

Research Article

Voices from the Factory Floor: Aligning Fashion Education with Regional Manufacturing Needs

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Abstract

The digital transformation of the global textile and apparel manufacturing industry has reshaped the skill requirements of the labor market; however, a significant skills mismatch persists between current higher fashion education systems and the imperatives of regional manufacturing upgrading. This study aims to accurately identify specific industry expectations and competency gaps by eliciting direct empirical feedback from the frontline of regional manufacturing enterprises. Adopting a qualitative research design, the study utilizes thematic analysis to systematically code and analyze field transcripts from regional apparel industry symposia. The findings reveal four core dimensions of competency shortages facing manufacturing firms: a lack of systems engineering and process standardization capabilities; a deficit in flexible production and global supply chain restructuring skills; a disconnect in omnichannel digital marketing and cost control proficiencies; and the exclusionary effect of the regional manufacturing environment on core technical talent. The results suggest that the current pedagogical paradigm, which overemphasizes artistic expression, has become increasingly inadequate in meeting the practical demands of modern intelligent manufacturing and complex business transformations. To bridge the industry-education gap, this study proposes a curriculum restructuring framework grounded in the logic of “industry-education co-creation,” emphasizing the integration of authentic factory technical documentation into educational assessments and the establishment of intensive local work-based learning modules. From a micro-empirical perspective, this research provides an objective evidence base for local higher education institutions to accurately align with industrial needs and optimize regional talent supply structures.

Keywords

fashion education, skills mismatch, regional manufacturing, qualitative research, industry-education co-creation

1. Introduction

The global textile and apparel manufacturing industry is currently undergoing a digital transformation. The application of Industry 4.0 technologies has profoundly transformed traditional industrial production models (Mahmood et al., 2025). Digital technologies have precipitated significant shifts within the supply chain processes of the fashion industry (Casciani et al., 2022). As the traditional apparel sector upgrades toward high-efficiency manufacturing, there is an escalating demand for a newly skilled workforce. Technological advancements and market environments have reshaped the structure of the labor market (Frings & Ilie, 2026). Regional manufacturing hubs urgently require technical talent equipped with the capabilities to adapt to modern manufacturing environments, thereby sustaining long-term industrial competitiveness (Carstensen et al., 2025).

A profound skills mismatch exists between the imperatives of industrial upgrading and the current higher education system. While industry skill expectations continually evolve in tandem with technological progress, the competencies of graduates cultivated by formal education consistently fail to meet current industrial demands (Hegde & Kavade, 2025). The curricula of fashion programs in higher education institutions are frequently disconnected from practical industry requirements. Specific empirical studies indicate that, due to a lack of adequate practical training facilities and opportunities, fashion students often exhibit a deficit in critical practical competencies and operational experience with specific tools upon entering the industry (Ademtsu & Pathak, 2023). Outdated pedagogical systems and limited industry-academia collaboration hinder students' smooth transition to the modern manufacturing floor (Hegde & Kavade, 2025). Consequently, there is an urgent imperative to realign university curricula with frontline operational requirements, a pervasive challenge currently confronting workforce readiness across multiple industries (Hegde & Kavade, 2025; Hussain et al., 2026).

Accurately identifying the industry's specific expectations regarding graduate competencies is a prerequisite for narrowing the industry-education gap. This study aims to decode the exact workforce requirements of contemporary factories by directly listening to the authentic voices from the frontline of regional manufacturing enterprises. Collecting empirical feedback from the industry can effectively delineate the competency gaps of graduates. Translating genuine industry demands into educational objectives provides an objective evidence base for local higher education institutions to restructure fashion education curricula. Rigorous curriculum adjustment frameworks contribute to enhancing students'

occupational adaptability, ultimately cultivating a labor force that genuinely fulfills the requirements of regional manufacturing upgrading.

2. Literature Review

2.1. The Phenomenon of Skills Mismatch in Fashion Education

The inadequate adaptability of the fashion education system to industrial technological transformations constitutes the core cause of the skills mismatch. The integration of digital twins, virtual supply chain visibility, and the application of eco-intelligent decision support systems have significantly propelled sustainable supply chain innovation in modern factories, thereby imposing higher demands on the dynamic adaptive capabilities within organizations (Abdullah et al., 2026). The penetration of Industry 4.0 technologies has driven a profound transformation in manufacturing paradigms; however, during the transition phase toward intelligent manufacturing, the industry continues to encounter multiple adoption barriers, including workforce readiness (Mahmood et al., 2025). Indeed, the digital transformation of the industry urgently necessitates workforce reskilling to accommodate emerging technologies such as 3D virtualization (Casciani et al., 2022). Nevertheless, the curricular architecture in numerous higher education institutions remains confined to traditional “top-down” design education paradigms (Lam et al., 2022).

