Evaluating the Effectiveness of E-commerce Talent Cultivation in Higher Vocational Education from the Perspective of Industry-Education Integration: Model Construction and Empirical Research

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Abstract:
In the digital economy era, higher vocational e-commerce talent cultivation faces the severe challenge of a structural mismatch with industrial demands. Grounded in the institutional context of industry-education integration, this study systematically investigates the evaluation and optimization of e-commerce talent cultivation effectiveness in higher vocational education by comprehensively employing methods such as text mining, grounded theory, questionnaire surveys, factor analysis, the Analytic Hierarchy Process (AHP), and the Fuzzy Comprehensive Evaluation (FCE) method. Initially, based on a large sample of job advertisement text analysis and small-scale expert interviews, and through item analysis, exploratory and confirmatory factor analysis, this study constructs a job skill model for higher vocational e-commerce talents, which demonstrates good reliability and validity. Subsequently, through textual analysis of talent cultivation programs from over ten higher vocational colleges, it reveals structural matching characteristics between the curriculum system and the skill model, specifically: "strong in fundamentals, weak in integration," "strong in operation, weak in decision-making," and "strong in domestic focus, weak in cross-border focus." Finally, an empirical evaluation was conducted targeting interns from Yunnan Technical College of Industry, revealing that students' overall skill levels are below average, presenting an imbalanced state characterized by "acceptable operational skills but weak strategic skills." The vocational skill model and evaluation framework constructed in this study provide a scientific theoretical tool and practical pathway for higher vocational colleges to accurately diagnose talent cultivation effectiveness and deepen industry-education integration.
Keywords: industry-education integration; higher vocational education; e-commerce; talent cultivation effectiveness; vocational skill model; fuzzy comprehensive evaluation

1. Introduction

The digital economy is reshaping the global economic landscape with immense force. As one of the most profoundly transformed fields and most closely integrated with the real economy, e-commerce has evolved from mere online transactions into a complex industrial ecosystem encompassing multiple dimensions such as artificial intelligence (AI), big data analytics, immersive live streaming, and cross-border digital trade. In 2025, China's e-commerce transaction volume exceeded 48 trillion yuan, with new business formats like cross-border and live streaming growing at an average annual rate of over 25%, creating an annual talent gap of approximately 3 million. However, in stark contrast to the rapid transformation on the industry side, the talent cultivation side faces increasingly severe challenges—45% of enterprises report that graduates suffer from "skills lagging behind industry developments, requiring an adaptation period of over three months." This structural mismatch has become a key bottleneck restricting the high-quality development of the industry.

Vocational education, as the main battlefield for cultivating technical and skilled talents, bears the mission of delivering high-quality e-commerce talents for the digital economy[1]. In 2026, the "Opinions on Deepening the Reform of Key Elements in Vocational Education Teaching" issued by the Chinese Ministry of Education explicitly stated the need to "focus on solving the problems of disconnection between vocational education and industries, relatively closed schooling, and inadequate adaptability and compatibility, promoting school-enterprise cooperation in running schools, cultivating talents, cooperating in employment, and cooperative development." Against this backdrop, industry-education integration has risen from a conceptual advocacy to a national institutional arrangement, becoming a core pathway to address talent cultivation challenges[2]. Practical explorations in vocational colleges in cities such as Nanjing, Chongqing, and Qingdao demonstrate that through innovative approaches like jointly establishing industry colleges, restructuring curriculum systems, and building dual-qualification teaching teams, the precise matching of talent cultivation with job requirements is gradually becoming a reality.

Nevertheless, upon deep examination of current practices in e-commerce talent cultivation within higher vocational education, we still face a series of fundamental questions that urgently need answers: Given the drastic changes in industrial demands, what core, measurable job skills should higher vocational e-commerce talents possess? To what extent does the existing curriculum system support the development of these skills? What is the actual gap between students' skill levels and job requirements? These inquiries all point to the same core issue: how to scientifically evaluate and effectively enhance the effectiveness of talent cultivation within the context of industry-education integration.

Existing literature explores these questions from multiple perspectives. In the field of industry-education integration research, scholars have systematically elucidated its conceptual evolution, policy development, and practical pathways, revealing the paradigm shift from "school-enterprise cooperation" to "industry-education integration." In the field of higher vocational talent cultivation research, researchers have conducted in-depth analyses of talent cultivation models, quality evaluation, and the matching between talent cultivation and industrial demands[3]. Within the e-commerce discipline, scholars have focused on innovations in talent cultivation models, curriculum system construction, and analysis of job competency structures.

