



RESEARCH ARTICLE

THE IMPACT OF DEEP INDUSTRY-EDUCATION INTEGRATION ON HIGH-QUALITY EMPLOYMENT: EMPIRICAL EVIDENCE FROM VOCATIONAL EDUCATION IN DONGYING

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ARTICLE INFO	ABSTRACT
Submission Jul. 23, 2026 Acceptance Jul. 27, 2026 Keywords Industry-education Integration; Vocational education; Employment quality; Human capital; Regional development Corresponding Author 470406906@qq.com john.doe@email.com	High-quality employment has emerged as a pivotal concern within the context of economic transformation and industrial upgrading. Vocational education plays a crucial role in supplying skilled labor; however, its effectiveness is largely contingent upon the depth of collaboration between educational institutions and industries. This study investigates the impact of deep industry-education integration on high-quality employment outcomes, using vocational education in Dongying as an empirical case. Drawing upon human capital theory and collaborative governance theory, this paper constructs an analytical framework that links the depth of industry-education integration to employment quality through mediating mechanisms such as skill matching, practical competence, and employment stability. Utilizing institutional data, policy documents, and graduate employment indicators, the findings reveal that deeper integration significantly enhances employment quality outcomes, including job-skill alignment, income levels, and career sustainability. The results provide empirical support for industry-education integration as an effective mechanism for improving employment quality and offer policy implications for vocational education reform.

1. INTRODUCTION

With the acceleration of industrial upgrading and technological change, labor markets increasingly demand skilled workers who possess not only technical expertise but also strong workplace adaptability. (if individuals lack the procedural abilities ,i.e., how they undertake work tasks (Billett, 2018). In this context, high-quality employment—Abundant employment

opportunities, optimized employment structure, professional alignment, complete rights protection, and sustainable development—has become a central objective of education and labor policies. However, despite continuous expansion of vocational education systems, persistent mismatches between education outcomes and industrial skill demands remain a major challenge, particularly in regions undergoing economic restructuring.

Vocational education is widely regarded as a critical bridge between education and employment, as it is directly oriented toward labor market needs and skill formation. Skills in firms highlights the significance of VET as an ‘input’ to companies’ decisions and processes (Cedefop, 2020). Nevertheless, traditional vocational training models are often dominated by school-centered curricula with limited and fragmented enterprise participation. Such models struggle to respond effectively to rapidly evolving industrial technologies and occupational standards. As a result, vocational graduates may achieve employment in quantitative terms while falling short in employment quality, including job–skill alignment and long-term career sustainability.

To address these challenges, deep industry–education integration has been promoted as a strategic pathway for vocational education reform. Unlike superficial forms of school–enterprise cooperation, deep integration emphasizes joint governance structures, co-designed curricula, shared training resources, and sustained enterprise involvement throughout the talent cultivation process. From a theoretical perspective, such integration enhances the efficiency of human capital formation by reducing information asymmetry between education providers and labor markets, while also strengthening collaborative governance among key stakeholders.

Although existing studies acknowledge the positive role of industry–education collaboration, several limitations persist in the literature. First, most empirical research focuses on employment rates rather than multidimensional employment quality outcomes. Second, industry–education integration is often treated as a binary or descriptive variable (Busemeyer & Iversen, 2020), with limited attention paid to integration depth and its internal mechanisms. Third, empirical evidence based on regional or institution-level cases remains scarce, particularly studies that systematically link specific integration practices to employment quality through theoretically grounded models. These gaps limit our understanding of how and why industry–education integration affects vocational graduates’ labor market outcomes (Chankseliani & Relly, 2020).

Against this backdrop, this study examines whether and how deep industry–education integration improves high-quality employment outcomes in vocational education. Using vocational education in Dongying as an empirical context, the study constructs an analytical framework that links integration depth to employment quality through mediating mechanisms such as skill matching, practical competence, and employment stability. The empirical analysis draws on institutional data, graduate employment indicators, and employer evaluations from Dongying Vocational College, providing a detailed illustration of how industry–education integration operates at the institutional level.