The disconnect between pedagogical content and the practical imperatives of the industrial frontline further exacerbates the contradiction between talent supply and demand (Hegde & Kavade, 2025). Current fashion education syllabi exhibit a significant misalignment with actual industry needs concerning resource allocation, leading to a pervasive predicament wherein students lack sufficient practical training opportunities and access to industry-specific digital tools (Ademtsu & Pathak, 2023). This imbalance in knowledge structure, coupled with lagging curricular systems, results in graduates frequently lacking critical workplace competencies and the capacity to adapt to continuously evolving industrial demands when confronted with authentic manufacturing environments (Hegde & Kavade, 2025). The inconsistency in competency standards between the educational and manufacturing sectors severely constrains the mobility of graduates within complex supply chain networks.

The skills mismatch is further manifested in the disconnect between digital operational capabilities and comprehensive workplace proficiencies (soft skills) (Bremner, 2017). Although digital technologies present the possibility of dematerialized production, students lacking empirical training find it difficult to navigate the resulting business model innovations and sustainable development transitions (Casciani et al., 2022). Existing pedagogical paradigms typically emphasize theoretical indoctrination, lacking a dynamic mechanism for

knowledge co-creation facilitated through in-depth industry-education collaboration (Lam et al., 2022). This profound supply-demand misalignment not only inflates the recruitment and training costs for enterprises but also, due to a deficiency in highly skilled labor and complementary skill structures, undermines the path-breaking capabilities of regional manufacturing sectors amidst technological evolution (Zhou et al., 2025).

2.2. Industry-Education Integration and Stakeholder Engagement

Constructing a co-evolutionary skills ecosystem is critical for narrowing the talent gap. Integrating industry employers as core stakeholders into the curriculum development process can effectively align educational objectives with market demands (Hegde & Kavade, 2025). Co-design, conceptualized as a relational practice, is capable of dismantling information silos between academia and industry (Zeivots et al., 2025). Through the joint participation of educators, students, and industry representatives, more forward-looking and pragmatic syllabi can be developed. This multi-stakeholder governance model contributes to the enhancement of educational quality.

Work-based learning (WBL), as a mature pedagogical approach, demonstrates significant advantages in enhancing graduates' employability (Ferns et al., 2025). By facilitating instruction within authentic or simulated professional environments, this paradigm fortifies students' professional competencies and vocational socialization (Jackson et al., 2025). Unlike traditional, unstructured internships, modern WBL emphasizes the execution of standardized assessments based on explicit learning contracts within real production environments. Integrating factory practices and practical experiences into the curriculum can truncate the transition period from the educational institution to the manufacturing floor (Appiah, 2023).

Curriculum co-creation not only amplifies learner engagement but also reshapes the culture of the professional domain. Learners assuming a proactive role in curriculum formulation facilitate the cultivation of a more inclusive and agile pedagogical environment (Stoddard et al., 2025). This bidirectional feedback mechanism ensures that instructional content is dynamically calibrated in response to industrial technological advancements. Effective industry-education integration necessitates policy advocacy, financial investment, and robust cross-institutional collaboration. Only through profound resource sharing and mutual accountability can professionals be cultivated to meet future industrial challenges (Curto-Reverte et al., 2025).

Although existing literature has extensively debated the phenomenon of skills shortages, the majority of research has focused on macro-level industry trends or generalized labor market policies. However, because the evolution of regional industries is highly contingent

upon local skill endowments and their complementarities (Zhou et al., 2025), macro-level studies often struggle to precisely elucidate the specific skill bottlenecks encountered by frontline practitioners during production transformations. Consequently, contemporary academia has increasingly emphasized micro-empirical research targeting manufacturing clusters within specific geographical regions, aiming to explore the authentic impact of agglomeration effects on skills supply and demand (König & Brenner, 2025).

Existing evaluations of fashion education are predominantly predicated on academically driven curriculum reviews, lacking empirical studies that directly elicit feedback from the production frontline. The authentic voices from the factory floor can provide the most direct evidence regarding competency gaps. Currently, there is a paucity of literature conducting micro-level qualitative explorations of regional manufacturing hubs. This study aims to bridge this research gap by directly decoding the demands of manufacturing enterprise managers and technical supervisors through focus group methodology. Analyzing voices from the frontline provides concrete empirical support for local higher education institutions to formulate highly aligned fashion education curricula. Such micro-perspective explorations hold irreplaceable value for optimizing the regional talent supply structure.