However, existing research still has three limitations. First, much of the research remains at the level of phenomenon description and empirical summarization, lacking quantitative diagnosis of the specific dimensions and degrees of "skill mismatch." Judgments such as "outdated curriculum" or "insufficient capabilities" are often based on qualitative observations and lack empirical validation based on data. Second, research perspectives often focus on a single level—either curriculum, faculty, or practical training—lacking a holistic analysis that views talent cultivation as an organic system[4]. While industry-education integration emphasizes "systemic integration," research often proceeds in a "fragmented" manner. Third, the concept of "job competency" used in research is often vague, lacking specific, measurable, and evaluable indicator systems[5]. This makes it difficult to compare conclusions across different studies and hinders the accumulation of research knowledge.

Driven by deep concern for these issues, this study has initiated a systematic exploration, comprehensively employing multiple research methods such as text mining, grounded theory, questionnaire surveys, factor analysis, AHP, and FCE, striving to achieve breakthroughs in the following areas: First, construct an empirically validated job skill model for higher vocational e-commerce talents, providing a scientific "competency yardstick" for measuring the quality of talent cultivation; Second, using this model as a benchmark, systematically evaluate the degree of matching between the current curriculum system and job skill requirements, accurately identifying strengths and weaknesses in curriculum design; Third, apply this model to empirically evaluate interns, diagnosing the imbalance in students' skill

levels and providing data support for the precise optimization of cultivation programs.

2. Research Design

2.1 Theoretical Framework

This study is guided by Competency-Based Education (CBE) theory as its core. This theory establishes "vocational competence" as the central coordinate for talent cultivation, achieving a paradigm shift from "what is taught" to "what is learned." In the field of e-commerce, this vocational competence manifests as a three-dimensional structure: technical operation dimension, business management dimension, and innovation development dimension. CBE theory introduces revolutionary innovations in evaluating learning outcomes, emphasizing that competencies must be verified through observable and measurable behavioral performances, which provides a methodological foundation for constructing a quantitative evaluation model in this study.

Simultaneously, this study introduces systems theory concepts, viewing talent cultivation as an organic system composed of multiple subsystems including curriculum design, faculty, practical training conditions, and evaluation mechanisms. Bertalanffy's principle that "the whole is greater than the sum of its parts" holds significant implications in vocational education: the effectiveness of e-commerce talent cultivation is not a simple arithmetic sum of elements like curriculum, faculty, and practical training, but rather the synergistic effect generated by the non-linear interactions among these elements under the mechanism of industry-education integration. This perspective necessitates research that focuses on the matching and synergy between various elements, rather than analyzing single factors in isolation.

The theory of vocational education and industry synergistic development provides a macro-level institutional background analysis framework for this study. Its essence lies in constructing a dynamic equilibrium relationship between the education system and the industrial economy, emphasizing the systemic symbiosis formed between educational and industrial entities through the exchange of resource elements. In the e-commerce field, this theory requires that talent cultivation must remain synchronized with industrial technology iteration and job competency evolution, achieving an organic connection between the education chain and talent chain with the industrial chain and innovation chain.

2.2 Research Approach

This study follows the logical path of "theoretical construction – current situation examination – model construction – matching analysis – empirical evaluation," comprehensively employing various research methods to form a complete cycle that originates from industry practice and returns to empirical testing.

Phase 1: Skill Element Extraction and Initial Model Construction. First, using a self-developed web crawler, job advertisements for e-commerce positions nationwide over a 365-day period were crawled from four major recruitment websites: "BOSS Zhipin," "Zhaopin," "51job," and "Liepin." After screening, valid advertisements were retained, and "skill requirements" information was extracted. Second, 30 experts who simultaneously met three criteria ("engaged in e-commerce work for no less than 10 years," "served as senior management or senior technical personnel for no less than 5 years," and "undertook external teaching duties at higher vocational colleges for no less than 5 years") were invited to participate in semi-structured in-depth interviews, averaging 150 minutes per person. Using NVivo 15 software, a three-level coding process based on grounded theory was applied to the interview transcripts to construct an initial skill indicator system.

Phase 2: Empirical Testing and Structural Optimization of the Model. A questionnaire was designed based on the initial indicator system, using a 5-point Likert scale. A total of 1,000 questionnaires were distributed, 537 were returned, and 406 valid questionnaires were retained after excluding invalid ones. The 406 valid questionnaires were

randomly split into two halves, each with 203 samples. SPSS 26.0 was used for item analysis and Exploratory Factor Analysis (EFA) on the first half of the data, while AMOS 25 was used for Confirmatory Factor Analysis (CFA) on the second half, along with reliability and validity testing.

Phase 3: Matching Analysis between Curriculum System and Skill Model. A systematic textual analysis was conducted on the e-commerce talent cultivation programs of 12 higher vocational colleges in China (covering various types such as comprehensive, science and engineering, and business-oriented institutions). The curriculum system was compared item by item with the finalized skill model to assess the degree of matching from three dimensions: coverage breadth, support depth, and competency level.

