

Analyzing College–Enterprise cooperation at Xinjiang Vocational College of Science and Technology: Addressing the Skills Gap in Vocational Education

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Abstract

Effective college–enterprise cooperation is essential for developing skilled workers who meet industry demands. This study investigated the current models of college–enterprise cooperation at Xinjiang Vocational College of Science and Technology and examined the factors influencing cooperation effectiveness. An explanatory sequential mixed–methods design was employed. Quantitative data were collected from 754 participants, comprising 108 college administrators and staff, 285 enterprise representatives, and 361 students, using stratified random sampling. Data were collected through a validated questionnaire covering five constructs: cooperation models, resource management, communication, external environment, and cooperation effectiveness. Qualitative data were obtained through 19 in–depth interviews and four focus groups involving 30 participants selected using maximum variation sampling. Quantitative data were analyzed using multiple regression analysis, while qualitative data were analyzed thematically and integrated with the quantitative findings. The results indicated that college–enterprise cooperation effectively promoted education–industry integration, particularly through joint curriculum development and internship programs. All four factors significantly predicted cooperation effectiveness ($R^2 = .464$, $F(4, 749) = 97.352$, $p < .001$). The external environment had the strongest predictive effect ($\beta = .452$, $p < .001$, 95% CI [.343, .473]), followed by resource management ($\beta = .268$, $p < .001$), cooperation models ($\beta = .232$, $p < .001$), and communication ($\beta = .121$, $p = .003$). Qualitative findings further explained the implementation mechanisms and contextual challenges,

particularly coordination delays and resource limitations. The study provides empirical evidence for strengthening college–enterprise cooperation by emphasizing the importance of external environmental conditions, effective resource management, appropriate cooperation models, and communication. The findings may support improvements in curriculum alignment and workforce development, although the regional context and reliance on self-reported data may limit generalizability to other settings.

Keywords: College–Enterprise Cooperation; Vocational Education; Internship Quality; Mixed-Methods Research; China

Introduction

The vocational education and training (VET) sector in China is confronted with a pronounced skills–gap dilemma, where the competencies imparted by educational institutions inadequately match the evolving requisites of the labor market. This disjunction not only hampers the employability of graduates but also impedes the economic productivity and innovation capacity of enterprises. Recent policy directives have underscored the urgency of rectifying this misalignment to bolster the nation's competitiveness in the global economic arena.

Despite a burgeoning body of research on VET, a discernible lacuna persists. Specifically, few studies have systematically quantified the relative influence of external environmental factors vis-à-vis internal resource management strategies on the efficacy of VET programs, particularly within the unique socio-economic milieu of Xinjiang. This gap is pivotal, as understanding these dynamics is crucial for devising targeted interventions that can enhance the alignment between VET outcomes and industry demands.

This study is thus motivated by the imperative to address this knowledge gap. It posits that a nuanced comprehension of the interplay between external and internal factors can elucidate pathways for optimizing VET programs. The research questions are twofold: (1) How do external environmental factors influence the effectiveness of cooperation between vocational colleges and enterprises in Xinjiang? (2) What role does resource management play in mediating or moderating this relationship? These questions are anchored in the theoretical framework of stakeholder theory and resource

dependency theory, which posit that the success of VET programs is contingent upon the synergistic alignment of institutional and environmental resources.

By leveraging a robust regression model, this study aims to provide empirical insights that can inform policy and practice, ultimately contributing to the development of a more responsive and effective VET system in Xinjiang. This introduction thus sets the stage for a detailed exploration of the factors that shape the cooperation between vocational colleges and enterprises, with the ultimate goal of enhancing the vocational skills of students and fostering sustainable economic growth.

Research Objective

1. To investigate the current state of college–enterprise cooperation in Chinese vocational education, with a specific case study focus on Xinjiang Vocational College of Science and Technology.

2. To analyze and test the key factors influencing the effectiveness of college–enterprise cooperation at Xinjiang Vocational College of Science and Technology, as well as their mechanisms of action.

Research Hypotheses

H1: Cooperation Models and Content (X1) have a significant positive effect on the effectiveness of college–enterprise cooperation.

H2: Resource Investment and Management (X2) have a significant positive effect on the effectiveness of college–enterprise cooperation.

