Research on Interactive Learning Needs and Vocational Education Development for Wuliangye in the Context of Industry-Education Integration

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Abstract

This study employs the Triple Helix Theory and Situated Learning Theory, guided by interactive learning needs, to systematically examine the determinants of vocational education training development at Wuliangye Group Co., Ltd., with a focus on optimization strategies within the context of industry-education integration. Employing a core-soul research method, this study surveyed 388 learners (368 valid responses) and used ANOVA and Kano models to decide how interactive learning needs factors should be prioritized and effectively used in vocational education. Empirical findings indicate that all five demand factors constitute key drivers for vocational education development, with both satisfaction enhancement and dissatisfaction elimination effects reaching significant levels. Vocational education interactive learning demands exhibit a priority hierarchy structured as “core-strategic-implicit.” The study emphasizes the establishment of institutionalized “production-learning communities,” the implementation of forward-looking “skills standard synchronization” mechanisms, the design of mission-oriented precision empowerment projects, and the co-creation of integrated “problem-to-solution” processes. Based on empirical analysis, this study constructs an analytical framework comprising “needs identification, model validation, and priority derivation.” By categorizing five types of factors according to their Kano attributes, it proposes prioritizing the development of essential core elements while incorporating modular curriculum design that balances strategic and latent needs. This framework provides actionable decision-making guidance for allocating vocational education resources in industries with distinctive characteristics.

Keywords: industry-education integration, Wuliangye Group Co., Ltd., interactive learning, vocational education, practical training development

1. Introduction

Against the backdrop of deepening national strategies for industry-education integration, industrial heritage sites are emerging as pivotal pillars for innovative vocational training bases, serving as vital platforms for informal education. Globally, Germany's Ruhr region has achieved the organic transformation of production spaces into learning spaces through its Industrial Heritage Education Corridor (Berger, 2019). Japan leverages its “Industrial Culture Education Bases” to promote collaborative development of training curricula between schools and enterprises (Shimahara, 1986). China actively responds to these international trends by enacting numerous policy guidelines explicitly encouraging the utilization of industrial heritage resources to develop vocational training programs. This aims to bridge the disconnect between traditional classrooms and industrial practice. This underscores the strategic value of industrial heritage in vocational education while integrating informal education bases into the industry-education integration system, providing institutional safeguards for the diversified development of training resources. However, how to effectively transform industrial heritage into informal education training sites remains a critical challenge in current industry-education integration efforts.

The Wuliangye Industrial Heritage Site was successfully included in the second batch of the National Industrial Heritage List in 2018, becoming a living testament to the industrial civilization of baijiu (Bu et al., 2024). However, while the Wuliangye Industrial Heritage Site (hereinafter referred to as Wuliangye) has actively promoted strategies for study tours and cultural-tourism integration, its operations remain primarily confined to sightseeing and brand promotion. Significant practical challenges and theoretical gaps persist in serving vocational education and practical training for secondary vocational, higher vocational, and undergraduate students. In practice, the educational functions of existing scenic areas are largely confined to one-way, static knowledge lectures and static displays, lacking interactive, exploratory, and skill-based hands-on components (Bano & Mehdi, 2011). In theory, systematic research and empirical evidence remain scarce regarding how industrial heritage can be systematically transformed into industry-education integration training bases and how to develop interactive learning programs tailored to different groups and educational levels (Hearn, 2023).

Against this backdrop, the integration of industry and education demands that vocational education shift from "knowledge transmission" to "competency development." As a benchmark for blending industrial heritage with cultural tourism, Wuliangye's contextual resources and immersive experiences perfectly align with learners' demands for interactive education. This study aims to bridge dual gaps in theory and practice. By analyzing the empirical challenges of Wuliangye's transformation from a "production space" to an "educational space," this study aims to establish a vocational training development framework centered on interactive learning. This framework provides a tripartite theoretical foundation of "space-content-experience" for industry-education integration, facilitating the conversion of Wuliangye's cultural tourism resources into replicable vocational training models. It thereby advances the high-quality development of vocational education, achieving a qualitative leap from 'observing' to 'doing,' and from 'touring' to 'learning.'

1.1 Research Questions

1) Under the framework of industry-education integration, what are the key components of Wuliangye's interactive learning requirements?

2) What are the priority sequence and attribute characteristics of these key factors in vocational education development?

3) How to design differentiated vocational education development pathways to promote deep integration between industry and education?

1.2 Research Objectives

1) To construct a factor framework for interactive learning needs in Wuliangye's industry-education integration.

2) To establish a priority model for vocational education development, the attributes and functional effects of demand factors must be clearly categorized and defined.

3) To propose an optimized approach for vocational education curriculum development and resource allocation.

1.3 Research Framework

This research framework centers on the Triple Helix Theory, Situated Learning Theory, and the Kano Model. Based on the triple helix theory (Etzkowitz & Leydesdorff, 2000) as a macro-level analytical framework, a theoretical field for the collaborative development of government, industry, and education under the context of industry-education integration has been constructed (Li et al., 2023). This field clearly defines the roles and interactive relationships among the industrial sector, educational sector, and governmental sector, forming the institutional foundation and resource flow mechanism for advancing vocational education. Building upon this, situated learning theory (Lave, 1996) is introduced to deconstruct the essence of "interactive learning." Zhong (2022) notes that learners' effective learning depends on their engagement in authentic or simulated professional contexts. Therefore, this study specifies interactive learning across three dimensions: environmental interaction (learner engagement with production settings, tools, and technologies), interpersonal interaction (collaboration and communication among learners, enterprise mentors, school teachers, and peers), and content interaction (learner comprehension and internalization of vocational knowledge, skills, and tasks within industry-education integration projects). These collectively form the theoretical basis for questionnaire design, providing operational indicators for subsequent data collection.

