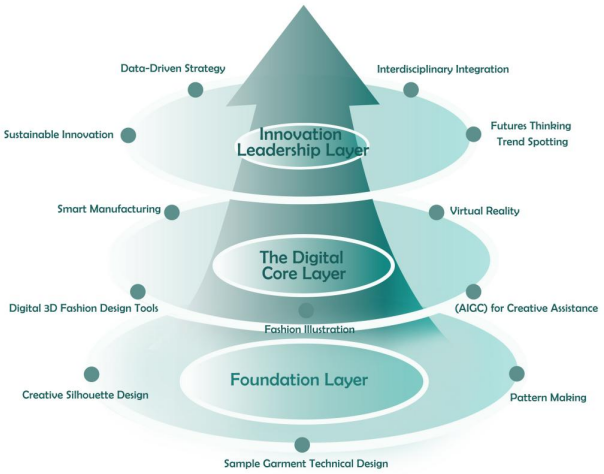

Figure 4. Three-tier progressive competency structure for future fashion design graduates.

The foundational layer forms the basis for cultivating professional talent, which mainly focuses on basic design and technical abilities that students need to master in the initial stage of their work and provides the technical basis for their development of upper-tier skills. Middle-tier skills act as a bridge to connect creation and practical implementation. Students use digital design tools to quickly create realizable and producible design ideas. Top-tier thinking is the most advanced ability of students. It is also the basic quality of future fashion design leaders.

To further simplify this competency structure, Table 2 describes the specific content and key technical courses and application scenarios for each skill tier.

Building cross-disciplinary integration and systems thinking

In the age of digital intelligence, the range of fashion design disciplines is no longer fixed. Fashion-design value-creation processes are no longer limited to aesthetic considerations in apparel design but now encompass the coordinated integration of materials, garment-engineering processes, cultural creativity, marketing, and digital operations.

Senge's system thinking theory proposes that overall cognition and cross-element coordination are indispensable. When meeting with problems, fashion designers in the age of digital intelligence should have a global view and coordinate resources across various disciplines (Gupta *et al.*, 2025).

First, in terms of integrating garment craftsmanship and structural design, future fashion professionals should master not only conventional garment structure and technology but also the latest developments in textile material innovations, such as recyclable fibers and functional fabrics, and in the application of environmentally friendly technology, such as zero-waste cutting. Garment engineering courses at Polimoda in Italy and Bunka Fashion College in Japan have already introduced textile innovations into garment teaching, and students can consider material characteristics and manufacturing conditions when designing garments, thereby achieving a high level of design-manufacture coordination (Michaelson *et al.*, 2024).

Second, in terms of cultural creativity, future fashion designers should integrate regional cultural symbols, brand narrative logic, and a comprehension of user experience into their design and creation so as to achieve a competitive advantage in a global context. This would highlight interdisciplinary integration, situational authenticity, and the ability to design system-based solutions (Xue *et al.*, 2025).

Therefore, future fashion-designer training should not focus on improving individual abilities, but by arranging courses and practices in a contextualized way, students can be trained to gain competence in cross-disciplinary integration and systems thinking so that graduates can achieve the efficient transfer of creativity and technology into competitive fashion products in different contexts.

Value orientation of sustainability and innovation-driven development

With the promotion of the united nations sustainable development goals and the continued advancement of educational informatization, sustainable fashion design education has gradually become a recognized future development trend in the international fashion academic

Table 2: Future-oriented integrated competency framework for fashion design

Competence level	Competence content	Key technologies and course alignment	Competence application scenarios
Foundation layer	Solid foundation in fashion technology, mastering basic skills, such as traditional patternmaking, sample garment process design, creative styling innovation, and fashion illustration	Garment structure and process, fashion illustration, creative styling design and three-dimensional construction	Fashion design fundamentals, meeting auxiliary needs for garment production and design
Digital core layer	Application of digital design tools, AIGC creative assistance, intelligent manufacturing collaboration, *etc.*	Digital 3D design tools, virtual reality, intelligent manufacturing systems courses, AIGC creative assistance design	Rapid translation of creative designs into production-feasible solutions, promoting digitalization and intelligentization of production processes
Innovation leadership layer	Cross-disciplinary integration capabilities, brand management and creative planning, design strategic thinking, *etc.*	Brand planning and marketing, fashion management and buying	Leading design innovation, conducting interdisciplinary integration and collaboration, brand strategic management