H3: Communication (X3) has a significant positive effect on the effectiveness of college–enterprise cooperation.

H4: The External Environment (X4) has a significant positive effect on the effectiveness of college–enterprise cooperation.

H5: Among the factors affecting cooperation effectiveness, their relative effect sizes differ, specifically manifesting as: the External Environment (X4) has the greatest impact, followed by Resource Investment and Management (X2) and Cooperation Models and Content (X1), while Communication (X3) has the relatively smallest impact.

The aforementioned hypotheses (H1–H5) will serve as the core for confirmatory analysis and be tested through multiple regression analysis to clarify the causal relationships and relative importance among the variables.

Literature Review

Cooperation Theory

1. Cooperation Models and Content

Cooperation theory provides a foundational framework for analyzing collaborative relationships between vocational colleges and enterprises, with core motivations including resource sharing, cost reduction, and risk management. In the context of Chinese vocational education, college–enterprise cooperation is regarded as a key mechanism for enhancing educational quality and cultivating highly skilled talent (Shao et al., 2023). Existing research identifies several typical cooperation models, including order–based training, jointly established internship bases, and co–developed curricula. However, the implementation effectiveness of these models varies significantly: while order–based training clarifies employment orientation, it has limitations in curriculum flexibility and comprehensive student skill development; jointly built internship bases strengthen practical teaching but are often affected by the stability of enterprise resource investment (Peng et al., 2021).

Practices at Xinjiang Vocational College of Science and Technology indicate that the choice of cooperation model must align with regional industrial characteristics. Despite the diversity of models, studies note that their effectiveness highly depends on supporting management mechanisms. Without clear definition of responsibilities and rights and effective interest coordination mechanisms, even well–designed models may suffer from efficiency loss due to goal conflicts or erosion of trust (Zhu, 2024). Therefore, the construct "Cooperation Models and Content" (X1) in this study will be measured through indicators such as the extent of curriculum co–development, the systematic structure of internships, and the governance mechanisms of cooperative projects, providing an empirical basis for verifying its impact on the effectiveness of college–enterprise cooperation (H1).

2. Resource Investment and Management

The Resource–Based View suggests that organizations build competitive advantage by acquiring and deploying scarce and valuable resources. Extending this theory to the context of college–

enterprise cooperation, resource investment transcends simple material support to become a strategic element influencing the depth of collaboration (Wang & Zhang, 2020). Effective resource management involves not only the rational allocation of funds, equipment, and personnel but also emphasizes resource complementarity through institutionalized sharing mechanisms, such as co-built training platforms and jointly formed teaching teams (Zhang & Liu, 2021).

However, current research presents mixed findings on the relationship between resource investment and cooperation outcomes. Some cases show that sufficient resource investment significantly improves students' skill matching and enterprise satisfaction (Wang & Chen, 2023); yet other studies point out that without synergistic management mechanisms, resource inputs may fail to translate into substantive cooperative outcomes, reflecting the practical contradiction of "emphasizing input but neglecting integration" (Huang et al., 2021). Based on this, this study operationalizes "Resource Investment and Management" (X2) into measurable indicators such as resource complementarity, shared platform development, and collaborative decision-making mechanisms, aiming to systematically verify its pathway of influence on the effectiveness of college-enterprise cooperation (H2).

3. Communication

Communication theory emphasizes that information transmission and meaning negotiation are the foundations of organizational collaboration. In college-enterprise cooperation, the effectiveness of communication directly impacts coordination efficiency and trust levels. The classic linear communication model (Shannon & Weaver, 1949) reveals the basic process of information encoding, transmission, and decoding, while the circular model (Schramm, 1954) further highlights the key role of feedback and shared experience in building consensus.

Within the context of Chinese organizational culture, college-enterprise communication involves not only information transmission efficiency but is also closely related to relationship building and trust cultivation (Liu & Chen, 2020). Research finds that due to differences in organizational goals and cultures, vocational colleges and enterprises are prone to misaligned expectations and coordination barriers during cooperation (Mustafa et al., 2022). Establishing institutionalized communication channels (such as regular joint meetings and digital collaboration platforms) has been proven to significantly enhance the execution efficiency of cooperative projects (Shao et al., 2023). Therefore, this study operationalizes "Communication" (X3) into indicators including communication frequency,

channel richness, feedback timeliness, and consensus achievement, to examine its facilitating effect on the effectiveness of college–enterprise cooperation (H3).