To comprehensively understand learners' actual learning needs within industry-education integration contexts, this study employed a combined approach of questionnaire surveys and semi-structured interviews to collect data from three groups: corporate employees, vocational college students, and teachers. Statistical methods analyzed differences in their needs across various dimensions of interactive learning, identifying their key concerns and developmental expectations. He (2024) proposed utilizing the Kano model for typological identification and prioritization of needs. Therefore, based on this model, learners' interactive learning needs were categorized into five types: basic quality, performance quality, excitement quality, indifferent quality, and reverse quality (Kano et al., 1984). By identifying different types of needs and assigning weights, a priority matrix for interactive learning needs was derived. Based on the matrix analysis results, a precise development path for vocational education training models is proposed. This clarifies which learning needs should be prioritized under different resource conditions, providing theoretical support and practical guidance for vocational education curriculum design, training platform construction, and teaching resource allocation. (Figure 1)

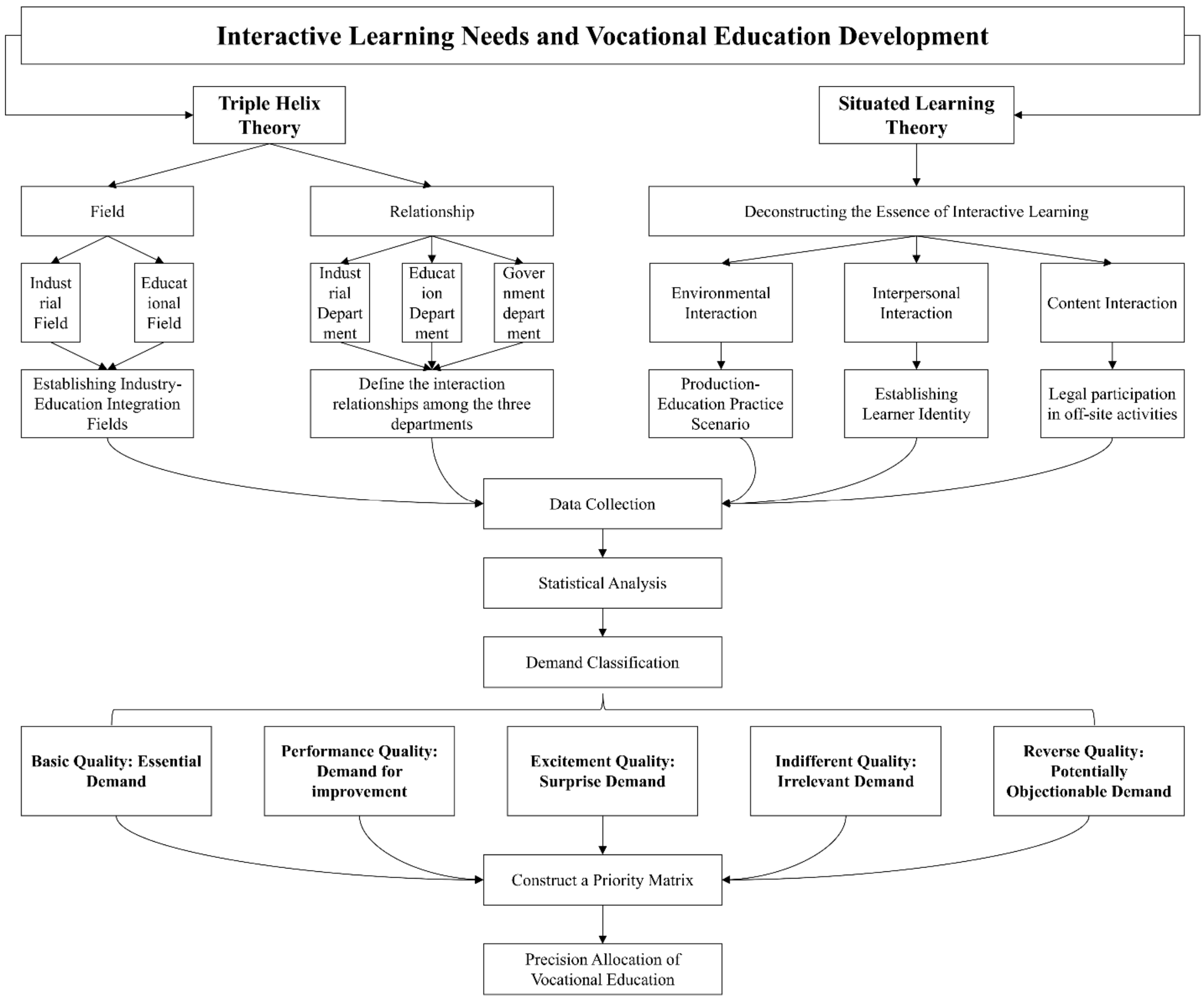

Figure 1. Research Framework

2. Literature Review

2.1 Building an Educational System for Industry-Education Integration

The establishment of an industry-education integration education system is a pivotal point in the modernization of vocational education, with its core lying in constructing a trinity educational framework of “knowledge-guided, practice-oriented, and industry-education integration” (Wu & Feng, 2025). With the advent of the “Internet Plus” era, digital teaching resource repositories have become a crucial factor for higher vocational colleges in building “Double High” institutions and achieving industry-education integration (Liu & Zhang, 2025). According to this article, digital teaching resource repositories are a novel content format appearing in the internet era, whose development plays a pivotal role in advancing industry-education integration and enhancing vocational education quality (Ke & Shi, 2025). This article notes that at the practical level, the development of a knowledge-graph-based industry-education integration curriculum system has become a key direction in current vocational education reform.

This approach not only innovates and expands traditional teaching models but also actively explores pathways for deep integration between education and industry, providing both theoretical support and a practical framework for integrating education and industry (Zhou, 2025).

The core challenge in constructing the current vocational education system lies in effectively integrating industry's practical demands into the educational framework. This article points out that corporate involvement in building professional teaching resource databases stays “superficial” or even “non-existent,” resulting in a disconnect between educational content and real-world industry needs (Zhang & Zhu, 2022). Simultaneously, the limitations of traditional education models—where “teachers are the primary knowledge disseminators, and students are passive learners”—are increasingly evident, making it difficult to cultivate high-quality technical and skilled personnel that meet industry demands (Wang et al., 2025). Therefore, providing an industry-education integration education system that effectively aligns with industrial needs is a critical issue requiring urgent resolution in current vocational education reform, providing a structural entry point for Wuliangye's interactive learning requirements.

2.2 Challenges of Interactive Learning in Industry-Education Integration

As industry-education integration deepens, the research focus has shifted from macro-level systems to the micro-level interaction between teaching and learning. This shift presents more complex challenges in information processing and resource allocation. Among these, the “idealistic” dilemma faced by enterprises stands out. This article points out that enterprises often hold overly high expectations when taking part in industry-education integration, believing it can swiftly address talent needs while overlooking the necessity for long-term investment and systematic planning (Zhang & Zhu, 2022). This article emphasizes that industry-academia collaboration requires strengthened cooperation between academic institutions and enterprises. However, significant discrepancies exist between the two parties about collaborative aims, benefit distribution, and cooperation models (He et al., 2023).

Simultaneously, interactive learning is deeply embedded within stakeholder interactions. This article employs stakeholder game theory analysis to show that students, as core stakeholders, often occupy a disadvantaged position in industry-education integration due to information asymmetry and inadequate rights protection (Shao, 2024). This article proposed a cross-technology information management system that dynamically integrates and analyzes teaching data, student data, and course data using big data technology to overcome interactive barriers in traditional teaching, such as the separation of theory and practice and the lack of statistical modeling training (He et al., 2023).