Phase 4: Empirical Evaluation of Talent Cultivation Effectiveness. Ten senior executives from a large e-commerce company were invited to evaluate 18 interns from the 2023 cohort of the E-commerce major at Yunnan Technical College of Industry, using the "Higher Vocational E-commerce Talent Core Job Skills Evaluation Scale" developed in this study. The Analytic Hierarchy Process (AHP) was used to determine indicator weights, and the Fuzzy Comprehensive Evaluation (FCE) method was used to diagnose skill levels.

3. Construction of a Job Skill Model for Higher Vocational E-commerce Talents

3.1 Extraction of Skill Elements and Initial Model Construction

Based on the textual analysis of 736 job advertisements, a total of 33 high-frequency skill points were summarized. The top five in frequency were "category planning and pricing design," "marketing tool promotion," "page design and content creation," "transaction and marketing data analysis," and "basic knowledge of economic management." These high-frequency skill points reflect the urgent needs of enterprises for e-commerce talents in areas such as operations, marketing, data analysis, and basic management.

Based on in-depth interviews with 30 experts, a three-level coding process using grounded theory was conducted with NVivo 15 software. During the open coding phase, through line-by-line reading and segmentation of meaning units from the original interview transcripts, a total of 74 free nodes were formed. During the axial coding phase, these 74 free nodes were summarized into 28 tree nodes through cluster analysis. During the selective coding phase, 13 core categories were further distilled. These 13 core categories can be divided into two types: one type comprises core job skills (Z1 Product and Service Information Management, Z2 Online Store Design and Decoration, Z3 Marketing Promotion, Z4 Business Processing, Z5 Customer Service, Z6 Business Data Analysis, Z7 Management and Planning), and the other type comprises general job skills (Z8 Professional Legal and Safety Literacy, Z9 Basic Tools and Digital Literacy, Z10 Business Communication and Professional Expression, Z11 Basic Knowledge of Economic Management, Z12 Innovation and Career Development Capability, Z13 Comprehensive Practice and Project Execution). Specific results are shown in Tables 1 and 2.

Table 1: Results of Open Coding Tree Node Formation

Tree Node	Free Node
Y1 Graphic and Multimedia Material Collection & Processing	X1 Basic Entry and Shooting; X2 Content Collection and Shooting Coordination; X3 Category Planning and Pricing
Y2 Product Information Strategy & Price	X4 Category Planning and Pricing Strategy; X5 Product Portfolio Optimization

Tree Node	Free Node
Management	
Y3 Store Basic Setup & Product Listing	X6 Store Registration and Product Listing; X7 Cross-border Store Setup and Listing
Y4 Decoration Elements & Page Design Production	X8 Online Store Content Design and Decoration; X9 Visual Element Design; X10 Store Style and Color Scheme Design; X11 Visual Style and Layout Optimization
Y5 Visual Marketing & Store Planning	X12 Visual Marketing and Store Planning
Y6 Content & Social Channel Promotion	X13 Content Publishing and Live Interaction; X14 Promotion and Live Event Planning; X15 Marketing Tool Application; X16 Overseas Social Media and Cross-border Live Streaming; X17 Cross-border Marketing Strategies and Plans; X18 Team Building and Omni-channel Marketing
Y7 Paid Traffic & Search Engine Promotion	X19 Keyword Optimization and Bidding Promotion; X20 Foreign Language Lexicon and International Search Promotion
Y8 Order & Logistics Operations	X21 Order Inquiry and Shipping; X22 Cross-border Order and Shipping; X23 Shipping, Return, and Exchange Processing; X24 Order Anomalies and Cross-border Logistics Costing
Y9 Supply Chain & Product Management	X25 Product Listing and Delisting Management; X26 Store Maintenance and Cross-border Product Selection; X27 Replenishment Planning and Data Management; X28 Procurement Planning and Warehouse Logistics; X29 Cross-border Operations and Fulfillment Strategy
Y10 Cross-border E-commerce Operations & Fulfillment	X30 Cross-border Transaction and Order Management; X31 Cross-border Logistics and Integrated Services
Y11 Customer Reception, Communication & Issue Resolution	X32 Customer Reception and Issue Resolution; X33 Foreign Language Cross-border Communication
Y12 Customer Relationship Management & Intelligent Service	X34 Intelligent Customer Service and Customer Segmentation; X35 Frequently Asked Questions (FAQ) Library Setup; X36 Community Operations and Loyalty Strategy; X37 Cross-border Disputes and Differentiated Marketing