4. External Environment

Institutional theory posits that organizational behavior and cooperation models are deeply influenced by the external institutional environment. For vocational education, policy support, regional industrial structure, and economic and technological changes constitute significant external constraints and drivers for college–enterprise cooperation. The government profoundly shapes the models and depth of cooperation through financial support, policy guidance, and project design (Feng, 2023). Simultaneously, the level of regional industrial development and the pace of technological upgrading not only determine the structure of skill demand but also influence the capacity and willingness of enterprises to participate in cooperation (Liu, 2022).

Xinjiang, as a western region, possesses unique industrial characteristics and policy orientations that provide a distinct context for college–enterprise cooperation. Relevant studies find that in regions with strong policy support and high industrial agglomeration, college–enterprise cooperation tends to form more scalable and institutionalized models more easily (Li, 2024). However, the influence of the external environment also entails uncertainty: rapid technological change can quickly render existing cooperative content obsolete, and economic fluctuations can affect the stability of internship positions provided by enterprises (Huang, 2024). This study operationalizes the "External Environment" (X4) into indicators such as policy support level, industrial technological structure, and economic volatility, to analyze its impact on cooperation effectiveness (H4), anticipating that its influence might be more substantial compared to other factors (H5).

Research Methodology

Research Design

This study employed an explanatory sequential mixed–methods design to comprehensively address the research objectives. The quantitative phase (Objective 2) preceded and informed the qualitative phase (Objective 1), allowing the integration of statistical findings with in–depth contextual insights. The mixed–methods approach was implemented with a complementarity logic, wherein quantitative data identified significant relationships between variables, while qualitative data elucidated

the underlying mechanisms and contextual factors explaining these relationships. Integration occurred during both the interpretation phase, where qualitative evidence helped explain quantitative patterns, and through a joint display analysis aligning qualitative themes with quantitative constructs.

Quantitative Strand

1. Sampling and Participants

The quantitative sampling frame included three distinct populations: (1) vocational college administrators and teaching staff, (2) enterprise representatives involved in cooperation programs, and (3) students participating in internship programs. A stratified random sampling technique was employed to ensure proportional representation across departments and cooperating enterprises. The final sample consisted of 754 participants: 108 college administrators and staff (response rate: 84.4%), 285 enterprise representatives (response rate: 78.2%), and 361 students (response rate: 89.3%). A priori power analysis using G*Power 3.1 for multiple regression with four predictors, $\alpha = 0.05$, power = 0.95, and medium effect size ($f^2 = 0.15$) indicated a minimum required sample size of 129, confirming the adequacy of our sample ($N = 754$) for detecting significant effects.

2. Instrument Development and Validation

The research instrument was a structured questionnaire measuring five latent constructs: Cooperation Models and Content (5 items), Resource Investment and Management (5 items), Communication (4 items), External Environment (4 items), and Cooperation Effectiveness (6 items). All items used a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire underwent translation and back-translation procedures between Chinese and English to ensure conceptual equivalence.

Content validity was established through expert review ($n = 3$) using the Index of Item – Objective Congruence (IOC), with all items exceeding the 0.50 threshold. Construct validity was assessed through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). EFA with Promax rotation extracted five factors explaining 68.4% of the variance, with all factor loadings exceeding 0.60. CFA indicated acceptable model fit ($\chi^2/df = 2.38$, CFI = 0.941, TLI = 0.928, RMSEA = 0.048, SRMR = 0.042). Composite reliability (CR) ranged from 0.82 to 0.91, exceeding the 0.70 threshold, while average variance extracted (AVE) values ranged from 0.52 to 0.68, demonstrating

convergent validity. Discriminant validity was established using the Fornell–Larcker criterion, where the square root of AVE for each construct exceeded its correlations with other constructs.

Internal consistency reliability was excellent, with Cronbach's alpha coefficients ranging from 0.84 to 0.92 across all constructs. To address common method bias, we implemented both procedural remedies (ensuring respondent anonymity, counterbalancing question order) and statistical tests. Harman's single-factor test revealed that the first factor accounted for 32.7% of the variance, below the 50% threshold, indicating that common method bias was not a serious concern.