3. Methodology

3.1. Research Design

This study adopts a qualitative research design. Qualitative methodologies are particularly well-suited for extracting in-depth empirical insights within specific industrial contexts. The research objective is to objectively delineate the authentic capability requirements of the regional apparel manufacturing industry by analyzing transcripts from industry meetings conducted in naturalistic settings. This design circumvents the inherent limitations and rigidities of pre-established quantitative questionnaires, thereby ensuring the objectivity and exploratory nature of the data. The research is fundamentally focused on elucidating the current pain points and workforce expectations of the industry.

3.2. Data Collection

Data were derived from the textual records of a regional apparel industry symposium convened in Henan Province in December 2025. To comply with corporate confidentiality and data anonymization protocols, specific institutional identifiers and exact participant counts have been redacted. The attendees constituted a purposive sample of key informants, primarily comprising management personnel and technical supervisors from representative regional apparel manufacturing enterprises. The core agenda of the symposium centered on

the enterprises' current operational status, the technological challenges encountered, and specific labor demands. The raw data took the form of detailed field notes and textual records generated during the symposium. This data collection modality enabled the direct capture of authentic voices from the factory floor.

3.3. Data Analysis

This study applied thematic analysis to process the collected symposium records. The analytical procedure commenced with a comprehensive reading of the entirety of the textual records to achieve data familiarization. Subsequently, qualitative data analysis (QDA) software was utilized to facilitate the extraction of core keywords and the execution of initial open coding. The voluminous textual data were systematically disaggregated, compared, and categorized. The analytical process iteratively consolidated preliminary textual codes into specific skill requirement categories. Ultimately, the coding outcomes were synthesized into several core themes, thereby accurately reflecting the authentic competency gaps currently confronting the manufacturing frontline.

4. Results

The textual records from the regional apparel industry symposium were systematically processed utilizing qualitative data analysis (QDA) software. The analytical procedure involved the extraction of core nodes and the completion of data coding. The textual coding outcomes are structurally presented via a thematic matrix. **Table 1**, positioned at the beginning of this section, visually delineates the specific competency gaps and operational pain points currently confronting manufacturing enterprises.

Table 1

Coding Matrix of Core Pain Points and Skill Demands in Regional Apparel Manufacturing

Core Theme	Key Coding Node	Empirical Frontline Transcripts (Illustrative Quotes)
Systems Engineering and Process Standardization	Absence of Process Standardization	<ul style="list-style-type: none"> • “There is a lack of automation for trousers domestically, primarily due to the excessive variations in trouser products.” • “The prerequisite for intellectualization, AI integration, and informatization is process standardization.”
		<ul style="list-style-type: none"> • “Initial orders often follow a small-batch model of 100 to 150 pieces.” • “With total order volumes reaching 10 million USD, there is a substantial deficit in in-house production capacity, necessitating the search for lower-cost
Flexible Production and Supply Chain Management	Production Capacity Mismatch	

Omnichannel Marketing and Cost Control	Business Model Restructuring	<p>contract manufacturers in inland regions.”</p> <ul style="list-style-type: none"> • “The return rate is as high as 60%.” • “Online operational costs constitute approximately 25% of the total costs.” • “We plan to expand to 30 live-streaming studios next year.”
Exclusionary Effect of Manufacturing Environments on Talent	Outflow of Core Functions	<ul style="list-style-type: none"> • “There is a severe shortage of ERP personnel and systems engineers.” • “Talents leave immediately upon realizing it is a factory setting.” • “The design and marketing departments have already been relocated to Hangzhou.”

4.1. Deficit in Systems Engineering and Process Standardization Capabilities

The transition toward intelligent manufacturing necessitates that enterprises establish a robust foundation of standardized operations. Feedback from frontline enterprises explicitly indicates that process standardization is the fundamental prerequisite for achieving the intelligentization and informatization of apparel production. Highly complex product variations severely impede the widespread adoption of automated equipment. Specifically, excessive stylistic variations in trouser products have resulted in a current absence of mature automation solutions within the domestic market. During the advancement of digital transformation, enterprises confront a severe shortage of systems engineering talent. The manufacturing floor exhibits an acute deficit of engineers capable of maintaining and optimizing Enterprise Resource Planning (ERP) systems. **Figure 1** illustrates the logical chain of upgrading dilemmas induced by non-standardized operations.

Figure 1

The Logic Chain of Manufacturing Upgrade Dilemmas Caused by Lack of Standardization

Current fashion education syllabi broadly lack training in systems engineering paradigms.