This study makes several important contributions to the literature on vocational education and employment quality. First, it shifts the analytical focus from employment quantity to employment quality by operationalizing employment outcomes through job–skill matching,

income level, and early-career employment stability. Second, it advances research on industry–education integration by explicitly examining integration depth and demonstrating how concrete institutional arrangements—such as modular curriculum design, enterprise-led teaching, and alignment with job standards—translate into improved employment outcomes. Third, the study develops a theoretically grounded mediation framework and applies regression-based analysis and structural equation modeling (SEM) to empirically test the mechanisms linking industry–education integration to employment quality. Finally, by leveraging detailed institutional and employer-level data from Dongying, the study provides contextually grounded yet analytically generalizable evidence for understanding vocational education reform in industrial regions.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1. Industry–Education Integration in Vocational Education

Industry–education integration has become a central concept in vocational education reform, widely regarded as a critical institutional mechanism for improving the relevance and effectiveness of skill formation. Existing studies generally argue that closer collaboration between vocational institutions and enterprises enhances curriculum relevance, strengthens practical training, and improves graduates' employability.

From a governance perspective, industry–education integration is often conceptualized as a collaborative arrangement involving governments, educational institutions, and enterprises, aiming to align educational supply with labor market demand. Empirical research has shown that enterprise participation in curriculum development, teaching delivery, and assessment contributes positively to students' workplace readiness and job performance.

However, much of the existing literature treats industry–education integration as a binary or superficial concept, focusing on whether cooperation exists rather than examining its depth and degree of institutionalization. As a result, limited attention has been paid to how different levels of integration influence graduate outcomes through specific mechanisms. This gap underscores the need for studies that move beyond descriptive accounts and adopt an analytically grounded approach to integration depth.

2.2. Employment Quality in Vocational Education

Employment quality has increasingly been recognized as a more comprehensive indicator of labor market outcomes than employment rates alone. Unlike traditional measures that focus on job attainment, employment quality emphasizes multidimensional attributes such as income adequacy, job–skill matching, employment stability, and early-career development prospects.

In the context of vocational education, employment quality is closely linked to the extent to which graduates' skills align with occupational requirements. Empirical studies suggest that vocational graduates with strong practical skills and industry-relevant competencies are more likely to obtain stable employment with higher returns and clearer career trajectories. Conversely, when training content is poorly aligned with enterprise needs, graduates may experience skill under-utilization, frequent job changes, or limited career progression, even if employment rates appear satisfactory (Clarke & Winch, 2019).

Despite its importance, employment quality remains under-explored in vocational education research, where many studies continue to prioritize short-term employment indicators. This limitation constrains the evaluation of vocational education reforms aimed at fostering sustainable and high-quality employment outcomes.

2.3. Industry–Education Integration Depth and Employment Quality

Recent scholarship has begun to emphasize the importance of industry–education integration depth in explaining the effectiveness of collaborative training arrangements. Integration depth refers not merely to the presence of cooperation, but to the extent to which enterprises are systematically embedded in curriculum design, teaching processes, training delivery, and evaluation mechanisms.

From the perspective of human capital theory, deeper integration reduces information asymmetry between education providers and employers, enabling vocational institutions to design training programs that more accurately reflect skill demand. This alignment enhances the efficiency of human capital formation and increases the labor market value of vocational qualifications.

Accordingly, deeper industry–education integration is expected to improve graduates' employment quality by facilitating smoother school-to-work transitions and improving the match between acquired competencies and job requirements. Based on this reasoning, the following hypothesis is proposed:

H1: Industry–education integration depth has a positive and significant effect on employment quality among vocational education graduates.

2.4. Practical Competence as a Mediating Mechanism

While industry–education integration is expected to influence employment quality, its effects are unlikely to occur entirely through direct institutional channels. Instead, the impact of integration is largely realized through changes in students' skill formation processes, particularly in the development of practical competence.

Practical competence refers to graduates' ability to apply technical knowledge in real workplace contexts, including hands-on operational skills, problem-solving capacity, and adaptability to production environments. Prior research consistently identifies practical competence as a core outcome of effective vocational training and a key determinant of employers' hiring and retention decisions.

Deep industry–education integration enhances practical competence by embedding students in authentic work settings through enterprise-led training modules, apprenticeships, and work-based learning arrangements. These experiences expose students to real production processes and organizational norms, facilitating the accumulation of task-specific and transferable skills that are highly valued in the labor market.

As practical competence directly influences job performance, income potential, and employment stability, it represents a critical mechanism linking institutional collaboration with

employment outcomes. Therefore, this study proposes the following mediation hypothesis:

H2: Practical competence mediates the relationship between industry–education integration depth and employment quality.

2.5. Analytical Framework

Based on the above hypotheses, this study constructs a parsimonious analytical framework in which industry–education integration depth affects employment quality both directly and indirectly through practical competence. This framework provides a theoretically grounded basis for the empirical models tested in subsequent sections and allows for a focused examination of the primary mechanism underlying high-quality employment outcomes in vocational education.