2.3 The Value of Vocational Education in Industry-Education Integration

A scientific assessment of the value of industry-education integration serves as the basis for deciding vocational education development priorities and resource allocation strategies. It can drive regional innovation and economic growth while promoting the intrinsic development of vocational education. This article shows that industry-education integration enhances graduates' employability, offering valuable insights for the future development of national vocational education (Zhang, 2025). For Wuliangye, this integration alleviates the demand for high-end technical talent and specifically improves the quality of the company's talent pool. This article demonstrates that the governance capacity of industry-education integration platforms is a key factor influencing the effectiveness of such integration. Enhancing this governance capacity requires establishing a collaborative governance structure among universities, government, and enterprises. This framework not only provides talent support for high-quality regional economic development but also offers valuable guidance for prioritizing the development sequence of implicit projects within regional innovation initiatives (Li et al., 2022).

3. Research Method

This study adopts a mixed-methods research paradigm, combining quantitative data with qualitative interviews to systematically deconstruct the intrinsic logic underlying Wuliangye's interactive learning needs and vocational education development within the context of industry-education integration (Creswell & Plano Clark, 2017). The research design strictly follows a progressive path of “needs identification-model validation-priority derivation”: First, by analyzing Wuliangye's official reports and media announcements, key demand indicators were extracted and incorporated into the survey questionnaire. Second, extensive empirical data from learners were collected through questionnaires and semi-structured interviews. Third, the scientific validity of group differences was verified to prioritize targeted vocational education development, providing actionable educational decision-making support for industry-education integration practices.

3.1 Population and Sample Group Sampling

Based on the Wuliangye Industry-Education Integration Practice Report and Industrial Heritage Vocational Education Transformation Case (Zhang et al., 2025), core learning needs were extracted from news reports and partner institution coverage of Wuliangye's industry-education integration initiatives from 2020 to 2024. A stratified random sampling method was employed to cover key stakeholders in industry-education integration, including teachers, students, enterprise employees, and training institution personnel—all core beneficiaries of vocational education. Reflecting the operational characteristics of industry-education integration, the sample primarily comprised students and teachers, supplemented by enterprise employees and training institution personnel. The final valid sample comprised 368 respondents, distributed as follows: full-time and administrative faculty (n=106, 28.8%); students across educational levels (n=150, 40.8%); corporate employees and managers (n=76, 20.7%); and vocational training institution personnel (n=36, 9.8%). The sampling ratio met the minimum requirements for Kano model analysis, with students and faculty constituting approximately 70% of the sample to ensure statistical validity (Ho & Tzeng, 2021). This approach also aligned with Wuliangye's industry-education integration practice centered on “faculty and students as pivotal participants,” effectively mitigating the common bias of “insufficient corporate involvement” typically observed in industrial heritage site case studies.

3.2 Model Construction

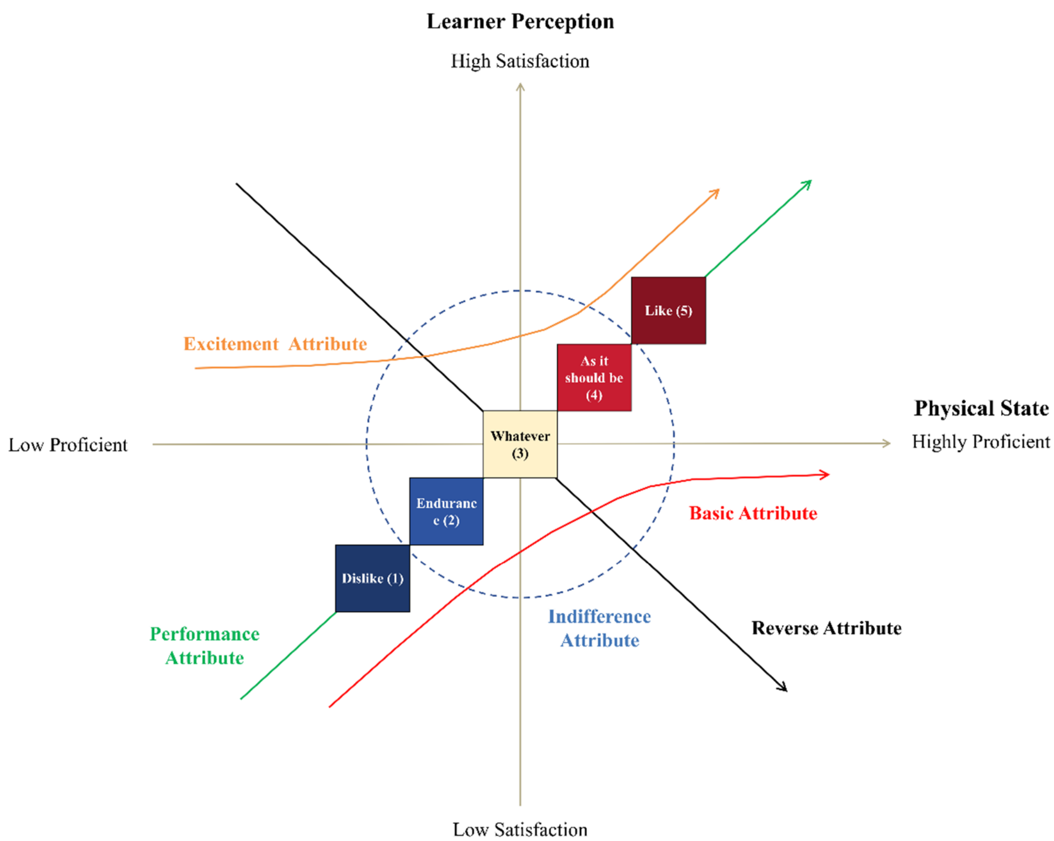

Figure 2. Kano Model Diagram

Source: Kano et al. (1984); Tontini (2007)

The research model and measurement tools strictly follow a two-phase approach: Phase One involves qualitative theme generation. A comprehensive collection and analysis of Wuliangye's textual materials on industry-education integration was conducted to extract key information regarding interactive learning needs and vocational education expectations, integrating these into initial measurement themes. The second phase focuses on questionnaire design. The questionnaire structure comprises two sections: demographic information and demand content. Demographic information covers basic learner details, while demand content primarily includes five dimensions: real-scenario training (RST), dual-system collaborative education (DSCE), standard content co-creation (SCCC), cultural identity internalization (CII), and research-driven innovation (RDI). These dimensions are measured using a 5-point Likert scale. Participants scored each dimension for both “present” and “absent” scenarios. Vocational education content attributes were typologized to determine development priorities (Dong et al., 2025). The Kano model construction process strictly adheres to established scale development specifications, ensuring that each dimension aligns with the practical scenarios of Wuliangye's industry-education integration (Zheng et al., 2022).