Tree Node	Free Node
Y13 Data Acquisition & Processing	X38 Basic Operational Data Acquisition; X39 Operational and Industry Data Collection and Cleaning
Y14 Data Analysis, Visualization & Reporting	X40 Tool Selection and Model Building; X41 Data Visualization Reports; X42 Transaction and Marketing Data Analysis; X43 Competition and Customer Data Analysis; X44 Project and Financial Analysis Reports; X45 E-commerce Model Analysis and Reporting
Y15 Technical Management & Training	X46 Job Task Coordination and Assessment; X47 Personnel Training and Evaluation; X48 Organizational Structure and Job Planning; X49 Job Training Plan Development
Y16 E-commerce Strategy & Models	X50 Industry Analysis and Strategic Planning
Y17 Professional Ethics & Legal Awareness	X51 Professional Ethics Practice; X52 Laws and Regulations Compliance
Y18 Security & Risk Prevention	X53 Network Security Protection; X54 Emergency Incident Handling
Y19 Information Technology Application Ability	X55 Office Software Application; X56 AI Application Understanding
Y20 Digital Content Basic Processing	X57 Basic Image Editing; X58 Basic Video Processing
Y21 Language & Communication Skills	X59 Chinese Business Communication and Writing; X60 English E-commerce Communication and Reading
Y22 Business Etiquette & Service Awareness	X61 Professional Etiquette Norms; X62 Customer Needs Understanding and Service
Y23 Economic & Market Understanding	X63 Understanding of E-commerce Economic Principles; X64 Market Structure and Business Logic
Y24 Financial & Cost Awareness	X65 Understanding of E-commerce Finance and Taxation; X66 Cost Accounting and Budget Control

Tree Node	Free Node
Y25 Innovative Thinking & Entrepreneurial Awareness	X67 E-commerce Project Conception and Planning; X68 Project Simulation and Feasibility Assessment
Y26 Career Planning & Development Ability	X69 Career Path Planning; X70 Practical Reflection and Capability Enhancement
Y27 Project Execution & Team Collaboration	X71 Team Role Assumption and Task Completion; X72 Project Process Understanding and Collaborative Promotion
Y28 Practical Reflection & Outcome Output	X73 Project Report Writing; X74 Results Presentation and Defense

Table 2: Selective Coding Results

Core Category	Subordinate Tree Nodes
Z1 Product and Service Information Management	Y1, Y2
Z2 Online Store Design and Decoration	Y3, Y4, Y5
Z3 Marketing Promotion	Y6, Y7
Z4 Business Processing	Y8, Y9, Y10
Z5 Customer Service	Y11, Y12
Z6 Business Data Analysis	Y13, Y14
Z7 Management and Planning	Y15, Y16
Z8 Professional Legal and Safety Literacy	Y17, Y18
Z9 Basic Tools and Digital Literacy	Y19, Y20
Z10 Business Communication and Professional Expression	Y21, Y22
Z11 Basic Knowledge of Economic Management	Y23, Y24
Z12 Innovation and Career Development Capability	Y25, Y26

Core Category	Subordinate Tree Nodes
Z13 Comprehensive Practice and Project Execution	Y27, Y28

3.2 Empirical Testing and Structural Optimization of the Model

3.2.1 Item Analysis

The extreme group comparison method was used for item analysis on the core skill sub-indicator system within the initial indicator system. Samples ranking in the top 27% of the total questionnaire score were designated as the high-scoring group, and those in the bottom 27% as the low-scoring group. An independent samples t-test was conducted. The results showed that p-values for the four indicators "X12," "X35," "X46," and "X50" were greater than 0.05, failing to reach significance, indicating insufficient discriminative power; thus, they were deleted. The remaining 70 indicators passed the discriminative power test ($p<0.01$, $t>3.5$).

3.2.2 Exploratory Factor Analysis (EFA)

EFA was conducted on the remaining indicators. The KMO value was 0.891, and Bartlett's Test of Sphericity yielded an approximate chi-square of 7583.217 (df=1035, p=0.000), indicating the data was highly suitable for factor analysis. Using principal component analysis with an initial criterion of eigenvalues greater than 1, combined with the scree plot suggestion, six factors were extracted, and varimax orthogonal rotation was applied. After rotation, a total of 29 indicators with low loadings or severe cross-loadings were deleted, ultimately retaining 41 indicators. These 41 indicators could be clearly classified into 6 factors, with a cumulative variance contribution rate of 68.7%.

Based on the core connotations of the indicators within each factor, the initial framework was restructured and renamed, forming a new six-dimensional structure: Factor 1 was named "Product and Visual Management," Factor 2 was named "Store Building and Visual Design," Factor 3 was named "Marketing Promotion and Traffic Operations," Factor 4 was named "Order and Supply Chain Management," Factor 5 was named "Customer Service and Relationship Maintenance," and Factor 6 was named "Business Data Analysis and Application."

3.2.3 Confirmatory Factor Analysis (CFA)

CFA was performed on the six-factor structure derived from EFA using data from the other half of the 203 questionnaires. The overall model fit indices showed: $\chi^2/df = 2.18$ (<3 indicates good fit), RMSEA = 0.062 (<0.08 indicates good fit), CFI = 0.941 (>0.9 indicates good fit), TLI = 0.932 (>0.9 indicates good fit), SRMR = 0.048 (<0.08 indicates good fit). All key indices met or exceeded accepted standards, indicating a good fit between the model and the data.