2.6. Theoretical Positioning and Contribution

This study does not aim to test human capital theory in its abstract form. Instead, it refines and contextualises human capital arguments by specifying how institutionalised industry–education integration improves the efficiency of skill formation.

Collaborative governance theory is incorporated as a complementary perspective to explain how multi-actor coordination between vocational institutions and enterprises reduces information asymmetry and enables effective implementation of human capital investments. In this sense, collaborative governance provides the institutional mechanism through which human capital formation is operationalised.

3. METHODOLOGY

3.1. Research Design

This study adopts a case-based empirical research design to examine the impact of deep industry–education integration on employment quality in vocational education, with practical competence specified as the sole mediating mechanism. Focusing on a single mediator allows for analytical clarity and enhances model robustness in contexts where data are institutionally grounded and sample sizes are moderate.

Grounded in human capital theory, the research design conceptualises practical competence as the key channel through which institutionalised collaboration between vocational colleges and enterprises is translated into labour market outcomes. To empirically test this mechanism, the study combines regression-based mediation analysis with a simplified structural equation modelling (SEM) approach.

3.2. Empirical Context and Data

The empirical setting of this study is vocational education in Dongying, a resource-based industrial city undergoing economic restructuring and industrial upgrading. Within this context, Dongying Vocational College serves as the focal institutional case, given its sustained implementation of enterprise co-developed curricula, enterprise-led training modules, and modern apprenticeship programmes.

Data are collected from multiple sources, including institutional administrative records,

graduate employment tracking systems, employer evaluation surveys, and relevant policy documents. The integration of these data sources enhances measurement validity and reduces reliance on single-source reporting.

3.3. Variable Measurement

Industry–education integration depth (IEI) is measured using a composite index capturing the extent of enterprise participation in curriculum design, teaching delivery, practical training, and assessment processes. Practical competence (PC) is assessed through a combination of employer evaluations and graduate self-reports, focusing on hands-on operational skills, problem-solving ability, and workplace adaptability. Employment quality (EQ) is constructed as a multidimensional indicator incorporating job–skill matching, initial income level, and early-career employment stability.

Control variables include programme type, major category, and relevant institutional characteristics to account for structural heterogeneity across vocational programmes.

3.4. Model Specification

The baseline model estimates the direct effect of IEI on employment quality:

$$EQ_i = \alpha_0 + \alpha_1 IEI_i + \alpha_2 X_i + \epsilon_i$$

The mediating role of practical competence is tested using the following equations:

$$PC_i = \beta_0 + \beta_1 IEI_i + \beta_2 X_i + \mu_i$$

$$EQ_i = \gamma_0 + \gamma_1 IEI_i + \gamma_2 PC_i + \gamma_3 X_i + v_i$$

Partial mediation is supported if the coefficient of IEI decreases after the inclusion of PC while remaining statistically significant.

To validate robustness, a simplified SEM is estimated to simultaneously assess direct and indirect paths from IEI to EQ through practical competence. Model fit is evaluated using standard indices (CFI, TLI, RMSEA).

3.5. Methodological Justification and Robustness

This study adopts a focused and theory-driven empirical strategy designed to balance analytical rigour with data feasibility in a vocational education context. Several methodological choices warrant explicit justification.

Structural Equation Modeling (SEM) Approach: A simplified SEM approach is employed primarily as a confirmatory tool to validate the hypothesised mediation structure rather than as an exploratory technique. Given the study’s emphasis on testing a theoretically specified pathway—namely, the indirect effect of industry–education integration depth on employment quality through practical competence—a parsimonious SEM framework is considered appropriate. This approach allows for simultaneous estimation of direct and indirect effects while avoiding over-parameterisation.

Sample Size Adequacy: The sample size is adequate for the chosen analytical strategy.

Although SEM is often associated with large samples, methodological literature indicates that mediation-focused SEM models with limited complexity can yield reliable estimates under moderate sample conditions. In this study, SEM is used to corroborate regression-based mediation results rather than to estimate complex latent structures, thereby enhancing robustness without imposing excessive sample size requirements.

Treatment of Common Method Bias: Potential common method bias is mitigated through the use of multiple data sources. Industry–education integration depth is measured using institutional and programme-level records, practical competence is assessed through employer evaluations and graduate self-reports, and employment quality is derived from graduate employment tracking data. This multi-source design reduces the likelihood that observed relationships are driven by single-source measurement artefacts.

