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Pathways to Enhancing the Employment Competitiveness of Vocational College Graduates under Industry-Education Integration

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SUMMARY: *Under the great background of industrial promotion and upgrading, digital change and transformation, and rising ability requirement in job market, this research studies how the combination of industry and education promotes the employment competitive power of vocational college graduated students. Based on the opinions from graduates of the 2024-2025 batches, this research constructs a three-source data framework that integrates student examination papers, company mentor evaluations, and campus employment outcome records, hence obtaining 836 valid observation samples. Multiple rounds of return regression, Bootstrap middle effect testing, and extra structural equation modeling are utilized to test the baseline effect, mechanism effect, and heterogeneity among different groups. The outcome manifests that the combination of industry and education is able to significantly promote the competition ability of obtaining employment. After we have controlled for individual, family, school, and regional factors, the coefficient of the core explaining variable drops from 0.412 to 0.284, hence it still remains significant on statistics. Digital employment ability and practice quality are regarded as the main transfer paths, hence professional identity still cannot provide stable explanation force in the short term. The positive influence can be more obviously discovered among students who study manufacturing and information connected majors, who are in eastern areas, and who study in schools that have deeper school-enterprise cooperation.Extra robust experiments which are based on other explained result variables and divided group calculations therefore confirm the steadiness of the obtained conclusions. On this foundation, this research puts forward four feasible roads, that is curriculum joint development, high quality practice posts, digital capability implantation, and tighter cooperation between double-qualification teachers and enterprise tutors. These result offer experiment support and realistic meanings for promoting ability nurturing, enhancing college-enterprise collaboration, and increasing the job competition ability of vocational school graduates.*

KEYWORDS: *industry-education integration; vocational college graduates; employment competitiveness; digital employability; school-enterprise collaboration*

1 Introduction

The graduates who come out from vocational colleges make up the main portion of technical and skillful workers for frontline industrial work posts. Their employment competitive ability is important not alone for individual career entering and growth, but also for regional industry promotion, working team steadiness, and the whole effect of vocational education.Along with

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the fast expansion of intellectual manufacture, the digital economic, platform-type employment, and green transition, employing units more and more highly regard a wider ability outline which includes professional ability, digital reading and writing ability, cooperation, learning agility, and the ability to adapt. Under such circumstances, vocational education has already become more deeply embedded in the mutual interaction among industrial chains, talent cultivation, and educational supply. Therefore, employment competitiveness has hence become an important index that measures training quality, and the depth as well as quality of industry-education integration determine the degree to which educational supply can match the demand of labor market.[1].

The traditional occupation education has on the whole relied on classroom instruction, campus practice training and graduation assignment work. This model obtained wide effectiveness when the industrial structures held a relatively stable condition and the requirements for skills had slow changes.However, under the situation of fast industrial upgrading and changing employment selection standards, its insufficient points have become more obvious. These are embodied in slow renewal of curriculum, weak matching between practical training and actual production procedures, comparatively inflexible capability evaluation, and restricted communication between schools and enterprises. To vocational college students, whose education is closely connected with job starting, these weaknesses can directly turn into skill not matching and lower labor market adaptation ability. Under this circumstance, the combination of industry and education provides a training framework that has more practice focus through letting enterprises participate in curriculum making, training design, supervision and assessment, therefore it promotes the relevance of training and supports a more smooth transformation from school to work. [2].

Currently existing research has already indicated that the employment competitive ability of vocational education is formed by the combination of multiple factors, and is not solely decided by technical mastery alone. General ability, digital skill, and professional attitude have been many times confirmed as the important aspects of employment ability. By making use of investigation data from graduated students, Pažur Aničić and other researchers discovered that general ability and digital ability both have remarkable influence on job results, hence therefore pointing out that occupation education ought to put more emphasis on transferable ability and digital compatibility[3]. Research in the Chinese environment further show that quality culture and university-industry cooperation can greatly enhance students' feeling about employability, hence therefore employment competition relies not only on the number of practice chances but also on organization support and the effect of cooperative training plans.

One related literature thread emphasizes the function of practice-based study in the building of employability. Adegbite has proved that digital reading and writing ability and life-career knowledge act as both intermediate and regulating elements in the connection between work-combined study and graduate employment ability [5]. This hereby indicates that practical working experience, when it is combined with career cognition and relatively stronger information handling ability, is more easy to bring out stable employment advantages. In the like manner, Pianda et al., in a systematical review on the study of internship, put forward that the contribution which internships give depends less on participation itself, and more on the quality of process, including authenticity of tasks, the level of participation, the support from mentors, and the chances for reflection and feedback [6]. Putting together, these studies point out that the worth of practice-based study in vocational education depends greatly on the substantial quality of training arrangement and work position participation.