Students are unable to translate fragmented technical craftsmanship knowledge into standardizable production directives. This cognitive disconnect renders it exceedingly difficult for new employees to meaningfully participate in the digital and intelligent upgrading processes of factories. The inability to standardize internal production directives further constrains an enterprise's capacity to orchestrate external production networks.

4.2. Deficit in Flexible Production and Global Supply Chain Restructuring Skills

Regional manufacturers are currently enduring highly complex supply chain management pressures. Frontline data reveal a profound contradiction between small-batch flexible orders and intelligentized scalable production. For certain enterprises, initial orders consist of a mere 100 to 150 units. This small-batch paradigm is inherently incompatible with intelligent manufacturing systems that strive for economies of scale. A substantial gap exists between the internal production capacity of enterprises and the massive volume of outsourced orders. Enterprises with annual order volumes reaching 10 million USD are compelled by intrinsic capacity constraints to seek cross-regional contract manufacturers. Furthermore, the severe volatility of international tariff policies obliges enterprises to restructure their global supply chain configurations. A tariff surge from 15.3% to 53% has precipitated strategies wherein semi-finished goods are exported to Southeast Asia for subsequent re-export.

In-depth virtual supply chain management demands dynamic organizational adaptability from enterprises (Abdullah et al., 2026). However, the fashion education system lacks practical training regarding transnational supply chain orchestration and capacity auditing. Graduates are ill-equipped to navigate the complexities of modern manufacturing networks. Beyond the complexities of supply chain orchestration, manufacturers are also compelled to directly navigate the highly volatile digital retail space to sustain profitability.

4.3. Disconnect in Omnichannel Digital Marketing and Cost Control Proficiencies

Traditional manufacturing enterprises are intensively reconfiguring their business models and distribution channels. The adoption of digital technologies has catalyzed polycentric business model innovations (e.g., decentralized distribution networks and multi-platform digital presences) (Casciani et al., 2022). Enterprises are deploying live-streaming matrices on a massive scale, strategically funneling online traffic to brick-and-mortar stores. The proliferation of live-streaming studios underscores the urgency of omnichannel marketing. Amidst this transition, persistently high product return rates have emerged as the primary factor eroding corporate profit margins. For specific enterprises, return rates peak at an alarming 60%, while online operational costs currently constitute approximately 25% of total

expenditures. To circumvent the high-inventory predicament, enterprises urgently require interdisciplinary talent possessing sophisticated brand positioning and specialized sales competencies. Conversely, the design talent cultivated under current syllabi is predominantly aesthetic-centric. Graduates subsequently lack the practical capabilities necessary to execute complex commercial conversions and rigorous cost accounting.

However, whether driving omnichannel marketing or intelligent manufacturing upgrades, these transitions are ultimately hindered by the foundational talent retention challenges within the regional labor market.

4.4. Exclusionary Effect of the Regional Manufacturing Environment on Technical Personnel

Attracting and retaining a professionally skilled workforce constitutes a structural challenge for regional industries. **Figure 2** delineates the network relationship between the regional manufacturing environment and core talent attrition. Empirical records indicate that job seekers manifest a pronounced aversion when confronted with authentic factory production environments. Consequently, the manufacturing floor encounters prolonged recruitment bottlenecks for pattern makers and systems management personnel. To circumvent this localized talent scarcity, leading manufacturing enterprises are compelled to wholesale relocate their research and development (R&D) and marketing centers to advanced metropolitan areas such as Hangzhou. This geographical displacement of functional departments further exacerbates the skills drain within regional manufacturing hubs. Given that the evolution of regional industries is highly contingent upon local skill endowments and their complementarities (Zhou et al., 2025), the absence of effective mechanisms for real-world industrial immersion deprives students of necessary psychological preparedness for authentic workshop conditions. The pedagogical system has ultimately failed to cultivate professional talent equipped with a robust vocational identification with the regional manufacturing environment.

Figure 2

Hierarchical Regression Analysis for Social Impairment (N = 412)



5. Discussion & Implications

5.1. Discussion of Findings

The findings reflect a significant structural deviation between the transformational demands of the regional apparel manufacturing industry and current fashion educational objectives. The frontline factory emphasis on process standardization and systems engineering capabilities reveals a qualitative shift in the fundamental competency requirements for the labor force driven by intelligent manufacturing. This aligns highly with the global manufacturing trend toward digitalization and high-efficiency upgrading. However, contemporary higher education remains excessively focused on artistic and emotional expression, resulting in a deficit of viable solutions among students when confronting complex technical problems in authentic industrial production. The practical imperatives of flexible production and global supply chain management further amplify this competency gap. Transnational production orchestration and precise cost accounting have emerged as core competitive advantages for enterprises; nevertheless, the absence of commercial logic within the educational system engenders a severe misalignment between talent supply and market demand. The business model transformations triggered by omnichannel marketing necessitate that practitioners possess a comprehensive literacy bridging technology, design, and commercial transformation, rather than a singular proficiency in aesthetic design.