Specification of Reflective Constructs: All latent constructs are specified as reflective. Observed indicators are assumed to reflect underlying theoretical concepts—such as practical competence and employment quality—rather than jointly forming them. This specification aligns with established practice in vocational education and employability research.

Analytical Parsimony: Finally, the study prioritises analytical parsimony by focusing on a single, theoretically grounded mediating mechanism and a streamlined model structure. This design choice enhances interpretability and reduces the risk of spurious findings, making it particularly suitable for applied research in vocational education settings.

4. EMPIRICAL RESULTS

4.1. Descriptive Statistics

Descriptive statistics indicate sufficient variation in industry–education integration depth (IEI), practical competence (PC), and employment quality (EQ), supporting subsequent regression analysis. Correlation analysis shows significant positive associations between IEI and PC, and between PC and EQ, providing preliminary evidence for the proposed mediation mechanism. Variance inflation factor (VIF) tests suggest no multicollinearity concerns.

4.2. Baseline Regression Results

Baseline regressions reveal a positive and statistically significant effect of industry–education integration depth on employment quality across all model specifications. The estimated coefficients remain stable after the inclusion of control variables, indicating that deeper institutionalized collaboration with enterprises is associated with higher-quality employment outcomes among vocational graduates.

These practices directly operationalise industry–education integration depth as conceptualised in Hypothesis 1.

4.3. Mediation Effect of Practical Competence

Regression results show that IEI significantly enhances graduates' practical competence. When practical competence is included in the employment quality model, it exhibits a strong positive effect, while the coefficient of IEI decreases but remains statistically significant.

This pattern indicates a partial mediation effect, suggesting that industry–education integration improves employment quality partly by strengthening graduates' practical competence. These findings provide empirical support for the mediation mechanism proposed in Hypothesis 2.

4.4. Structural Equation Modeling Results

A simplified structural equation model (SEM) is estimated to validate the mediation mechanism. The model demonstrates acceptable fit indices (CFI and TLI above conventional thresholds; RMSEA within acceptable range). Path coefficients confirm significant direct effects of IEI on employment quality and significant indirect effects through practical competence, consistent with the regression-based results.

4.5. Summary of Findings

Overall, the empirical evidence consistently indicates that deep industry–education integration significantly enhances employment quality in vocational education, both directly and indirectly through the development of practical competence. Within the institutional context of Dongying Vocational College, the findings illustrate how structured collaboration with industry effectively translates educational reform into measurable labor market outcomes.

A clear empirical basis for the subsequent discussion and policy implications.

5. EMPIRICAL ANALYSIS: EVIDENCE FROM DONGYING

5.1. Industry–Education Integration Practices

Vocational institutions in Dongying have established long-term cooperation mechanisms with key enterprises, including co-designed curricula, enterprise-led training modules, and modern apprenticeship programs. Enterprise experts participate in teaching and assessment, ensuring alignment with industry standards.

Take Dongying Vocational College as an example. The content shown in the following figure is the suggestions from employers for the college's talent cultivation and employment services in 2024. The main suggestions from employers regarding the school's talent cultivation and employment services (this survey is a multiple-choice question), the top three are "strengthening practical teaching links", "focusing on comprehensive quality and ability training", and "enhancing professional knowledge and skills training", with each having a proportion of over 44%.

According to the requirements of enterprises in 2024, the school's energy equipment manufacturing major has deepened the integration of industry and education, precisely aligning with the demands of the dominant industries in the Dongying region such as petroleum

equipment and high-end manufacturing. It has solved the problem of disconnection between traditional teaching and job skills. The Energy Equipment Manufacturing College has collaborated with industry leaders such as United Ceramics, Hexicon, and Haomai Machine Tools to launch the teaching mode reform for the equipment manufacturing major group. The core of this reform is modular teaching, which restructures the curriculum system and innovates the training path, aiming to create a "new engine" for cultivating high-skilled talents. "The teaching content must precisely align with the job standards!" This is the core principle of the reform. The college and the cooperative enterprises jointly established a course research and development team, went deep into the production frontlines of enterprises, and sorted out more than 20 core skill points such as digital processing, PLC programming, and intelligent detection. These were used to restructure the teaching content and compile characteristic textbooks.