The Kano model's five categories and one suspicious attribute (Q): Basic attribute (M). When such features are provided, learner satisfaction does not significantly increase, but satisfaction drops substantially when they are not offered. Performance attribute (O): When such features are provided, user satisfaction increases; conversely, satisfaction decreases when they are not offered. Excitement attribute (A): When such features are not provided, user satisfaction does not decrease, but satisfaction increases dramatically when they are offered. Indifference Attribute (I): User satisfaction remains largely unchanged regardless of whether these features are provided. Reverse Attribute (R): User satisfaction decreases when these features are provided, even though users did not initially expect them. Suspicious attribute (Q): Respondents did not fully understand a specific question or provided incorrect answers. (Figure 2)

3.3 Model Validation

Before conducting a large-scale survey, a pretest was performed on a small pilot sample to assess questionnaire reliability using Cronbach's α coefficient. Data validity was evaluated through KMO values and Bartlett's sphericity test. (Hair et al., 2019). Combining construct reliability (CR) and average variance extracted (AVE) measures, we examined internal consistency and convergent validity (Wen et al., 2024). This ensured the questionnaire content fit the data well, confirmed the applicability of exploratory factor analysis, provided methodological assurance of demand differentiation characteristics, and enhanced the accuracy of vocational education attribute classification.

3.4 Data Analysis Strategy

The study employs a phased, progressive approach combining quantitative and qualitative analysis. In the quantitative phase, descriptive statistics and one-way ANOVA were conducted using SPSS 25.0 to explore differences in learning needs across distinct groups during interactive learning processes. The Kano model was applied to rank specific vocational education development factors, finding “M” “O” and “A” to establish priority sequences for curriculum development content. Qualitative analysis integrated semi-structured interviews, as described in Sánchez-Guardiola Paredes (2021), with quantitative findings. Mixed-methods triangulation enhanced the educational value and practical applicability of the research conclusions.

4. Research Results

4.1 Sample Characteristics Analysis

Table 1. Distribution of Demographic Characteristics in the Sample Population (N=368)

Group	Type	Number	Percentage (%)
Teacher	Professional Faculty	61	16.6%
	Teaching Administrator	45	12.2%
Student	Vocational high School Student	47	12.8%
	Technical College Student	48	13.0%
	Undergraduate Student	55	14.9%
Corporate Personnel	Corporate Employee	51	13.9%
	Corporate Manager	25	6.8%
Training Institution	Institutional Staff	30	8.2%
	Institutional Supervisor	6	1.6%

A total of 388 questionnaires were distributed in this study, with 368 valid responses collected, achieving a response rate of 94.8%. Table 1 shows the sample distribution, revealing significant diversity in learner categories. In-school students constituted the largest proportion (40.7%), encompassing secondary vocational, higher vocational, and undergraduate levels, aligning with this study's core focus on the interactive learning needs of key groups within industry-education integration. Experience depth spanned employees across various positions and institutional personnel, collectively accounting for approximately 30.5%, providing robust support for educational practice, industrial integration, and professional application.

4.2 Sample Quality Validation

Using SPSS 25.0, reliability and validity tests were conducted across five dimensions. As shown in Table 2, the Cronbach's α coefficients for all questionnaire samples exceeded 0.70, indicating good reliability. Exploratory factor analysis revealed KMO values above 0.60 and a significant Bartlett's sphericity test ($p<0.001$), confirming the questionnaire samples' strong validity. Using the average variance extracted (AVE) and composite reliability (CR) measures from Hamid et al. (2017), the CR values were 0.921 and 0.951, both exceeding 0.85, indicating high internal consistency among the five dimensions. Factor loadings within each dimension ranged from 0.538 to 0.952, all exceeding 0.50, confirming the questionnaire sample meets interactive learning requirements. AVE values were 0.707 and 0.797, both exceeding 0.50, indicating good convergent validity of the questionnaire sample. The sample structure and theoretical support confirm the applicability of the assessment method in the development of vocational education training programs at Wuliangye.

Table 2. Validity Analysis Results Across Five Dimensions

Dimension	Factor loadings	CR	AVE	Cronbach's alpha	KMO	Bartlett's observed values	df	p
If there is RST	0.835							
If there is DSCE	0.952							
If there is SCCC	0.905	0.951	0.797	0.936	0.802	1851.94	10	0.000
If there is CII	0.857							
If there is RDI	0.909							
If there isn't RST	0.932							
If there isn't DSCE	0.901							
If there isn't SCCC	0.902	0.921	0.707	0.741	0.660	827.02	10	0.000
If there isn't CII	0.538							
If there isn't RDI	0.867							

Note: Abbreviations are defined in 3.2 (same applies below).

4.3 Analysis of Sample Variability

4.3.1 Descriptive Statistics

Table 3. Descriptive Statistics Results for Five Dimensions

Dimension	N	Minimum	Maximum	Mean	Std. deviation	S-W test
If there is RST	368	2	5	3.60	1.137	0.843^{***}
If there is DSCE	368	2	5	3.37	1.151	0.834^{***}
If there is SCCC	368	1	5	3.14	1.357	0.846^{***}
If there is CII	368	2	5	3.23	1.070	0.847^{***}
If there is RDI	368	2	5	3.22	1.189	0.809^{***}
If there isn't RST	368	1	3	1.33	0.484	0.610^{***}
If there isn't DSCE	368	1	3	1.52	0.639	0.722^{***}
If there isn't SCCC	368	1	4	1.63	0.845	0.720^{***}
If there isn't CII	368	1	4	1.66	0.725	0.770^{***}
If there isn't RDI	368	1	4	1.66	0.852	0.735^{***}

Note: The Shapiro-Wilk test is a method for testing normality, suitable for small sample data (sample size ≤ 5000); ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively (same applies below).

Based on Lawless's (2010) descriptive analysis, Table 3 indicates that all five dimensions exhibit characteristics of normal distribution. The mean scores for each dimension exceed 3, reflecting an overall positive orientation ranging from "expected" to "liked." Among these, the mean score for RST is the highest (3.60), indicating its most prominent demand within industry-education integration. Under the "lacking" condition, the mean scores for all dimensions were significantly below 2, falling into the negative range of "dislike" to "tolerate." RST elicited the most concentrated negative evaluations. Comparing the dispersion of the two data sets, the standard deviation was relatively larger under the 'present' condition and generally smaller under the "lacking" condition.