The exclusionary effect of the regional manufacturing environment on talent is, at its core, a disconnect in vocational identification and the comprehension of authentic industrial realities. Due to the absence of authentic workshop operational logic incorporated into the pedagogical process, students harbor cognitive biases regarding technical roles within the manufacturing transformation process. This bias directly precipitates recruitment bottlenecks

for core technical positions and the outward migration of R&D functions. Furthermore, alongside these hard technical deficits, successfully navigating these complex factory environments fundamentally requires resilient communication and teamwork competencies (soft skills) to truly bridge the vocational identification gap. The findings demonstrate that merely elevating students' aesthetic capabilities is insufficient to sustain the leapfrog development of regional economies; the pedagogical fulcrum must pivot toward industrial practice and commercial viability.

5.2. Pedagogical Interventions and Curriculum Optimization

To narrow the talent supply-demand gap, this study proposes a curriculum optimization framework predicated on the logic of “industry-education co-creation.”

Recommendation 1 entails integrating authentic factory specification sheets and technical packages into studio assessments. Course evaluations must dismantle assessment criteria solely centered on visual effects. Design studio modules must mandate students to submit comprehensive, industrial-grade technical documentation, encompassing bill of materials (BOM), waste rate calculations, sewing process routings, and precise unit cost accounting reports. Through compulsory standardized documentation training, students' capacities to translate creativity into quantifiable production directives are cultivated. Within the final course grading rubric, the evaluation weight assigned to the accuracy and viability of these industrial-grade technical documents should be at least equal to that of visual aesthetic performance, thereby compelling students to prioritize engineering logic. Assessment rubrics should be co-developed by academic tutors and factory technical supervisors to ensure the industrial feasibility of students' design proposals.

Recommendation 2 involves establishing intensive work-based learning (WBL) modules. The graduation phase must be tightly integrated with localized, authentic supply chain conditions. Higher education institutions should require students to immerse themselves in regional manufacturing hubs, utilizing local factory production lines and raw material resources to finalize their project developments. Curriculum design should encompass cross-regional supply chain management practices, requiring students to simulate navigating the equilibrium between small-batch flexible orders and mass production. Through authentic immersion in real-world manufacturing environments, students' vocational identification with modern workshop operations is enhanced, thereby mitigating the psychological push-back effect during the job-seeking process. Educational syllabi must incorporate practical modules such as Enterprise Resource Planning (ERP) system operations and digital marketing cost

control to ensure that talent cultivation profiles precisely align with the digital and intelligent transformational demands of enterprises.

5.3. Limitations of the Study

The data source for this study is exclusively predicated on regional industry symposium transcripts within a specific timeframe, with the sample coverage primarily concentrated on representative apparel enterprises in Henan Province. Given the limited number of participating enterprises and distinct regional characteristics, the generalizability of the findings to manufacturing industries with different typologies or in distinct geographical regions requires further empirical validation. For instance, future comparative studies could contrast the skills expectations of emerging inland manufacturing clusters with those of mature coastal manufacturing hubs. Future research should broaden the investigatory scope and conduct large-scale quantitative analyses or longitudinal tracking studies to explore the sustained impact of curriculum reform on enhancing regional manufacturing competitiveness.

6. Conclusion

This study addresses the critical skills mismatch between higher fashion education and regional manufacturing upgrading. By conducting a thematic analysis of authentic textual records from the frontline of the apparel industry, the research accurately decodes the contemporary competency demands of modern factories. The findings reveal a profound deficit in systems engineering, global supply chain management, and omnichannel marketing capabilities among current graduates. The results demonstrate that traditional aesthetic-driven pedagogical paradigms are inadequate for the digital transformation of regional manufacturing. To bridge this divide, higher education institutions must implement curriculum co-creation strategies. Integrating industrial-grade technical documentation into academic assessments and establishing intensive work-based learning modules are essential interventions. This micro-empirical investigation provides actionable evidence for realigning educational objectives with industrial realities. The proposed curriculum restructuring framework effectively enhances workforce readiness and sustains the long-term competitiveness of regional manufacturing hubs.

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Data Availability

No datasets were generated or analysed during the current study.

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The authors declare that there is no Conflict of interest.

Ethics approval

Not applicable.

Consent to participate

Not applicable.

Consent for publication

All authors have given their consent.

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