AIGC, artificial intelligence generated content.

community (D'Itria, 2020). Taking into consideration research on global sustainability strategies and international consumers' demand for personalization, this paper discusses the changes in intrinsic requirements for fashion design graduates triggered by the latter. Fashion design professionals should not only focus on aesthetic presentation but also create green value and perpetual innovation. Vocational undergraduate training should not be limited to transcending the old model of merely emphasizing "doing" skills but should also stress the ability to "envision, validate, and express" and to create in sustainable ways. This is because the labor demand logic at the industrial and enterprise levels is changing from one focusing on "usability" to one emphasizing "creativity". Professionals who merely complete simple work but are not extended creatively will soon be dismissed (Hong *et al.*, 2025). On the other hand, in the fashion industry, consumption logic and technology have normalized personalization, small-batch production, rapid response, and digital presentation, thus changing the intrinsic requirements for fashion design roles. Therefore, to face new challenges, future designers should have the ability to validate creativity with digital tools and constrain design solutions within the logic of sustainability. Vocational undergraduate programs should not be homogenized with general undergraduate and higher vocational programs. Only when they take the lead in furnishing graduates with intrinsic competence in sustainable and autonomous innovation can these programs' unique advantages be sustained so that they open a path for graduates to enter mid- and high-level professional positions (Liu *et al.*, 2023).

In summary, undergraduates' competence in future skills-oriented fashion design can be established through a three-tier paradigm: A foundation of solid craftsmanship and digital literacy, cross-disciplinary integration at the intermediate level, and sustainability-driven autonomous innovation at the peak. This combination constitutes a distinct Chinese model of vocational undergraduate education serving the dual transformations of digital intelligence and green development in the fashion industry.

PATHWAYS FOR CONSTRUCTING A TALENT TRAINING MECHANISM IN VOCATIONAL UNDERGRADUATE FASHION DESIGN EDUCATION IN THE AGE OF DIGITAL INTELLIGENCE

The "training mechanism" for vocational undergraduate fashion design education in the age of digital intelligence is not merely a sum of its teaching components but a whole-process reshaping of educational ideas and curricula, as well as the coupling of industry and education, faculty development, and evaluation mechanisms. Currently, most vocational undergraduate schools in China treat this type of model either as an "upgraded version of higher vocational education" or as a "combination of general undergraduate education". Limited social recognition, vague employer requirements regarding job roles, and employee remuneration can restrict this type of education in terms of its distinctiveness and attractiveness. Therefore, training should begin with the three most important questions—"Who to cultivate, how to cultivate them, and by what standards to evaluate them"—and provide answers to typological positioning and standardization of competency standards.

Strengthening digital-intelligence empowerment: Optimizing "AI+ " teaching content and methods

With the arrival of the age of digital intelligence and the maturity of AI, big data, and virtual simulation technology, the curricula of traditional fashion design programs need to be deeply integrated with these new technologies to meet new industry development demands. Many educational researchers aim to rebuild professional curriculum knowledge maps by designing interdisciplinary modules such as "AI+ design thinking"

and "AI+ styling innovation" to enhance students' abilities in using intelligent tools to quickly express creativity and design optimization judgment (Gangoda *et al.*, 2023). At the same time, their goal is also to enhance teaching using technological means, such as virtual simulation and digital twins, and to transform experience-based teaching into intelligent teaching.

Preliminary research has found that AI+ optimization and the reconstruction of undergraduate courses are the most suitable approaches to vocational education in China in general. This study proposes reconstructing the curriculum content of fashion programs into three course clusters—collaborative innovation design, intelligent manufacturing, and sustainable design—and empowering them with AI+ (Figure 5).

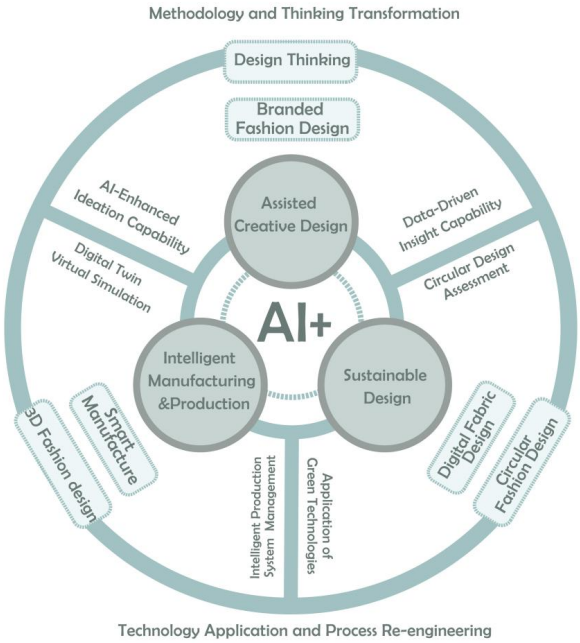

Figure 5. AI+ curriculum matrix for vocational undergraduate fashion design education. AI, artificial intelligence.