The internal quality test results showed: standardized factor loadings of all observed indicators on the latent variables ranged from 0.63 to 0.86, all significant at the $p<0.001$ level. The Composite Reliability (CR) for each dimension ranged from 0.84 to 0.90, all exceeding the standard of 0.7; the Average Variance Extracted (AVE) ranged from 0.51 to 0.60, all exceeding the standard of 0.5, indicating good convergent validity. Discriminant validity tests showed that the square root of AVE for each latent variable (ranging from 0.71 to 0.77) was greater than the correlation coefficients between that latent variable and others (the highest being 0.62), indicating sufficient discriminant validity among dimensions.

3.2.4 Reliability and Validity Testing

Cronbach's α coefficients were calculated for the final 6 dimensions and the total scale. The results showed: Product and Visual Management dimension $\alpha=0.872$, Store Building and Visual Design dimension $\alpha=0.891$, Marketing Promotion and Traffic Operations dimension $\alpha=0.901$, Order and Supply Chain Management dimension $\alpha=0.858$,

Customer Service and Relationship Maintenance dimension α=0.845, Business Data Analysis and Application dimension α=0.886, and the total scale α=0.934. All α coefficients were above 0.84, and the total scale α coefficient reached as high as 0.934, indicating the scale has extremely high measurement reliability and stability.

3.3 Final Model Structure

After the systematic testing and optimization described above, the finalized official version of the job skill model for higher vocational e-commerce talents consists of two major modules: core skills and general skills (see Table 3).

Table 3: Official Job Skill Model for Higher Vocational E-commerce Talents

Primary Indicator	Secondary Indicator	Tertiary Indicator
A Product & Visual Management	A1 Graphic Material Collection & Processing	A11 Basic Entry and Shooting; A12 Content Collection and Shooting Coordination
	A2 Product Information & Pricing Strategy	A21 Category Planning and Pricing Strategy; A22 Product Portfolio Optimization
B Store Building & Visual Design	B1 Store Basic Setup & Listing	B11 Store Registration and Product Listing; B12 Cross-border Store Setup and Listing
	B2 Decoration Elements & Page Design	B21 Online Store Content Design and Decoration; B22 Visual Element Design; B23 Store Style and Color Scheme Design; B24 Visual Style and Layout Optimization
C Marketing Promotion & Traffic Operations	C1 Content & Social Promotion	C11 Content Publishing and Live Interaction; C12 Promotion and Live Event Planning; C13 Marketing Tool Application; C14 Overseas Social Media and Cross-border Live Streaming; C15 Cross-border Marketing Strategies and Plans
	C2 Paid & Search Promotion	C21 Keyword Optimization and Bidding Promotion; C22 Foreign Language Lexicon and International Search Promotion
D Order & Supply Chain Management	D1 Order & Logistics Operations	D11 Order Inquiry and Shipping; D12 Cross-border Order and Shipping; D13 Shipping, Return, and Exchange Processing; D14 Order Anomalies and Cross-border Logistics Costing

Primary Indicator	Secondary Indicator	Tertiary Indicator
	D2 Supply Chain & Product Management	D21 Product Listing and Delisting Management; D22 Store Maintenance and Cross-border Product Selection; D23 Replenishment Planning and Data Management; D24 Procurement Planning and Warehouse Logistics; D25 Cross-border Operations and Fulfillment Strategy
	D3 Cross-border E-commerce Operations & Fulfillment	D31 Cross-border Transaction and Order Management; D32 Cross-border Logistics and Integrated Services
E Customer Service & Relationship Maintenance	E1 Customer Communication & Issue Resolution	E11 Customer Reception and Issue Resolution; E12 Foreign Language Cross-border Communication
	E2 Customer Relationship & Intelligent Service	E21 Intelligent Customer Service and Customer Segmentation; E22 Community Operations and Loyalty Strategy; E23 Cross-border Disputes and Differentiated Marketing
F Business Data Analysis & Application	F1 Data Acquisition & Processing	F11 Basic Operational Data Acquisition; F12 Operational and Industry Data Collection and Cleaning
	F2 Data Analysis & Reporting	F21 Tool Selection and Model Building; F22 Data Visualization Reports; F23 Transaction and Marketing Data Analysis; F24 Competition and Customer Data Analysis; F25 Project and Financial Analysis Reports; F26 E-commerce Model Analysis and Reporting
G Professional Legal & Safety Literacy	G1 Professional Ethics & Legal Awareness	G11 Professional Ethics Practice; G12 Laws and Regulations Compliance
	G2 Security & Risk Prevention	G21 Network Security Protection; G22 Emergency Incident Handling
H Basic Tools & Digital Literacy	H1 Information Technology Application Ability	H11 Office Software Application; H12 AI Application Understanding