4.3.2 One-Way Analysis of Variance

Based on Kim's (2014) one-way ANOVA, Table 4 reveals significant heterogeneity in the perception of interactive learning needs across different learner groups. Attitudes within each group exhibit varying degrees of dispersion and intergroup differences. If the overall standard deviation falls between 1.070 and 1.357, it indicates significant divergence in perceptions across different groups. The intergroup difference for "if there is SCCC" was most significant (F=51.70, p<0.001), with teachers (SD=1.363) and institutions (SD=1.32) exhibiting the highest attitudinal dispersion toward SCCC, indicating that SCCC may face the greatest consensus challenges in practical implementation. Students exhibited relatively concentrated attitudes if there is "CII" (SD=0.844) and "DSCE" (SD=1.003), indicating higher consensus on these elements. If there isn't, the overall dispersion of attitudes across different groups has decreased. However, if there isn't "SCCC" and "RDI" still exhibit significant divergence, particularly with the standard deviation for students in the "if there isn't SCCC" condition reaching 0.976, far higher than other groups. This indicates pronounced attitudinal fluctuations within the student cohort when SCCC is absent, potentially reflecting heightened sensitivity to uncertainty or unmet needs. Enterprises also exhibit elevated standard deviations if there isn't "CII" (SD=0.795) and "RDI" (SD=1.008), indicating their deeper dependency on cultural identity and innovation development. Overall, interactive learning needs exhibit significant identity-dependent characteristics. Educators and institutions prioritize the clarity and institutional safeguards of SCCC, while students place greater emphasis on the authenticity and stability of RST. Enterprises, meanwhile, favor the deep internalization of CII and the sustained development of RDI. Consequently, vocational education development should abandon one-size-fits-all approaches and instead focus on precisely identifying and addressing group-specific needs to enhance the suitability and effectiveness of educational offerings.

Table 4. Analysis of Single-Factor ANOVA Results Across Five Dimensions

Dimension	Identity (Std. Deviation)					Levene's statistic	Welch's variance test
	Teacher	Student	Enterprise	Institution	Total		
If there is RST	0.955	1.241	1.132	1.099	1.137	6.85^{***}	$F=3.44^{**}$
If there is DSCE	1.244	1.003	1.050	1.256	1.151	6.25^{***}	$F=9.96^{***}$
If there is SCCC	1.363	0.929	1.174	1.32	1.357	24.31^{***}	$F=51.70^{***}$
If there is CII	1.098	0.844	1.204	1.059	1.070	11.67^{***}	$F=13.48^{***}$
If there is RDI	1.256	1.069	1.190	1.178	1.189	5.99^{***}	$F=7.19^{***}$
If there isn't RST	0.502	0.348	0.548	0.506	0.484	61.00^{***}	$F=18.01^{***}$
If there isn't DSCE	0.477	0.648	0.763	0.478	0.639	15.17^{***}	$F=12.11^{***}$
If there isn't SCCC	0.400	0.976	0.663	0.232	0.845	80.35^{***}	$F=52.26^{***}$
If there isn't CII	0.498	0.777	0.795	0.697	0.725	6.50^{***}	$F=9.72^{***}$
If there isn't RDI	0.535	0.935	1.008	0.504	0.852	39.10^{***}	$F=13.01^{***}$

Table 5 data indicate that SCCC exhibits the most prominent effect size in both the if there is and if there isn't groups, with partial η^2 values of 0.278 and 0.262, respectively. The corresponding f values are 0.620 and 0.596, demonstrating the most significant attitude differences among stakeholder groups and an impact intensity reaching a substantial effect level. RST exhibits the smallest effect size (f=0.154), suggesting it generates weaker attitudinal divergence among groups and may be perceived more as a foundational, consensus-building element. If there isn't, RST yields a medium-to-high effect size (f=0.360), indicating that its omission may actually stimulate more pronounced attitudinal contrasts. If there is a CII group, the effect size was relatively large (f=0.321), indicating it possesses a certain degree of discriminative power in positive construction. Meanwhile, both RDI and DSCE exhibited moderate effect sizes across both if there is and if there isn't groups, suggesting a degree of stability in their influence on attitudes, but not yet forming a strong focal point for group differentiation. In summary, SCCC represents the core dimension with the most concentrated divergence in attitudes and the greatest impact intensity in current vocational education development. Whether it is incorporated or how it is implemented has become a key variable driving differences in perceptions and demands among four stakeholder groups—teachers, students, enterprises, and institutions—in the practice of industry-education integration. This necessitates further clarification of the interests and demands of all parties and optimization of the co-development mechanism for vocational education curricula.

Table 5. Analysis of Effect Size Quantification Results Across Five Dimensions

Dimension	Intergroup difference	Total deviation	Partial η²	Cohen's f
If there is RST	11.026	474.478	0.023	0.154
If there is DSCE	35.727	485.997	0.074	0.282
If there is SCCC	187.784	675.932	0.278	0.620
If there is CII	39.180	419.902	0.093	0.321
If there is RDI	27.866	518.609	0.054	0.238
If there isn't RST	9.830	85.889	0.114	0.360
If there isn't DSCE	11.522	149.780	0.077	0.289
If there isn't SCCC	68.695	262.250	0.262	0.596
If there isn't CII	12.353	192.859	0.064	0.262
If there isn't RDI	20.700	266.217	0.078	0.290

Note: Partial η^2 reflects the size of the difference; Cohen's f shows the effect size.

4.4 Kano Model Analysis Results

Based on the Kano model, we conducted positioning comparisons and development sequence analysis across five dimensions. Following the priority principle of M > O > A > I." Table 6 reveals that "RST" stands as the sole basic feature (M) with the highest absolute dissatisfaction coefficient (worst coefficient: -0.67). This indicates that this dimension serves as the cornerstone of the industry-education integration teaching model and must be prioritized to prevent learner dissatisfaction. In contrast, "DSCE," "SCCC," "CII," and "RDI" all fall within the "I", indicating learners currently exhibit low sensitivity to these dimensions. However, in-depth analysis of better-worse coefficients reveals that the worse coefficients for these dimensions significantly exceed their better coefficients. This indicates a latent tendency toward transformation into fundamental characteristics, revealing a current mismatch between vocational education training development and perceived learning needs. Therefore, in curriculum development and teaching reform, it is essential to strengthen the practical training system centered on authentic work scenarios, establish survival thresholds, enhance learners' awareness of dual-system collaboration and corporate cultural value, and shift from formal integration to precise empowerment driven by learning needs.