AI-enhanced creative design course module (AI-enhanced creativity)

In the fashion design process, AI technology can provide creative inspiration for designers, helping them quickly create mood boards, trend color data, and fabric design ideas. Design assistance supported by AIGC technology can accelerate the iteration of design concepts and promote the transformation of fashion design from traditional manual production and human analysis to digitalization and intelligence through the use of mood boards and intelligent trend analysis. AI-enhanced creative design is a broad concept. By constructing a three-dimensional matrix of curriculum—competency—AI penetration points—the points at which competencies are supported by AI are identified in basic courses, such as design thinking, fashion color, and textile materials science.

The mapping ultimately connects to a vocational competency specification for new modular injection and AI+ knowledge unit design. Without changing the categories of courses and credits, AIGC creative ideation, data-supported color and user insights, and digital 3D patternmaking/virtual fitting are decomposed into transferable small units and embedded into basic creativity, fashion color, garment structure and craftsmanship, and brand fashion design courses according to the logic of "input—process—output" (Quintero Rodriguez *et al.*, 2025).

AI+ smart manufacturing and production course module (smart manufacturing)

As a critical element of intelligent manufacturing in the Industry 4.0 age, the application scenarios of smart manufacturing in the fashion industry are extensive, ranging from automation control and robotics technology to big data and AI, all of which will completely reshape the fashion industry's product, cost, and customization workflow. With their advanced technical application skills, undergraduate fashion design students should understand and master the basic ideas and practical applications of smart manufacturing technology in fashion, such as using 3D digital design software, virtual fitting technology, and operating automatic production systems (Nam *et al.*, 2025). In developing fashion design undergraduates' skills, the smart manufacturing module is not only a response to future production technology but also an inevitable means of preparing them to meet their future work requirements. In the future, the fashion industry will enter the "intelligence + customization" era. Traditional fashion technology courses cannot meet the requirements of the fashion industry for innovation and efficient production. Therefore, we should introduce a curriculum that provides relevant knowledge and applications of smart manufacturing to cultivate students to master the ability to manage future industry changes.

AI+ sustainable design course module

The concept of sustainable development in fashion design is one of the core objectives of contemporary fashion education. Particularly with the large-scale application of smart manufacturing and AI-assisted design today, the scope of sustainable fashion design has expanded. In curriculum content, sustainable design concepts are embedded into the teaching system, which advocates innovative strategies, such as the circular economy and zero-waste design, to reduce resource consumption and environmental impacts (Ryan, 2025). Through technologies such as AIGC digital generation,

intelligent big-data analysis, and 3D virtual simulation, students can complete material recycling, sustainable structural optimization, and green alternative production processes without producing physical samples. This not only enhances their understanding of the importance of sustainable design but also enables them to actively apply environmental concepts in future design practice, promoting the fashion industry's development toward low-carbon, green, and intelligent approaches.

Reconstructing the curriculum: Building a new interdisciplinary platform for "art-engineering integration"

In this century, the scope and trajectory of design education have gradually shown a trend of interdisciplinary extension, which has gradually influenced fashion design education. In the past, fashion courses centered on "craft skills training". Students' training was limited to the "can-do" level and lacked systematic training in logical thinking, overall integration, and technological innovation. This not only divided the knowledge structure and stacked courses in a disorderly manner but also caused students to feel lost and helpless when they were faced with new materials, new technologies, and new ideas (Chai, 2020).

To meet the new requirements of the digital-intelligence transition and the green transition, the vocational undergraduate curriculum can be reformed from a foundational curriculum concept. Based on the need for interdisciplinary integration in the clothes design and technology process as the core of "art-engineering integration", as well as new liberal arts, a progressive three-level course-cluster system of foundational, professional, and integrational can be established.