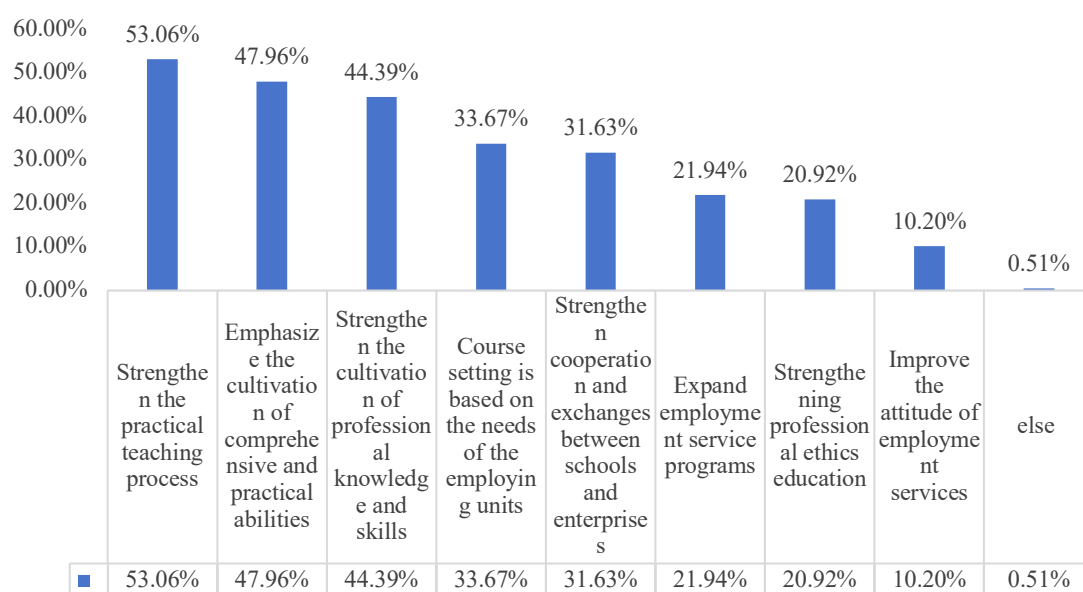


Figure 1 The suggestions of the employer regarding the school's talent cultivation and employment services

The reform covers five majors including mechanical manufacturing and automation, mechatronics technology, and numerical control technology. It is based on the entire industrial chain process of "equipment design - processing - control - debugging - intelligent operation and maintenance", and builds a three-level curriculum system of "basic sharing + position core + characteristic expansion". In the first and second semesters, all majors uniformly offer basic courses such as mechanical drawing and electrical and electronic technology to lay a solid foundation for general skills; in the third and fourth semesters, two core modules of digital design and manufacturing, and electrical automation control are alternately implemented to strengthen the core position capabilities; in the fifth semester, six characteristic position modules such as industrial robots, 3D printing, and inspection and testing are added. Students can flexibly choose according to their professional direction and career planning, and achieve "one person, one plan" personalized training.

At present, the reform has entered the stage of comprehensive promotion. By 2025, the key tasks will be to complete the training of teachers' skills, the compilation of 6 core textbooks, and

the establishment of a virtual simulation training platform; in 2026, 2 majors will be selected to carry out pilot modular teaching, and at the same time, the joint construction of the industry-academia integration training base will be completed; after the pilot phase, modular teaching will be fully promoted, the first job skills proficiency assessment will be conducted, and feedback from enterprises will be collected to optimize the teaching plan; in the future, a dynamic adjustment mechanism for course modules will be established. Every academic year, based on the industrial upgrading needs of the Dongying region, the teaching content will be updated to ensure that the reform always keeps pace with the development of the industry. The curriculum reform is an important measure for schools to deepen industry-academia integration and serve regional industries.