Table 6. Analysis of Kano Model Results

Dimension	Proportion (%)						Kano model	Better coefficient	Worse coefficient
	A	O	M	I	R	Q			
If there is RST If there isn't RST	0.27	26.9	40.22	32.61	0.00	0.00	M	0.27	-0.67
If there is DSCE If there isn't DSCE	0.00	20.65	34.78	44.57	0.00	0.00	I	0.21	-0.55
If there is SCCC If there isn't SCCC	1.09	25.0	26.9	39.67	0.00	7.34	I	0.28	-0.56
If there is CII If there isn't CII	0.00	14.13	34.51	51.36	0.00	0.00	I	0.14	-0.49
If there is RDI If there isn't RDI	0.00	21.47	35.33	43.21	0.00	0.00	I	0.21	-0.57

Based on the quadrant analysis of the Better-Worse matrix in Figure 3, RST falls within the first quadrant. Its relatively high Better coefficient (0.27) and negative Worse coefficient (-0.67) collectively indicate that this factor is a performance factor in vocational education development. It is not merely an optional enhancement but a core determinant of industry-education integration competitiveness and fundamental user evaluation. SCCC resides in the second quadrant, representing an excitement factor in vocational education development capable of delivering unexpected satisfaction leaps. Its current absence does not yet constitute a widespread “pain point,” presenting a strategic opportunity to create differentiation and uniqueness. DSCE and CII occupy the third quadrant, functioning as indifferent factors in vocational education development. These require re-evaluation and innovative design to prevent inefficient resource allocation. RDI sits at the boundary between the third and fourth quadrants, balancing both indifference and basic factors. This suggests it possesses significant “foundational safeguarding” attributes, where the risk of its absence far outweighs the visible benefits of its provision. It implies a potential cornerstone for maintaining system stability and preventing satisfaction collapse.

Overall, the development of an industry-education integration interactive learning system should not mechanically follow a linear priority sequence. Instead, it should implement differentiated strategies based on the quadrant attributes of each dimension. This entails adopting a combined strategy of “securing the baseline, focusing on leverage, tapping into excitement, and reconstructing indifference.” Prioritize ensuring high-quality enhancement of scenario-based training, actively explore innovative models for co-creating content, and elevate students' explicit awareness of dual-system collaboration and cultural value through pedagogical reform. This transforms their feeling from the “indifference” blind spot to higher-level needs.

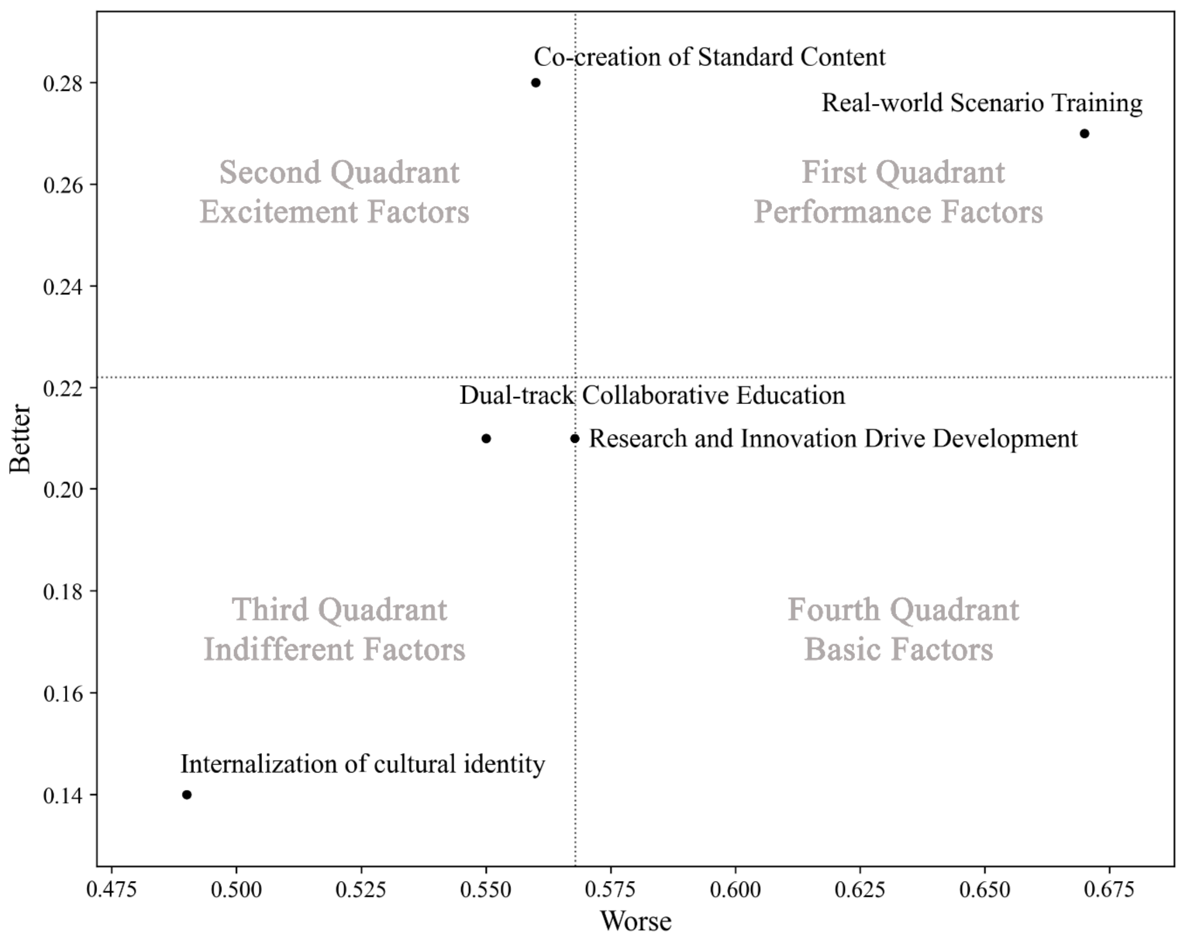

Figure 3. Better-Worse Matrix Analysis Chart

4.5 Participatory Observation and Semi-structured Interviews

To elucidate the formation mechanisms underlying quantitative research findings, this study conducted participant observation and semi-structured interviews with 10 key informants, thereby providing support and interpretation for the statistical analysis results across five major dimensions.

4.5.1 First Dimension: Basic Demand for RST

Interviews and observations consistently indicate that "RST" is the primary factor driving the effectiveness of Wuliangye's interactive learning. Corporate employee E1 emphasized: "Students lacking hands-on workshop experience struggle to handle complex brewing situations, even if they memorize process parameters." Industry-academia integration project trainer I1 concurred: "Only by physically handling distillery residue and sensing temperature changes can students establish truly effective vocational skill pathways." Full-time instructor T1 observed: "When course projects are directly embedded within Wuliangye's actual production processes, students experience a qualitative leap in their professional understanding." Administrative instructor T2 elaborated further: "Authentic scenario training transcends mere skill drills; it represents the deep integration of vocational education with industry standards."