Taking the foundational level as the starting point, design thinking, art literacy, and science literacy are integrated. Aesthetic training is strengthened. Digital intelligence tools, such as data analysis and virtual simulation, are introduced. Taking the professional core level as the main body of the concept, garment structure and technical processes are combined with engineering thinking, with market logic integrated, to form a strong complementarity between artistic creation and technical implementation. Taking the integration and extension levels as the main line, cultural creativity, brand planning, digital marketing, and sustainable design are combined to strengthen the ability to communicate with designers, businesses, society, and technologies in a multidimensional way in an interdisciplinary field (Liu *et al.*, 2024).

This system is characterized by multidimensional cooperation with humanistic and social orientation. In addition to the previous advantages of "aesthetics-craft-practice" fashion education and based on the construction of an interdisciplinary implementation platform, the "islands of technique" are broken to foster students' systematic knowledge building and integrative abilities from conceptual design to final products (Figure 6). The basic aim of the system is to cultivate versatile graduates who can take multiple roles in the process of digitally empowered and industrialized fashion design development and to promote a genuine transition from "skills-oriented" to "competency-oriented" training in undergraduate fashion design education.

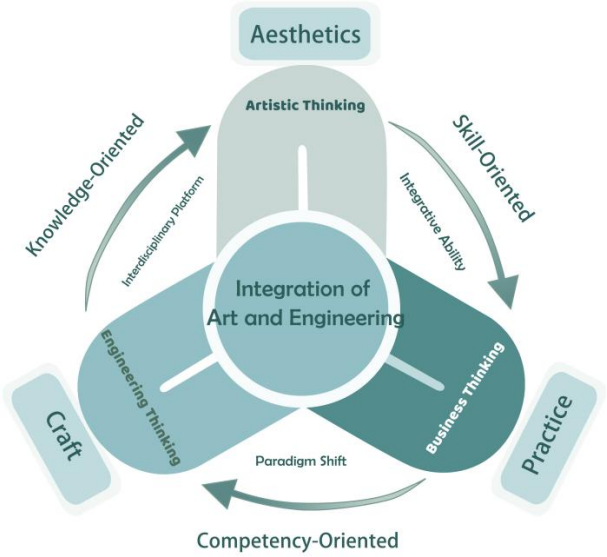

Figure 6. Logical framework of the "art-engineering integration" curriculum.

Deepening school-enterprise cooperation: Creating a new teaching model of authentic co-creation with regional characteristics

School-enterprise cooperation is a key element in vocational undergraduate talent cultivation that connects teaching content and industry. It places students' learning processes in a real industrial context, realizing a "knowledge learning—skill practice—employment transition" connection. As shown in China's newly issued "industry-education integration community" concept, this type of cooperation involves the multiparty participation of schools, enterprises, industries, and governments. Through the sharing of resources, standard co-construction, and process co-management, it realizes a fitting connection between educational supply and industrial demand (Hu & Li, 2024). This approach to cooperation is essentially a deep integration of industry-academia-research, regional cultural characteristics, and authentic project co-creation. It constructs a closed-loop teaching link that encompasses school-enterprise co-

construction, co-research, co-creation, and co-evaluation around the technical chain, creative chain, and industrial chain needs of fashion design programs.

Through the "dual mentor system" mechanism, "enterprise project studios", and "regional industry alliances", students can realize "learning by doing, doing by learning" by linking the real production of enterprises with the real market environment in schools (Yang, 2022).

In Shenzhen, some local application-oriented universities' fashion design programs have formed a "new, three-chain integrated school-enterprise cooperation model" of the "teaching chain—creative chain—industry chain" by cooperating with local fashion enterprises, promoting the development of the local fashion industry, and improving the training quality. They cooperate with local enterprises to conduct brand product-design project practical courses in depth and to explore a new type of "school-enterprise co-creation" talent-cultivation model. The joint brand-fashion design training between Shenzhen University and Shenzhen Ellassay Fashion Group, and the pre-employment design-innovation training courses for graduates organized by Shenzhen Polytechnic University and the Shenzhen Fashion Industry Association, are typical cases of successful school-enterprise cooperation in recent years. Through school-enterprise co-creation courses, university students directly participate in the product-design stage of fashion enterprises and complete market-oriented product development through trend analysis, style design, sample patternmaking, and market testing carried out by university teachers and enterprise mentors. Through the joint teaching of enterprise mentors and university teachers, job standards and industry norms are incorporated into the teaching link.