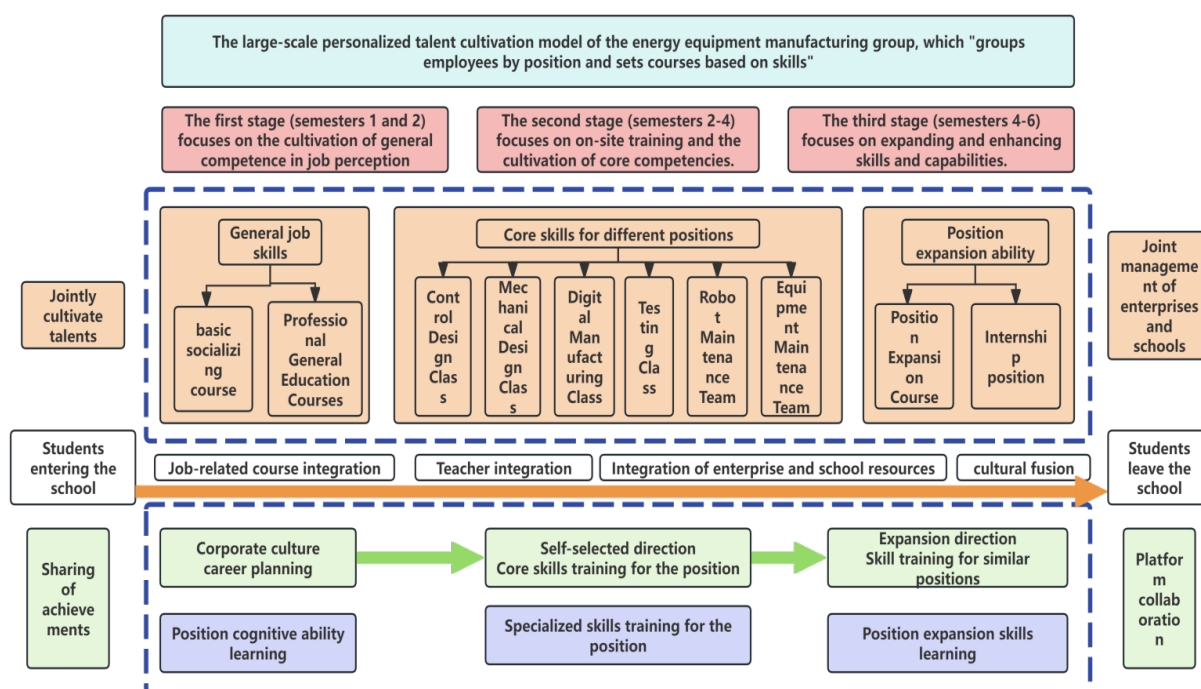


Figure 2 Curriculum Reform of Industry-Academia Integration

5.2. Employment Quality Outcomes

Empirical evidence indicates that graduates from deeply integrated programs exhibit: Higher job-skill matching rates. Higher initial salaries compared to non-integrated programs. Greater employment stability within the first three years after graduation. These outcomes suggest that deep industry-education integration contributes positively to employment quality.

5.2.1. Main Positions

The statistics of the main job positions occupied by Dongying Vocational College in the workplace for the year 2024 are shown in the following chart. According to the job position survey of graduates from Dongying Vocational College in 2024, the students who chose technical positions accounted for the largest proportion, at 39.29%.

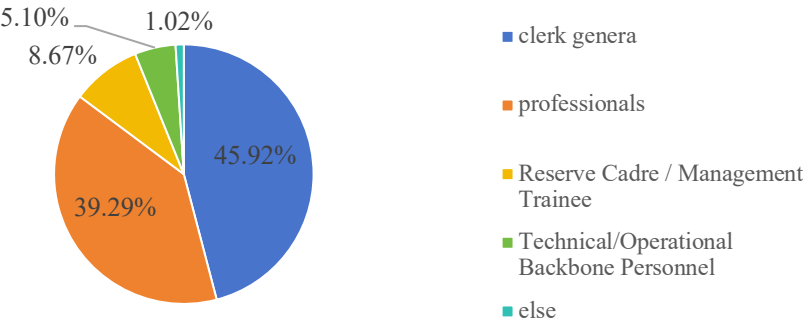


Figure 3 Main positions occupied by graduates of Dongying Vocational College in their employers

5.2.2. Employers' Evaluation of Graduates

The employers evaluated the overall performance of the graduates from Dongying Vocational College, with 19.39% rating it as "excellent", 53.57% rating it as "good", and 25.51% rating it as "average".

The employers evaluated the competence level of the graduates from this school (the sum of the proportions of the options "very good", "good", and "average") as 98.47%; the employers evaluated the job stability of the graduates from Dongying Vocational College (the sum of the proportions of the options "very good", "good", and "average") as96.94%.