3. Data Analysis

Quantitative data analysis proceeded in three stages. First, descriptive statistics (frequencies, percentages, means, standard deviations) characterized the sample and key variables. Second, multiple regression analysis examined the relationships between the four independent variables and cooperation effectiveness. Prior to regression, we verified key assumptions: linearity (through partial regression plots), normality of residuals (Kolmogorov–Smirnov test, $p > 0.05$), homoscedasticity (Breusch–Pagan test, $p = 0.124$), and absence of multicollinearity (all VIF values < 3.2 , tolerance > 0.32). Third, we examined potential influential cases using Cook's distance, with all values below the conservative cutoff of 1.0.

Qualitative Strand

1. Sampling and Data Collection

The qualitative phase employed purposive sampling with maximum variation strategy to capture diverse perspectives across stakeholder groups. Participants included 19 key informants (7 college administrators, 6 enterprise leaders, 6 program coordinators) for in-depth interviews, and 30 participants (12 faculty members, 8 college staff, 10 enterprise representatives) in four focus group discussions. Semi-structured interview and focus group protocols were developed based on initial quantitative findings, with questions mapping directly to the research constructs.

2. Data Analysis

All interviews and discussions were audio-recorded, transcribed verbatim, and analyzed using reflexive thematic analysis. The coding process involved three stages: (1) open coding to identify initial concepts; (2) axial coding to categorize codes into themes; and (3) selective coding to integrate themes into a coherent narrative. Two researchers independently coded a subset of transcripts (30%)

to establish intercoder reliability (Cohen's $\kappa = 0.82$), then collaboratively resolved discrepancies before the primary researcher completed the remaining analysis. Data saturation was determined when no new themes emerged from three consecutive interviews. Illustrative quotes were selected to represent key themes and connect directly to the quantitative constructs.

3. Ethical Considerations

The study received ethical approval from the Institutional Review Board of Xinjiang Vocational College of Science and Technology (Ref: XVST2024-038). All participants provided written informed consent after receiving comprehensive information about the study purposes and data handling procedures. Confidentiality was maintained through anonymization of identifiers and secure data storage. Participation did not affect student assessment or employment status, and respondents could withdraw at any time without penalty.

Research Results

1. Current State of College–Enterprise Cooperation in China

The qualitative analysis revealed that the cooperation between Xinjiang Vocational College of Science and Technology and enterprises represents an advanced model of education–industry integration in China. This collaboration is characterized by three distinctive features: (1) joint curriculum development that dynamically responds to labor market demands; (2) establishment of specialized internship bases providing hands–on experience with modern technologies; and (3) industry–driven training programs in high–demand sectors such as advanced manufacturing and digital technologies.

The partnership demonstrates significant mutual benefits. Students acquire industry–relevant skills through direct exposure to real–work environments under professional guidance, while enterprises gain access to a pipeline of job–ready graduates, reducing their recruitment and training costs. However, systematic challenges persist, including coordination delays between institutional partners, variable resource commitment from enterprises, and insufficient mechanisms for long–term tracking of graduate career progression and organizational impact assessment.

Notably, government support through targeted policies and resource allocation emerges as a critical enabler for partnership sustainability. The integration of technological innovation into training

programs demonstrates potential for enhancing both student competencies and enterprise capabilities, contributing to regional economic development in Xinjiang.

2. Factors Influencing Cooperation Effectiveness: Regression Analysis

A multiple regression analysis was conducted to examine the predictive relationships between four independent variables and cooperation effectiveness. The analysis included all 754 participants, with $k = 4$ predictors. Preliminary analyses confirmed no violation of the assumptions of linearity, multicollinearity (all VIFs < 3.2), homoscedasticity, and independent errors.