Primary Indicator	Secondary Indicator	Tertiary Indicator
	H2 Digital Content Basic Processing	H21 Basic Image Editing; H22 Basic Video Processing
I Business Communication & Professional Expression	I1 Language & Communication Skills	I11 Chinese Business Communication and Writing; I12 English E-commerce Communication and Reading
	I2 Business Etiquette & Service Awareness	I21 Professional Etiquette Norms; I22 Customer Needs Understanding and Service
J Basic Knowledge of Economic Management	J1 Economic & Market Understanding	J11 Understanding of E-commerce Economic Principles; J12 Market Structure and Business Logic
	J2 Financial & Cost Awareness	J21 Understanding of E-commerce Finance and Taxation; J22 Cost Accounting and Budget Control
K Innovation & Career Development Capability	K1 Innovative Thinking & Entrepreneurial Awareness	K11 E-commerce Project Conception and Planning; K12 Project Simulation and Feasibility Assessment
	K2 Career Planning & Development Ability	K21 Career Path Planning; K22 Practical Reflection and Capability Enhancement
L Comprehensive Practice & Project Execution	L1 Project Execution & Team Collaboration	L11 Team Role Assumption and Task Completion; L12 Project Process Understanding and Collaborative Promotion
	L2 Practical Reflection & Outcome Output	L21 Project Report Writing; L22 Results Presentation and Defense

4. Matching Analysis between Curriculum System and Job Skill Requirements

4.1 Current State of the Curriculum System

Through a systematic review of the e-commerce talent cultivation programs of 12 higher vocational colleges, the integrated courses were categorized into five types based on their nature. There were 7 ideological and political courses, all directly corresponding to national curriculum standards, reflecting a high degree of standardization. There were 14 public basic courses, most of which directly corresponded to national curriculum standards, with some matched through extension forms. There were 19 professional basic and core courses, highly aligned with national curriculum standards, with the vast majority directly corresponding. There were 14 professional extension courses, with a more diverse correspondence to national standards; some courses, such as "E-commerce Logistics," "Supply Chain Management," "International Trade Practices," and "Web Page Design and Production," lacked clear correspondence, reflecting personalized institutional settings in extension areas. There were 7 practical training courses, most of which corresponded to national vocational competency modules.

From the course statistics, it is evident that ideological and political courses, public basic courses, and most professional core courses have a very high offering rate across institutions, reflecting the basic consensus and standard requirements for e-commerce talent cultivation. In the areas of professional extension and practical training, institutions show some differences based on their own positioning and regional industrial demands, such as uneven offering distribution of courses like "Cross-border E-commerce," "Python/Big Data Applications," "Agricultural Product E-commerce," and "Supply Chain Management," highlighting the trend towards characteristic institutional development.

4.2 Analysis of Matching between Curriculum and Skills

A systematic comparison and analysis of the aforementioned curriculum system against the skill model constructed in this study reveals distinct structural characteristics (see Table 2).

Table 4: Analysis of Matching between Curriculum System and Job Skills

Matching Level	Competency Area	Typical Performance	Representative Courses/Skills
High Match	Visual Design, Customer Service, Basic Tools, Economic Management, Innovation & Career Development, Comprehensive Practice	Course content highly overlaps with job operational tasks, mostly equipped with specialized practical training components, effectively supporting skill development.	Courses like Visual Marketing Design, Graphic Image Processing, Customer Service, Business Etiquette, Information Technology, Innovation and Entrepreneurship Education, and Internship support basic skills in modules A, B, E, H, I, J, K, L.
Medium Match	Composite skill modules such as Supply Chain Management, Data Analysis, Cross-border Operations	Courses emphasize theoretical framework instruction, lacking deep integration with real business scenarios. Students face challenges in knowledge transfer when dealing with complex tasks	Courses like Supply Chain Management, E-commerce Logistics, Business Data Analysis, Data-driven Operations, and Cross-border E-commerce support advanced skills in modules D, F,

Matching Level	Competency Area	Typical Performance	Representative Courses/Skills
		like business decisions, anomaly handling, and multi-variable coordination.	C.
Low Match	Advanced strategic skills such as Cross-border Dispute Handling, Project Financial Analysis, Emergency Incident Handling, Business Model Design	There is almost no clear corresponding support in existing courses, or only conceptual introductions are provided, lacking systematic training.	Skills such as Cross-border Dispute Handling (E23), Project and Financial Analysis Reporting (F25), E-commerce Model Analysis and Reporting (F26), and Handling Emergencies (G22).

Overall, the matching status between the curriculum system and job skill requirements exhibits distinct structural characteristics: "strong in fundamentals, weak in integration," "strong in operation, weak in decision-making," and "strong in domestic focus, weak in cross-border focus."