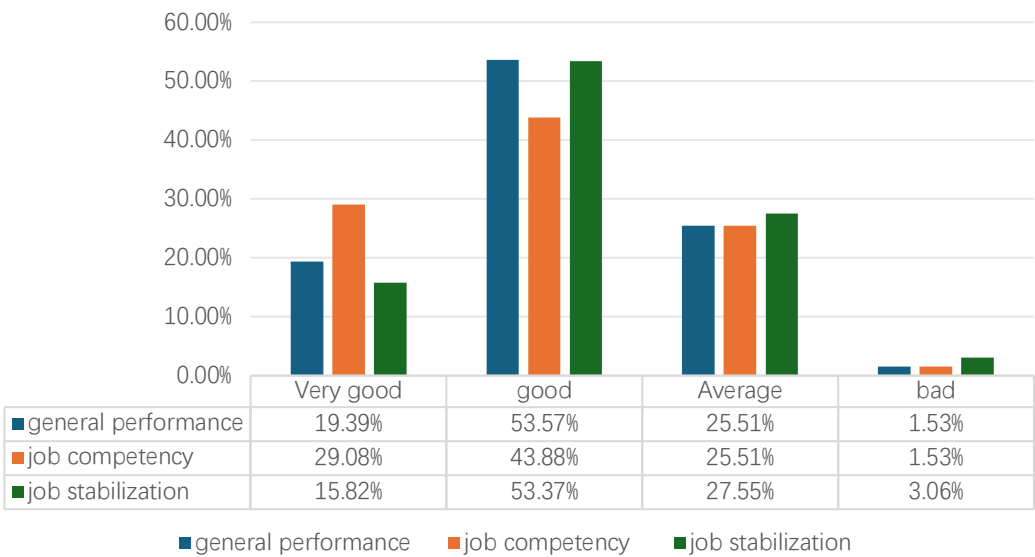


Figure 4 Evaluation of the job performance of this school's graduates by employers in 2024

5.2.3. Trend Chart of Professional Alignment Changes

The following is the statistics on the professional matching of graduates from Dongying Vocational College in 2024 and 2025. In the professional matching data, we can observe that the figures are steadily increasing. Through the improvement of students' course skills, the matching degree between individuals and positions is enhanced.