4.5.2 Second Dimension: Strategic Opportunities for SCCC

Regarding SCCC as a strategic opportunity, undergraduate student S1 shared insights from their learning experience: "The comprehensive training guide for Baijiu production includes numerous real-world workshop cases and troubleshooting manuals, clearly outlining the standard basis for each operation and its practical industrial applications." Corporate technician E2 emphasized: "Corporate involvement in setting teaching standards essentially integrates job responsibilities into the training process." Institutional specialist I2 noted: "Wuliangye's unique 'Bao Bao Qu' fermentation starter production process and multi-grain fermentation pit technology both feature highly exclusive standards that textbooks struggle to cover. The core of content co-creation lies in directly translating internal quality control into educational language, ensuring talent development standards resonate in sync with industry technology iterations."

4.5.3 The Third Dimension: The Resource Core of DSCE

The interview reveals the resource conversion logic and value symbiosis relationship in DSCE. Full-time instructor T3 noted regarding teaching resource transformation: "Traditional, single-dimensional content-based instruction struggles to convey Wuliangye's complex production systems. The essence lies in converting corporate production elements into educational components, enabling students to leap from theoretical understanding to professional competence through engagement with authentic industrial resources." Student S2 added: "Completing a small-scale product development project under the guidance of dual-qualified instructors from both industry and academia deepens our understanding of industrial technology and academic research."

4.5.4 The Fourth Dimension: The Latent Gene of CII

Interviews and observations reveal that the internalization of CII as an implicit driving force in industry-education integration, subtly shaping learners' professional identities and sense of belonging like a "cultural gene." Intern S3 shared, "At first, I only found the operating procedures cumbersome. But through my mentors' persistent daily focus on 'temperature' and 'humidity,' I gradually felt a sense of belonging rooted in cultural commitment—something exams could never provide." Trainer I1 noted, "Cultural identity forms a closed loop of 'perception-experience-practice-acceptance,' transforming external cultural symbols into personal cognitive tendencies." It isn't directly imparted through formal curricula but permeates through verbal instruction, meticulous attention to detail, and the collective pride in solving practical problems.

4.5.5 The Fifth Dimension: The Potential Cornerstone of RDI

Short-term efforts are often underestimated, yet prove decisive in long-term competition. Institutional Specialist I2 notes, "After completing standard skill training, guiding students to participate in various micro-projects can elevate them from 'proficient operators' to 'problem identifiers.' Initially, students often view this as an extra task." Undergraduate S1 shared, "During my sophomore year, working on research projects with professors felt distant from real-world work. I'd rather have practiced wine tasting more. Yet through experimental design and failure analysis, I developed stronger problem-solving skills. Now, when facing complex processes, I instinctively try to break them down and analyze them."

5. Discussion

5.1 The Establishment of Institutionalized "Production-Learning Communities"

RST is a Performance factor in vocational education development (Better=0.27, Worse=-0.67). Given the complexity of Wuliangye's industrial processes, the training system serves not only as a venue for skill transfer but also as an entry point for learners into the "community of practice." Situated learning theory identifies "RST" as a fundamental characteristic directly driving satisfaction, ensuring learners' genuine transition from the 'periphery' to the "core." Implicit knowledge, such as Wuliangye's brewing environment and microbial community maintenance, cannot exist independently of physical contexts. Therefore, vocational education development must strictly adhere to the baseline of "full-scale replication," meaning the construction of physical and cognitive environments synchronized with Wuliangye's frontline production operations.

As Liao et al. (2012) noted, skill training detached from real-world contexts leads to knowledge "inertia." When students directly handle actual production orders and assume quality responsibility, their depth of process understanding and speed of developing professional operational habits far surpass those achieved through traditional classroom instruction (Lanza et al., 2015). This study proposes establishing training bases that integrate high-fidelity virtual simulations with physical workshops. This approach ensures students engage in legitimate peripheral participation within non-high-risk environments, meeting enterprises' rigid demands for foundational skills. It fundamentally mitigates satisfaction declines caused by the disconnect between learning and application, laying an unshakable cognitive foundation for subsequent advanced competency development.

Practical implementation of RST: First, establish a "production-learning consortium" through industry-academia collaboration, co-led by Wuliangye production workshop directors and institutional administrators. Each semester, jointly develop an "immersive rotational training plan" aligned with actual production cycles, ensuring every student completes at least one full production batch under designated corporate mentors at critical process stages. Second, develop an integrated "work order-study guide" manual that directly converts daily enterprise process operation orders into teaching materials. While executing authentic work orders, students must refer to the study guide to complete learning and reflection on relevant knowledge points. Third, introduce the enterprise's actual quality control system. Students' training outcomes undergo on-site inspections and quality control department spot checks using the same standards as enterprise employees, with results directly linked to training credits.

5.2 The Implementation of Forward-Looking "Skills Standard Synchronization" Mechanisms

SCCC serves as an excitement factor in vocational education development (Better = 0.28, Worse = -0.56). To achieve a leap from "adequacy" to 'excellence' in vocational education development, we must focus on the exciting characteristic that creates surprises—namely, the deep co-creation of standard content between schools and enterprises. According to the triple helix theory, the boundaries between education (schools), industry (Wuliangye), and government (standard-setting) should be permeable. The "overlap layer" generated by the interaction among these three parties serves as the wellspring of innovation, rapidly transforming corporate knowledge demands into educational offerings to achieve efficient knowledge circulation.

Wuliangye's frontline technical standards should not merely be passively adapted into textbooks; instead, they should be jointly developed by industry and academia into universally applicable teaching standards and vocational qualification frameworks. This deep collaboration, transcending traditional "practical training classes," embodies the process of knowledge capitalization. Rongmin's (2024) research confirms that when vocational education content transcends enterprises' immediate explicit demands and instead leads to industry technical standards, it significantly enhances learners' professional confidence and corporate brand recognition. Educational offerings that far exceed expectations become the key driver for a leap in learner satisfaction.

The detailed implementation plan primarily consists of two aspects: On one hand, establishing a "Joint Laboratory for Baijiu Industry Skills" through collaboration between schools and enterprises, with its core function being "forward-looking technical analysis." On the other hand, based on new standards, jointly developing "certified course packages" with enterprises, where each package includes online micro-courses, virtual simulation software, an enterprise case repository, and skill certification exam questions.