Research workers have also put forward the points that teachers, employer feedback, and system coordination play parts in the forming of employment competitiveness. Zhao and Ko

have pointed out that in the cooperation between factories and universities, teachers not only act as knowledge teachers but also act as planners of on-job study and helpers of the growth of professional conduct [7]. Tee and other colleagues, through utilization of employer survey data, furthermore discovered that demand for digital skills keeps on increasing, meanwhile a quite large gap still exists between enterprise anticipations and graduate preparation levels[8]. This gap hence points out that we have the requirement for training systems which have better alignment with technology, occupations, and employer demand.

Existing researches check single factors, but rarely verify the multi-channel influence of the combination of industry and education upon vocational college graduates' employment competition ability. Methodologically, research has increasingly moved toward mechanism-based analysis. Shen et al. found that future orientation does not directly strengthen students' confidence in their employability; its effect is transmitted through variables such as vocational identity clarity and internship effectiveness [9]. This indicates that the relationship between industry-education integration and employment competitiveness should be examined not only in terms of association, but also through mediating pathways and contextual conditions. Illahibaccus-Sona and Abdullah further argued, on the basis of cross-national evidence, that the effectiveness of curriculum integration should be evaluated through the combined feedback of academics, students, and employers [10]. Multi-source data, cross-validation, and multidimensional measurement have therefore become increasingly important in employability research.

Several problems still have not obtained enough discussion. First of all, the measurement work for employment competitive power is still comparatively narrow in many current research works. Subjective opinions or individual employment results frequently gain the most attention, while work matching, beginning salary, job stability, and later career development opportunities are less systematically brought in. Second, the mechanism that industry-education integration uses to influence employment competitiveness has still not got enough research exploration. Especially speaking, the functions of practice quality, digital work ability, and occupation self-recognition need more careful checking to confirm if they work as key transfer paths and if their contributions have differences among different results. Third, the great part of current proof comes from samples of one single school, one-source question sheets, or static transverse section designs, therefore this makes it have difficulty to research educational procedures, evaluations from the enterprise side, and real working destinations inside one analytical framework. Under the situation of industry transformation and increasingly separated skill requirement, therefore these limitations limit the explanation scope of existing research.

Under this background, this current research investigates the routes through which the combination of industry and education promotes the employment competitive ability of vocational college graduating students. This paper discusses three questions: whether the combination of industry and education has a remarkable positive influence on employment competitive ability, through what kinds of mechanisms this influence functions, and whether its effect has differences among different discipline groups, school types, and degrees of enterprise participation. For answering these questions, this research combines student questionnaire data, evaluations from company mentors, and school employment records, and builds a multi-dimension analysis frame. In this frame, the direct influence of the combination of industry and education is estimated, the middle acting mechanisms are inspected, and the difference among different situations is tested. The results are hoped to give experimental support for promoting vocational training systems, reinforcing school-enterprise cooperation education, and pushing forward the actual execution of industry-education combination.

2 Methods

2.1 Research Design, Sample, and Data Sources

The research design adopts a three-source data matching strategy to avoid overreliance on a single type of respondent. As shown in Table 1, the three data sources differ in origin, sample size, and analytical function.

This research takes as its research object the vocational college graduates who belong to the 2024-2025 enrollment batches. From eastern, central, and western China, six to eight higher vocational colleges are chosen, with endeavors done to include main discipline groups like manufacturing, information technology, finance and business, and public services.In the same moment, the specimen is made balanced, to the greatest extent possible, from the perspective of regional industrial structure, institutional grade, and the degree of deepness of enterprise participation. When we put this cross-institutional arrangement and the single-institution design together to compare, this arrangement lets people more easily observe in what way the integration of industry and education plays its role in different education environments, therefore it reduces the risk that research results are caused by the features of one single specific college.

In the aspect of student level, we target 700-900 effective questionnaire papers. The questionnaire investigates students' participating in industry-education combination, views on course-work matching, practice quality, digital work ability, occupation recognition, and work quality. These data are utilized by us to grasp how students undergo the training procedure and how they make evaluation of its connection to later job obtainment. On the enterprise aspect, 120-150 evaluation materials are collected from work place guidance persons or employing units. These appraisals concentrate on work fitting, team cooperation, occupational behavior, and digital ability, and hence are put forward to supply an outside reference for the information which students report by themselves. On the institution level, employment management systems and graduate tracking files are utilized to obtain outcome-focused indicators, which contain employment rate, job type, major-job correspondence, employment location, and initial salary interval. When placed in comparison with single-source questionnaire data, this three-source design permits the analysis to connect students' subjective percipience, enterprise-side evaluations, and real employment results within one identical framework. Such as what Table 1 shows, the three data sources respectively correspond to process experience, external evaluation, objective employment performance, and together they give a more comprehensive foundation for evaluating the employment competitiveness of vocational college graduates.