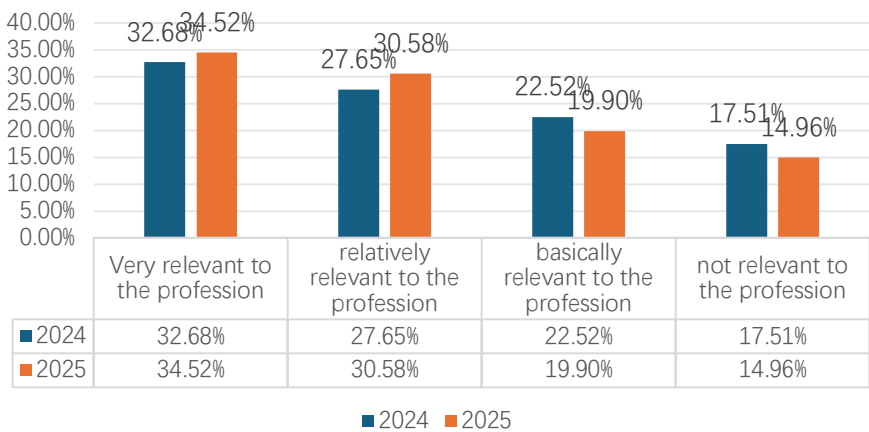


Figure 5 Trend Chart of Professional Alignment Changes in 2024 and 2025

5.2.4. Comparison of Job Stability

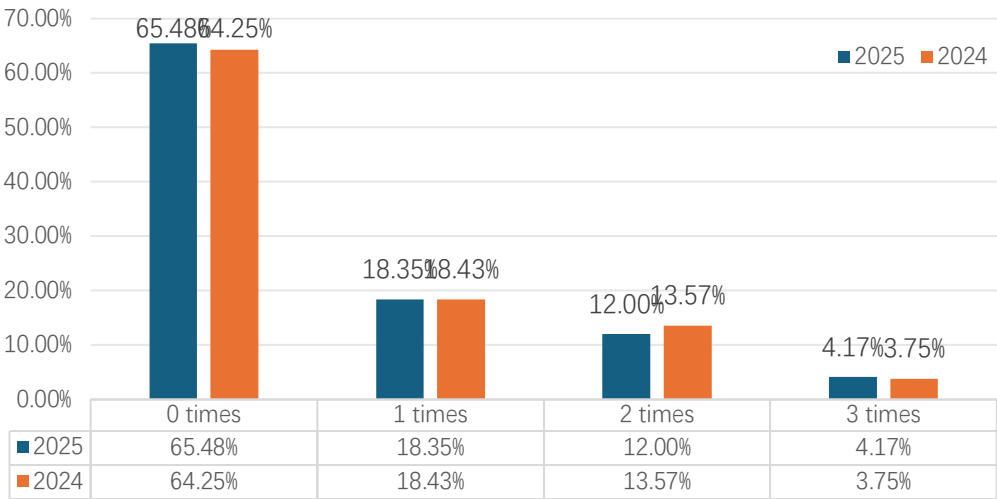


Figure 6 The number of job changes for graduates

5.3. Mechanism Analysis

The school has strengthened the integration of industry and education, closely linking with the economic upgrading of Dongying region. It serves the needs of enterprises, collaborates with the school and enterprises to cultivate talents, thereby enhancing students' practical abilities. When students seek employment, the rate of professional alignment increases, the satisfaction of enterprises improves, and their ability for sustainable development in their positions also strengthens. Improving the quality and stability of jobs to develop on-the-job learning (Gessler & Peters, 2020).

6. DISCUSSION

This study provides empirical evidence on how deep industry–education integration contributes to high-quality employment outcomes in vocational education, with a particular focus on the mediating role of practical competence. The findings yield several important insights.

First, the results confirm that industry–education integration depth exerts a significant and positive effect on employment quality, extending prior research that primarily focused on employment rates or short-term placement outcomes. By shifting the analytical focus to employment quality, this study demonstrates that institutionalized collaboration with enterprises contributes not only to job attainment but also to more stable, better-matched, and higher-quality employment trajectories. This finding aligns with human capital theory by illustrating how closer alignment between training systems and labor market demand enhances the economic returns to vocational education.

Second, the mediation analysis reveals that practical competence plays a central role in translating institutional collaboration into labor market outcomes. While industry–education integration has a direct effect on employment quality, a substantial portion of its impact operates through improvements in graduates’ hands-on skills, problem-solving abilities, and workplace adaptability. This result refines existing literature by moving beyond broad claims about “school–enterprise cooperation” and identifying a specific, measurable mechanism through which integration produces employment benefits.

Third, the prominence of practical competence as a mediating mechanism highlights the importance of deep rather than symbolic integration. Superficial forms of cooperation—such as short-term internships or nominal enterprise involvement—are unlikely to generate comparable effects if they fail to reshape skill formation processes. In contrast, practices such as enterprise co-developed curricula, enterprise-led training modules, and sustained work-based learning appear to be more effective in fostering competence that is valued by employers.

Finally, the case-based evidence from Dongying Vocational College illustrates how institutional context matters. The college’s systematic approach to embedding enterprises into training processes provides a concrete example of how vocational institutions can operationalize industry–education integration in ways that generate observable labor market outcomes. While the findings are context-specific, they offer transferable insights for regions with similar industrial structures and skill demand profiles.

7. CONCLUSION AND POLICY IMPLICATIONS

This study examines the impact of deep industry–education integration on employment quality in vocational education, using a case-based empirical approach and a single-mediator analytical framework. The findings demonstrate that deeper integration with industry significantly enhances graduates’ employment quality, both directly and indirectly through the development of practical competence.

From a theoretical perspective, the study contributes to vocational education research by linking institutional collaboration to employment quality through a clearly specified human capital mechanism. By identifying practical competence as the key transmission channel, the analysis moves beyond descriptive accounts of cooperation and provides a more precise explanation of how industry–education integration generates labor market value.

From a policy and practice perspective, the results suggest that vocational education reform should prioritize institutionalized, competence-oriented collaboration with enterprises.

Policymakers should encourage enterprises to participate not only in training provision but also in curriculum design, assessment, and long-term talent development strategies. For vocational institutions, investing in work-based learning environments and enterprise-led training arrangements may be more effective than expanding cooperation in name only.

Several limitations should be acknowledged. First, the case-based design limits the generalizability of the findings, and future research could test the proposed mechanism using multi-institutional or cross-regional data. Second, employment quality is measured at an early career stage; longitudinal studies could further explore long-term career development effects. Finally, future research may examine how contextual factors—such as regional economic conditions or industry characteristics—moderate the effectiveness of industry–education integration.

Overall, this study provides robust empirical support for the view that deep, competence-centered industry–education integration is a critical pathway to achieving high-quality employment outcomes in vocational education, offering both theoretical refinement and practical guidance for policymakers and educators.

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CONFLICT STATEMENT

The authors declare no conflict of interest.

COOPERATION STATEMENT

All authors contributed equally to this work and approved the final manuscript.

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