5. Empirical Evaluation of Talent Cultivation Effectiveness

5.1 Determination of Indicator Weights

AHP was used to calculate weights for the six primary indicators. After constructing the judgment matrix and passing the consistency test, the resulting weight vector was: (0.109, 0.064, 0.194, 0.278, 0.064, 0.291). The results (see Table 3) show that "Business Data Analysis and Application" (F, 0.291) and "Order and Supply Chain Management" (D, 0.278) have the highest weights, reflecting that data-driven decision-making ability and supply chain efficiency management are considered the most critical core competencies in e-commerce operations. Following closely is "Marketing Promotion and Traffic Operations" (C, 0.194), indicating that acquiring and converting traffic remains a crucial capability in the competitive e-commerce environment. "Product and Visual Management" (A, 0.109) is at a medium level, while "Store Building and Visual Design" (B, 0.064) and "Customer Service and Relationship Maintenance" (E, 0.064) have relatively lower weights.

Table 5: Primary Indicator Weight Distribution

Primary Indicator	A Product & Visual Management	B Store Building & Visual Design	C Marketing Promotion & Traffic Operations	D Order & Supply Chain Management	E Customer Service & Relationship Maintenance	F Business Data Analysis & Application
Weight	0.109	0.064	0.194	0.278	0.064	0.291

Looking at the total weights of the tertiary indicators, skills such as F12, D14, D13, C13, C21, C22 have relatively high comprehensive weights and should be prioritized and strengthened in talent cultivation.

5.2 Diagnosis of Student Skill Levels

Taking 18 interns from the 2023 cohort of the E-commerce major at Yunnan Technical College of Industry as the evaluation subjects, 10 enterprise experts rated them using the "Higher Vocational E-commerce Talent Core Job Skills Evaluation Scale." A triangular membership function was used, setting the evaluation levels to 5 levels: 2 (poor), 2.5 (relatively poor), 3 (average), 3.5 (good), 4 (excellent). After calculation, the membership degree of each indicator for each level was obtained and synthesized step by step, ultimately resulting in the comprehensive membership degree vector for student skill levels:

V = (0.0051, 0.4758, 0.4831, 0.0360, 0.0000)

The results indicate that the students' overall skill level falls between "relatively poor" and "average," with only 3.60% at the "good" level or above, and 0% at the "excellent" level. This "average" evaluation essentially masks a severe imbalance in skill structure.

The diagnostic results for each dimension (see Table 4) show:

Basic skills (B, D, E) are rated as "average." The membership degree for Store Building and Visual Design (B) module is average (53.09%), for Order and Supply Chain Management (D) module is average (56.27%), and for Customer Service and Relationship Maintenance (E) module is average (57.84%). This indicates that after training, students can perform well in areas such as platform operation, product listing, order processing, and basic customer service, forming the foundation that prevents the overall evaluation from falling into the "relatively poor" category.

Key strategic skills (A, C, F) are rated as "relatively poor." The membership degree for Product and Visual Management (A) module is relatively poor (76.15%), for Marketing Promotion and Traffic Operations (C) module is relatively poor (54.29%), and for Business Data Analysis and Application (F) module is relatively poor (49.80%). Particularly, the highest-weighted F module falls into the "relatively poor" range, meaning that the data-driven decision-making capability urgently needed by the industry is precisely the weakest link in current talent cultivation. Specifically, items such as Cross-border Marketing Strategy (C15), Overseas Social Media Promotion (C14), Business Model Design and Analysis (F26), and Financial and Project Analysis (F25) scored between 2.3 and 2.4, indicating that students mostly remain at the cognitive stage when facing complex tasks requiring market insight, strategic planning, and data modeling.

Table 6: Fuzzy Evaluation Results for Each Primary Indicator

Primary Indicator	**Fuzzy Membership Vector (V1, V2, V3, V4, V5)**	**Max Membership Level**	**Conclusion**
A Product & Visual Management	(0.0311, 0.7615, 0.2074, 0.0000, 0.0000)	Relatively Poor	Insufficient Strategic Capability
B Store Building & Visual Design	(0.0000, 0.3464, 0.5309, 0.1227, 0.0000)	Average	Basic Skills Acceptable
C Marketing Promotion & Traffic Operations	(0.0000, 0.5429, 0.4571, 0.0000, 0.0000)	Relatively Poor	Capability Shortcoming
D Order & Supply Chain Management	(0.0000, 0.3360, 0.5627, 0.1013, 0.0000)	Average	Basic Skills Acceptable

Primary Indicator	Fuzzy Membership Vector (V1, V2, V3, V4, V5)	Max Membership Level	Conclusion
E Customer Service & Relationship Maintenance	(0.0000, 0.4216, 0.5784, 0.0000, 0.0000)	Average	Basic Skills Acceptable
F Business Data Analysis & Application	(0.0059, 0.4980, 0.4963, 0.0000, 0.0000)	Relatively Poor	Greatest Shortcoming

6. Conclusion and Discussion

6.1 Main Research Conclusions

Grounded in the perspective of industry-education integration, this study systematically reveals the current state and dilemmas of e-commerce talent cultivation effectiveness in higher vocational education by constructing a scientific job skill model and conducting empirical evaluations. The main conclusions are as follows:

First, an empirically validated core job skill sub-model for higher vocational e-commerce talents was constructed. This model encompasses 6 core skill dimensions, 13 secondary indicators, and 41 specific indicators. The Cronbach's α coefficient for the total scale is as high as 0.934, and the various fit indices from the CFA all meet good standards, indicating strong reliability and validity. This model provides a scientific and operational "competency yardstick" for measuring the quality of talent cultivation, effectively responding to the "question of standards".