5.3 The Design of Mission-Oriented Precision Empowerment Projects

CII (Better=0.14, Worse=-0.49) and DSCE (Better=0.21, Worse=-0.55) are indifferent factors in vocational education development. Under resource constraints, transforming "cultural identity" and "dual-system collaborative" from non-differentiating universal inputs into "high-impact" characteristics targeting key groups is central to perfecting resource allocation. Situated learning theory emphasizes that the learning process is inherently one of "identity construction." For Wuliangye, with its profound historical heritage, students are not merely getting technical skills but also internalizing the core values and spirit of the corporate culture. Strategies should focus on prospective employees and reserve talent for core technical positions. Through carefully designed 'situations' and "roles," cultural indoctrination and competency development can be seamlessly integrated, creating a deeply immersive cultural environment.

Luo (2011) demonstrates that deep cultural internalization can significantly reduce friction costs in career matching. Advocating for the establishment of a "dual mentor" system linking schools and enterprises, this approach transforms cultural identity education from abstract lectures into an embedded, implicit curriculum within micro-practices like mentor-apprentice interactions and craftsmanship transmission. By precisely targeting and deeply understanding "cultural bearers," overlooked cultural factors become high-leverage points for enhancing learner satisfaction. For technical succession groups, the "Passing the Torch" Master Workshop Program was launched. Through "cultural narrative workshops," veteran artisans share oral histories and decipher the decision-making stories behind classic craftsmanship, requiring participants to produce interpretive reports. For high-potential management groups, participants serve as assistants concurrently engaged in one institutional educational reform project and one corporate practice project. Co-mentored by academic supervisors and corporate middle managers, they are assessed on their ability to integrate university-enterprise resources and resolve complex problems.

5.4 The Co-Creation of Integrated "Problem-to-Solution" Processes

RDI balances both indifference factor and basic factor in vocational education development (Better=0.21, Worse=-0.57). It serves as a foundational attribute in industry-education integration, acting as a potential cornerstone to prevent learner satisfaction from collapsing. According to the tri-helix theory's dynamic model, an innovation system can only sustain continuous operation when academic research, industrial practice, and policy support form a stable upward structure. For university-industry collaboration, without sustained technological research and development and innovation feedback, educational content will rapidly lag behind industrial iteration, leading to functional failure. Therefore, it is imperative to establish a long-term mechanism integrating industry, academia, research, and application, positioning the resolution of practical technical challenges on the production frontline as the starting point for teaching and research.

Awasthy et al. (2020) noted that research and innovation activities based on real-world projects serve as the critical link for sustaining university-industry collaboration. By establishing joint research and development centers, faculty and students directly engage in technological improvements and product innovations for Wuliangye. This approach not only addresses the company's technical challenges but also provides a continuous stream of real-world case studies for teaching, ensuring the stability and irreplaceable nature of industry-education integration. An "industry-education integration innovation fund" could be established, where enterprises propose research topics and jointly bid with university-industry teams. Establish "frontier laboratories" within academic institutions to relocate non-core yet educationally suitable exploratory phases of corporate research and development to universities. Faculty and students would undertake foundational data accumulation, creating a relay model of "corporate research and development -educational exploration." Regularly host "innovation days" to showcase outstanding student proposals, graduation theses, and corporate innovations on the same platform. Invite investment, production, and marketing departments to jointly evaluate these projects, fostering the incubation of viable solutions. Deeply integrate research with innovation to prevent superficial industry-education integration and ensure the vitality of research-based learning.

6. Conclusions and Recommendations

6.1 Research Conclusions

This study empirically examines the primary factors in the development of vocational training programs at Wuliangye, drawing upon the Tri-Helix Theory, Situated Learning Theory, and the Kano Model. Data collection involved 368 questionnaires alongside participatory observation and semi-structured interviews with 10 key informants. Kano model findings reveal: RST is the primary factor in vocational education development. SCCC serves as a strategic factor. RDI is a latent factor. CII and DSCE represent implicit factors. The ranked influence sequence addresses practical challenges in vocational education, providing theoretical justification for prioritizing training program development.

The significance of this research manifests across three dimensions. First, theoretical construction and expansion:

The innovative introduction of the Kano model concretizes abstract vocational education into measurable demand characteristics and satisfaction attributes. Second, addressing the misallocation of practical training resources: Targeting the prevalent issues of “high investment, low output” and “disconnect between learning and application” in vocational education, priority ranking analysis provides scientific guidance for developing practical training programs. Third, reshaping diversified industrial talent cultivation: Emphasizing the strategic value of CII and DSCE in specific contexts helps address the challenge of transforming tacit knowledge into explicit transmission within traditional apprenticeships.

The theoretical contribution of this study lies in integrating the triple helix theory, situational learning theory, and the Kano model to construct a priority sequence analysis for vocational education training development. This deepens the theoretical implications of industry-education integration and provides methodological support for the convergence of education and industry. The practical contribution involves proposing four actionable strategies based on the Kano model's priority framework. These strategies enable dynamic alignment between educational supply and industrial demand, offering a standardized practical paradigm for collaborative development between schools and enterprises.

6.2 Practical Recommendations and Policy Implications

Research recommendations can be developed in three areas: resource allocation, governance mechanisms, and evaluation systems. First, regarding resource allocation, policymakers and institutional administrators should prioritize investments in desired attributes like “real-scenario,” treating them as quality control red lines to prevent the generation of “inert knowledge” caused by distorted external environments. They should concentrate superior resources on tackling exciting attributes such as “standard co-creation,”

Second, regarding governance mechanisms, confer legal entity status or operational entity qualifications on industry-academia collaborative entities. Establish incentive compensation systems driven by “research-driven,” transforming the implicit costs of corporate talent development into explicit benefits like technological research and development and process improvements. This ensures enterprises maintain primary motivation within “dual-system collaborative.”

Finally, in the evaluation system, increase the weight of “process data” in assessments, encourage the development of tools to measure quantifiable ‘craftsmanship’ and “tacit knowledge,” and drive practical training back to its educational essence—shifting focus from “what one can do” to “what kind of person one becomes.”

6.3 Research Limitations and Future Prospects

Although empirical findings on vocational education development have been obtained, certain limitations remain. The sample was primarily collected in Yibin City, limiting the possibility of cross-regional comparisons. Due to constraints in research duration and participant numbers, data collection and organization were not comprehensive. Future studies should expand beyond geographical limitations, select multiple comparable cases for comparative analysis, and conduct long-term follow-up.

Although data underwent reliability and validity testing, interview content remains susceptible to social bias and faulty memory. Qualitative findings are based solely on statements from 10 key informants, indicating limited sample coverage. Future qualitative research should broaden its scope beyond key informants to encompass multiple stakeholders from both schools and enterprises, as well as individuals at different career stages.

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