Therefore, to realize the new teaching model of authentic school-enterprise co-creation with regional characteristics by deepening school-enterprise cooperation, the most important thing is to give full play to regional advantages and form a "three-chain integration model" encompassing the teaching chain, the creative chain, and the industry chain (Wan & Li, 2024). The teaching chain relies on the course-module link to ensure the systematic transmission of theoretical knowledge and professional skills; the creative chain is driven by the project's goal of strengthening training in original thinking and instilling comprehensive design ability; and the industry chain turns learning achievements into real products that conform to market logic through an authentic school-enterprise co-creation scene, so that the learning achievements can be transferred into the industrial logic. The dynamic interaction of the three chains not only improves the fashion students' job and innovative practice skills but also greatly enhances regional schools' ability to retain talent and the service level of industries.

Advancing the digital-intelligence transformation of faculty: Cultivating a dual-track, application-oriented teaching structure

Curriculum innovation and teaching model innovation should be promoted through faculty construction and structural adjustment. In the case of digital intelligence development, faculty members should have strong academic backgrounds and research strengths, enhanced practical industry experience, and cross-disciplinary knowledge (Yang & Yan, 2024).

In terms of faculty building, Shenzhen Polytechnic University has carried out a preliminary exploration in constructing the fashion program faculty. One approach is to invite famous designers and technical masters in the industry to set up a flexible co-teaching mode of "academic teacher + enterprise mentor". Another is to enhance the faculty through internal and external training. Through external training, teachers can master advanced means of digital intelligence design and management, such as AIGC, virtual simulation, and intelligent manufacturing, to develop courses with advanced-level industry coordination. In conjunction with Zuoshang Fashion (Hangzhou) Co., Ltd., the Beijing Institute of Fashion Technology has jointly set up Fashion Brand and Product Planning. Under the guidance of teachers and enterprise personnel, students conduct course projects in the hot and bustling Sijiqing apparel market in Hangzhou. Project courses can greatly enhance students' abilities in creative expression and practical application while exploring new ways to reform project-based, industry-coordinated teaching in fashion and apparel design programs (Li & Li, 2023).

In short, by building a flexible, robust faculty team, a cutting-edge, real-time practice-teaching team model has emerged. It can transform teachers from simple "knowledge transmitters" into "facilitators of industry practice". On the one hand, it can guarantee that courses match the innovation level of the industry. On the other hand, it can ensure that students experience a learning process that is coordinated with the needs of the job market.

Improving the outcome-based education (OBE) evaluation system: Embedding new pathways for future skills certification

OBE, as an educational philosophy centered on learning outcomes, emphasizes using predetermined learning outcomes as an approach to driving the design and assessment of teaching processes. This model requires the educational process to revolve around four key

questions: What competencies do students need to acquire? Why do they need these competencies? How do they acquire these competencies? How do we verify learning results? This forms a closed-loop logic of objectives, implementation, evaluation, and feedback. The OBE approach provides a scientific curriculum-learning evaluation system to cultivate fashion design talent.

Improving the talent cultivation closed loop: OBE-oriented alignment from course objectives to industry standards

Under the OBE teaching evaluation framework, course learning outcomes should be closely aligned with industry demands for job competencies. Traditional fashion design education often focuses on skill training and theoretical knowledge instruction, but lacks the systematic cultivation of applied industry skills. Through the implementation of the OBE evaluation system, every course design module should clearly correspond to industry standards and future skill requirements, ensuring that knowledge points, skill requirements, and actual job competencies in each teaching unit can gradually achieve effective alignment with course objectives, skill training, and competence assessments (Du, 2022).

Taking the fashion design rendering techniques course as an example, traditional teaching often focuses on teacher demonstrations and student imitation. While this can improve copying skills, it hardly exercises students' innovative consciousness and job adaptability. By introducing OBE, the course treats drawing ability, creative expression, and market adaptability as core learning outputs. Through inspirational, inquiry-based, and project-based training methods, it guides students to incorporate multidimensional job-competence evaluation elements—such as market research, technical feasibility, and fashion trends—into their work presentations.

Diversified evaluation system: Multidimensional assessment of job-course-competition-certification integration under the OBE system

The job-course-competition-certification integrated assessment combines four dimensions—job skills, course knowledge, competition standards, and professional certificates—into a comprehensive evaluation system. Through this model, students can not only accumulate project experience through courses, practice, and competitions during their school years but also obtain "job certificates" through corresponding industry certifications, making it easier for them to enter the industry after graduation, with market competitiveness.