Second, there is a structural mismatch between the curriculum system and job skill requirements. Through textual analysis of the talent cultivation programs of 12 higher vocational colleges and systematic comparison with the comprehensive vocational skill model, this study reveals that the current curriculum system and job skill matching exhibit structural characteristics of "strong in fundamentals, weak in integration," "strong in operation, weak in decision-making," and "strong in domestic focus, weak in cross-border focus." While the curriculum system can adequately support the cultivation of basic operational skills, there are systemic shortcomings in cultivating composite, decision-making skills such as data analysis, cross-border operations, and marketing strategies, directly addressing the "question of matching".

Third, students' skill levels exhibit an imbalanced state of "acceptable operational skills but weak strategic skills." The empirical evaluation results targeting interns from Yunnan Technical College of Industry show that the students' overall skill level falls between "relatively poor" and "average." The students' capability structure is severely skewed towards basic operations, while the most highly weighted and most urgently needed strategic skills such as data analysis and marketing promotion are very weak. This skill gap clearly confirms the practical dilemma of the "question of effectiveness".

6.2 Theoretical Contributions and Practical Implications

In terms of theoretical contributions, this study systematically introduces Competency-Based Education (CBE) theory into research on e-commerce talent cultivation in higher vocational education. By integrating the "technology-business" dual-structure characteristics of e-commerce, it constructs a job skill model aligned with the development of the digital economy, expanding the application boundary of CBE theory in the digital economy field. Additionally, the study proposes a theoretical framework for "curriculum-skill" matching analysis, evaluating the appropriateness of curriculum design from three dimensions—coverage breadth, support depth, and competency

level—providing a reusable theoretical tool for diagnosing and optimizing curriculum systems in vocational education. Furthermore, the study deepens the systematic understanding of the "skill mismatch" phenomenon, deconstructing the matching issue between talent cultivation and industrial demand into three levels: skill structure mismatch, competency level mismatch, and job direction mismatch, revealing their specific manifestations through empirical data[6].

In terms of practical implications, the skill model, matching matrix, and evaluation scale developed in this study can be directly applied by higher vocational colleges for revising talent cultivation programs, optimizing curriculum systems, diagnosing teaching quality, and evaluating school-enterprise cooperation. Institutions can use the model for reverse curriculum design, clarifying the specific skill indicators each course should support. Students can self-assess their capabilities against the model to clarify learning objectives and career orientations. Enterprises can translate the model into recruitment competency models to improve the accuracy of person-job fit. The research paradigm demonstrated in this study can provide methodological references for constructing vocational competency models and optimizing curriculum systems in other professional fields such as logistics management, tourism management, and intelligent manufacturing.

6.3 Research Limitations and Future Prospects

This study has several limitations. First, although the 12 higher vocational colleges selected for curriculum text analysis have strong regional representativeness, limitations in sample acquisition channels prevented full coverage of institutions across all provinces in China. The empirical evaluation only selected interns from one institution as evaluation subjects, restricting the generalizability of the conclusions. Second, the e-commerce industry undergoes rapid technological iteration, with job competency requirements continuously evolving. The skill model constructed in this study is essentially a "snapshot" based on current industry demands; with the deep penetration of new technologies like generative AI and the metaverse, the model requires dynamic updates. Finally, the analysis of curriculum-skill matching was primarily based on judgments made from course names, objectives, and typical teaching content, without in-depth analysis of the teaching hours, depth, and effectiveness of supporting each skill point within specific courses.

Future research can be deepened in the following directions: First, focus on the revolutionary impact of AI technology on talent cultivation paradigms, deeply exploring the reshaping effect of artificial intelligence on job competencies and the cultivation pathways for "AI+E-commerce" compound talents. Second, explore new pathways for integrating standardized education with professional education, cultivating students' understanding and application of industry standards, technical standards, and management standards. Third, construct an effectiveness evaluation framework for vocational education serving regional economic development, investigating from a broader perspective the contribution of higher vocational e-commerce talent cultivation to regional industrial development. Fourth, promote the digital transformation and intelligent upgrading of evaluation tools, developing online adaptive assessment systems to enable dynamic monitoring and immediate feedback of student capabilities.

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