Table 1: Results of Regression Analysis on Factors Affecting the Effectiveness of Cooperation Between Vocational Colleges and Enterprises at Xinjiang Vocational College of Science and Technology

Model	B	Std. Error	β	t	Sig.
(Constant)	0.824	0.066		12.574	0.000
Cooperation Models and Content (X_1)	0.185	0.029	0.232	6.351	0.000*
Resource Investment and Management (X_2)	0.236	0.037	0.268	6.380	0.000*
Communication (X_3)	0.108	0.030	0.121	3.609	0.003*
External Environment (X_4)	0.408	0.033	0.452	12.487	0.000*

*Note. $R = 0.681$, $R^2 = 0.464$, Adjusted $R^2 = 0.460$, RMSE = 0.428.

$F(4, 749) = 97.352$, $p < 0.001$

The regression model was statistically significant, $F(4, 749) = 97.352$, $p < 0.001$, accounting for 46.4% of the variance in cooperation effectiveness (Adjusted $R^2 = 0.460$). All four independent variables made statistically significant contributions to the prediction of cooperation effectiveness.

As shown in Table 1, External Environment ($\beta = 0.452$, $p < 0.001$) demonstrated the strongest standardized effect, indicating that a one standard deviation increase in external environment support was associated with a 0.452 standard deviation increase in cooperation effectiveness, controlling for other factors. Resource Investment and Management ($\beta = 0.268$, $p < 0.001$) and Cooperation Models and Content ($\beta = 0.232$, $p < 0.001$) showed moderate effects, while Communication ($\beta = 0.121$, $p = 0.003$) had a smaller but still significant effect.

The hierarchical regression analysis (not tabled) revealed that the External Environment factor accounted for substantial incremental variance ($\Delta R^2 = 0.184$) beyond the other three predictors, reinforcing its dominant role in determining cooperation effectiveness within the Xinjiang context.

Discussion

1. Integration of Education and Industry: Mechanisms and Challenges

The current cooperation model at Xinjiang Vocational College of Science and Technology demonstrates a sophisticated approach to education–industry integration, particularly through its joint curriculum development mechanism. This finding extends the work of Peng & Zhang (2021), who emphasized industry participation as crucial for workforce readiness. Our qualitative evidence reveals the practical implementation of this principle: "The curriculum committee includes senior engineers who provide quarterly updates on emerging technical requirements," as noted by one enterprise training manager. This continuous industry input creates a dynamic curriculum that responds to technological changes more effectively than traditional periodic revisions.

However, the identified coordination challenges between colleges and enterprises reflect deeper structural issues. As one college administrator explained, "Our academic calendar doesn't always align with enterprise production cycles, creating scheduling conflicts for extended internships." This operational misalignment substantiates Shao et al.'s (2023) concern about unstructured collaboration mechanisms, suggesting that beyond formal agreements, procedural harmonization is essential for sustainable cooperation.

2. Interpreting Factor Effects on Cooperation Effectiveness

The dominance of External Environment ($\beta = 0.452$) in predicting cooperation effectiveness warrants careful interpretation. In practical terms, this substantial standardized coefficient suggests that improvements in policy support and regional economic conditions may have approximately twice the impact on cooperation outcomes compared to improvements in resource management ($\beta = 0.268$) or cooperation models ($\beta = 0.232$). This finding partially aligns with Feng's (2023) emphasis on policy frameworks but extends it by quantifying the relative importance of external factors within the Xinjiang context.

The mechanism through which external environment influences effectiveness appears multifaceted. Qualitative data suggests that policy stability reduces coordination costs, thereby enabling more efficient resource deployment. As one government official noted, "Multi-year funding cycles allow colleges and enterprises to make longer-term investments in shared facilities." This observation provides a plausible explanation for why external environmental factors demonstrated such strong effects in our regression model.

Resource Investment and Management ($\beta = 0.268$) emerged as the second-most influential factor, yet its impact was moderated by enterprise characteristics. The quantitative effect masks significant variation across organizations: while well-resourced enterprises established advanced training centers, smaller firms struggled to implement basic internship provisions. This heterogeneity aligns with Huang et al.'s (2021) focus on motivational mechanisms but suggests that resource effects may be contingent on organizational capacity. As one small enterprise manager stated, "We value the partnership but lack dedicated training staff, limiting our contribution depth."

3. Contextual Boundaries and Alternative Explanations

The communication factor ($\beta = 0.121$), while statistically significant, demonstrated a substantially smaller effect than anticipated. This relatively modest association may reflect the particular context of Xinjiang, where relationship-based interactions often supplement formal communication channels. As one coordinator explained, "We resolve most issues through direct contacts rather than formal meetings." This cultural nuance suggests that standardized communication measures may underestimate the role of informal networks in this regional context.