For example, the garment structure and process course is a foundational course in fashion design programs whose core objectives are not only to teach students how to conduct structural design and process implementation but also to cultivate their innovative ability, sustainable design consciousness, and industry application capability. In terms of content, beyond basic traditional design and pattern-making skills, green process design, virtual garment production, and digital process analysis have been added. Course assessment combines skill-certificate evaluation with project-based practices, allowing students to embed future skills certification automatically into their learning process. While completing course learning, students not only receive academic performance evaluations from the school but also obtain industry-recognized professional skill-level certificates—3D digital fashion design professional skill certificates—from the textile and apparel industry, thereby completing the full closed-loop cultivation of learn—do—evaluate (Seock & Shin, 2025).

In addition, the multidimensional evaluation system under the OBE framework needs to transform abstract competency objectives into observable, measurable, and specific indicators and express them through structured evaluation rubrics. For example, in the garment structure and process course, detailed evaluation standards can be constructed from the dimensions in Table 3.

CONCLUSION AND FUTURE PROSPECTS

In summary, this study explored the reshaping of talent cultivation mechanisms in undergraduate fashion design education in the age of digital intelligence. It not only responded to practical demands for high-level vocational design talent arising from domestic industrial digital transformation and green development but also demonstrated the unique value of a "China solution" at the international level. The research proposed a distinctively Chinese competence-cultivation framework for fashion design talent featuring solid craftsmanship and digital literacy as the foundation, cross-disciplinary integration as the intermediate support, and sustainability-driven autonomous innovation as the apex. This competency framework not only addresses current industry demands but also highlights the direction of the future development of vocational fashion design education.

The core value of China's undergraduate fashion-design talent cultivation program lies in organically combining national strategies, regional industrial clusters, and educational typological characteristics to form a model logic of local practice, typological positioning, and international transformation. The depth of this model lies in its firm grounding in industry by leveraging globally renowned textile and fashion industry clusters in regions such as the Yangtze River Delta and Pearl River Delta, as well as "fashion capitals", such as Shanghai and

Table 3: Assessment rubric for OBE competencies in the garment structure and process course

Assessment dimension	Specific indicators	Evaluation standards
Creativity	Students' creative application and uniqueness in garment structural design, whether breaking through traditional frameworks	Design demonstrates uniqueness; structural design breaks through traditional design boundaries
Technical feasibility	Whether design works meet process requirements and can be realized within existing production processes	Design conforms to process standards; production is feasible and considers manufacturing constraints
Sustainability	Whether design conforms to sustainable design principles, including material selection, production methods, and energy consumption.	Uses 3D virtual garment design to reduce material waste; considers waste reduction and recycling
Process optimization and resource utilization (efficiency and resource optimization)	Whether design considers structural and process economic optimization in the production process	Optimization thinking for design iterations; design expansion to seek optimal solutions
Market suitability	Whether design meets market demands and has commercial value	Design aligns with market trends and mass production standards; possesses certain market promotion potential

OBE, outcome-based education.

Shenzhen. Taking Shenzhen as an example, "technology + fashion" centered on AI has already formed a complete local industrial ecosystem. Integrating interdisciplinary content such as "3D virtual digital fashion", AI-assisted creativity, and green process practices into curricula ensures that students' learning resonates with the regional economic pulse, forming distinctive regional positioning characteristics.

Looking to the future, the development of undergraduate fashion design education in China needs to continue deepening within the framework of digital intelligence empowerment and educational system reconstruction. This involves promoting comprehensive upgrades to curriculum content, teaching methods, and evaluation systems, enabling technological progress to truly transform into internal mechanisms for competency generation. China's exploratory experience in the field of fashion design education is expected to transform into globally applicable and transferable educational resources, gradually forming a development pathway from a Chinese experience to a global paradigm.

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Author contributions
Cao YP contributed solely to the article.

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Ethics approval
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Informed consent
The participants were informed that the interview data were only used for research purposes, and their information would be anonymized when presenting the research result. Moreover, they are also allowed to stop the recording at any moment during the interview, and they can refuse to respond to any question asked during the review.

Conflict of interest
The author has no conflicts of interest to declare.

Use of large language models, AI and machine learning tools
None.

Data availability statement
No additional data.

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