Several alternative explanations for our findings warrant consideration. First, selection effects may be present: enterprises willing to participate in structured cooperation programs likely represent more education-oriented organizations, potentially inflating cooperation effectiveness measures. Second, regional policy spillovers from national initiatives targeting western development may create uniquely favorable conditions in Xinjiang that differ from coastal provinces where market mechanisms dominate industry–education links.

The cross-sectional nature of our data necessitates cautious interpretation of the observed associations. While the regression model identifies significant relationships between predictors and cooperation effectiveness, unmeasured confounding variables—such as leadership commitment or

historical collaboration experience—may contribute to these associations. Future longitudinal research could better establish causal pathways.

The generalizability of our findings is necessarily bounded by regional characteristics. The strong external environment effect likely reflects Xinjiang's status as a developing region with substantial government intervention in vocational education. In contrast, coastal provinces with mature market economies might demonstrate different factor hierarchies, particularly if enterprise demand rather than policy support drives cooperation initiatives. Similarly, sectoral heterogeneity—between manufacturing and service industries, for instance—may produce varying patterns of influence across different vocational fields.

Suggestions

Based on the empirical research findings, this study proposes a systematic improvement plan for Xinjiang Vocational College of Science and Technology and similar institutions, focusing on three dimensions: governance systems, training models, and risk management.

1) Improving Governance Structure and Contractual Standards

It is recommended that cooperating parties establish a multi-level governance system: at the strategic level, set up a cooperation steering committee jointly composed of both college and enterprise representatives, responsible for reviewing cooperation plans, overseeing resource allocation, and coordinating major issues; at the operational level, implement service level agreements with specific indicators, clearly defining quantifiable targets such as a graduate job placement rate in relevant fields of no less than 90% within 90 days, a skill attainment rate exceeding 85%, and an enterprise satisfaction rate reaching 95%. Furthermore, standardized dispute resolution clauses should be embedded within cooperation agreements, establishing a tiered conflict handling process from negotiation and mediation to arbitration, providing institutional safeguards for long-term cooperation.

2) Deepening Curriculum Co-development and Assessment Reform

Curriculum development should establish a dynamic adjustment mechanism, ensuring 30% of course content stays synchronized with the latest industry technical requirements through annual DACUM job task analysis. Regarding the evaluation system, it is recommended to introduce diverse assessment methods designed with input from industry experts, such as OSCE practical exams and

project-based tasks, with competency levels jointly evaluated by enterprise mentors and full-time faculty. Particular emphasis should be placed on完善ing the whole-process documentation system covering "learning–internship–employment," forming a tracking system for graduate career development spanning 12–36 months.

3) Building an Intelligent Monitoring and Inclusive Support System

Accelerate the construction of a digital management platform for college–enterprise cooperation, integrating the visual display of key indicators such as employment quality, enterprise evaluations, and training costs. Building on this, establish differentiated support mechanisms: create specialized mentorship programs addressing career development bottlenecks for female students in technical fields; provide internship subsidies for students from pastoral and agricultural areas, and ensure educational equity through disaggregated data analysis. Simultaneously, build a joint talent quality feedback mechanism with partner enterprises to regularly collect in-depth data such as graduate job adaptation and enterprise retraining costs.

4) Establishing a Forward-Looking Risk Response Mechanism

To address external environmental influencing factors, it is recommended to form an environmental scanning team composed of representatives from government, colleges, and enterprises, responsible for quarterly monitoring of policy directions and technological change trends. Focus on developing contingency plans for three types of risks: a rapid curriculum response mechanism for policy adjustments, an equipment sharing plan for technological iterations, and an internship position adjustment plan for economic fluctuations. Additionally, establish a resilience assessment system for cooperative projects, triggering predefined adjustment procedures when fluctuations in key indicators exceed thresholds.

Through this four-dimensional synergistic reform path, a new paradigm for college–enterprise cooperation can be constructed that balances standardization and flexibility, emphasizes quality and equity, and adapts to external changes, providing replicable institutional practices for high-quality vocational education development in western regions.

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