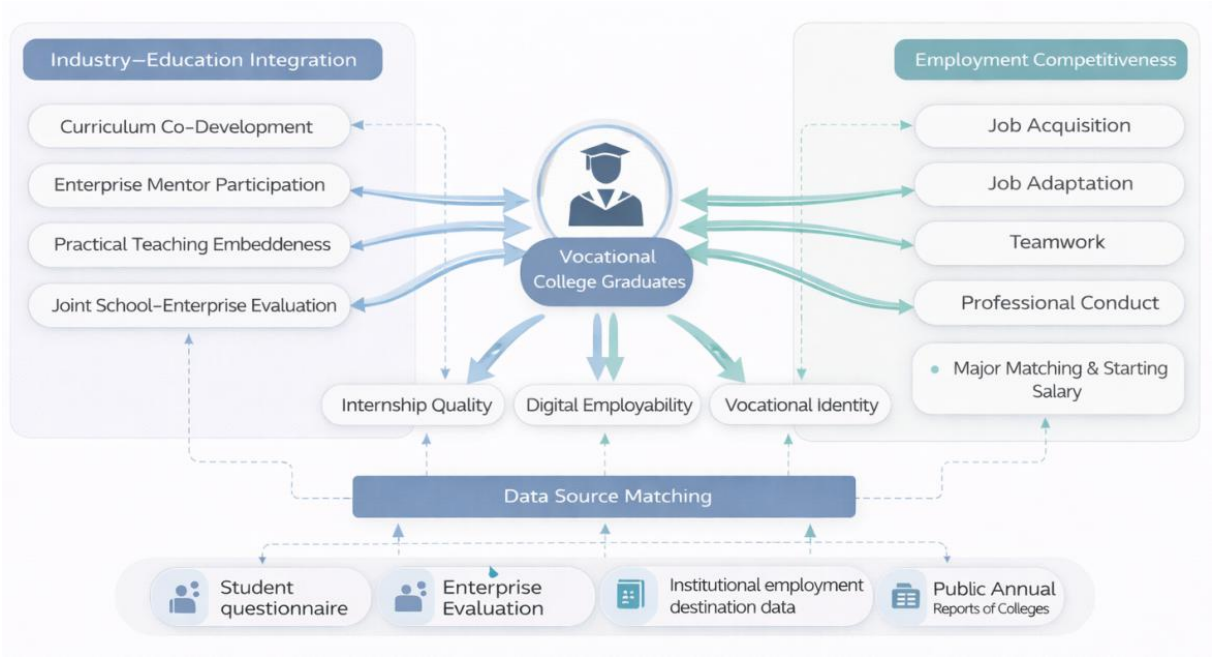

Figure 1: Node Relationship Framework of Vocational College Graduates, Industry-Education Integration, and Employment Competitiveness

As illustrated in Figure 1, this study conceptualizes the relationship among industry-education integration, capability formation, and employment competitiveness as a sequential process. Industry-education integration does not translate into employment outcomes automatically; rather, it first affects such intermediate dimensions as internship quality, digital employability, and vocational identity, and then becomes reflected in job acquisition, job adaptation, and employment quality. In Figure 1, vocational college graduates occupy the central position linking the training side and the employment side; the left side represents the major components of industry-education integration, the right side shows the manifestations of employment competitiveness, and the lower part indicates the matching sources of the three datasets.For making comparability better, institutions, employment kinds, industry places, regional movement, and salary groups are recoded by unified standards, hence the three data collections are connected by means of anonymized graduate identification codes.

Because public channels seldom offer micro-level question papers or employer assessment forms, therefore this research adds to the questionnaire with institution-level targets from yearly employment reports, which include employment rate, major matching degree, industry distribution, and satisfaction degree. The data set is displayed in Table 1.

Table 1: Three-Source Data Design and Sample Configuration

Data source	Observation target	Planned sample size	Main indicators	Main purpose
Student questionnaire	Graduates from the 2024-2025 cohorts of vocational colleges	700-900	Perceived participation in industry-education integration, course-job matching, internship quality, digital employability, vocational identity, perceived employment quality	To construct the core explanatory variables, mechanism variables, and part of the outcome variables
Enterprise mentor or employer evaluation	Workplace mentors, frontline supervisors, or HR managers	120-150	Job adaptation, teamwork, professional conduct, digital competence	To provide external assessment and cross-validation for student self-reports
Institutional employment destination data	College employment systems and graduate tracking records	Matched records from 6-8 colleges	Employment placement rate, job category, major-job matching, employment destination, starting salary range, further education	To construct objective outcome indicators
Institution-level public annual reports	Public employment quality reports and vocational education quality reports	Publicly available data from 6-8 colleges	Employment rate, major relevance, industry distribution, satisfaction, etc.	To support background control, external validity checks, and nested analysis

Just like what Table 1 displays, these data are not applied to the matching on individual level, but they have usefulness for the control of institutional background and the checks of external validity. For the sake of enlarging the explanation scope, the public annual report targets on the institution level may be added to link the conditions of school level with the results of student level.

2.2 Variable Construction and Measurement

The present research carries out the definition of its variables surrounding the question of how the integration between industry and education promotes the employment competition ability of vocational college graduating students. As can be seen from Figure 2, the analysis connects the core explaining variable, mechanism variables and control variables, and every construct is measured by observable indexes that come from student questionnaires, enterprise assessments and organization employment files.

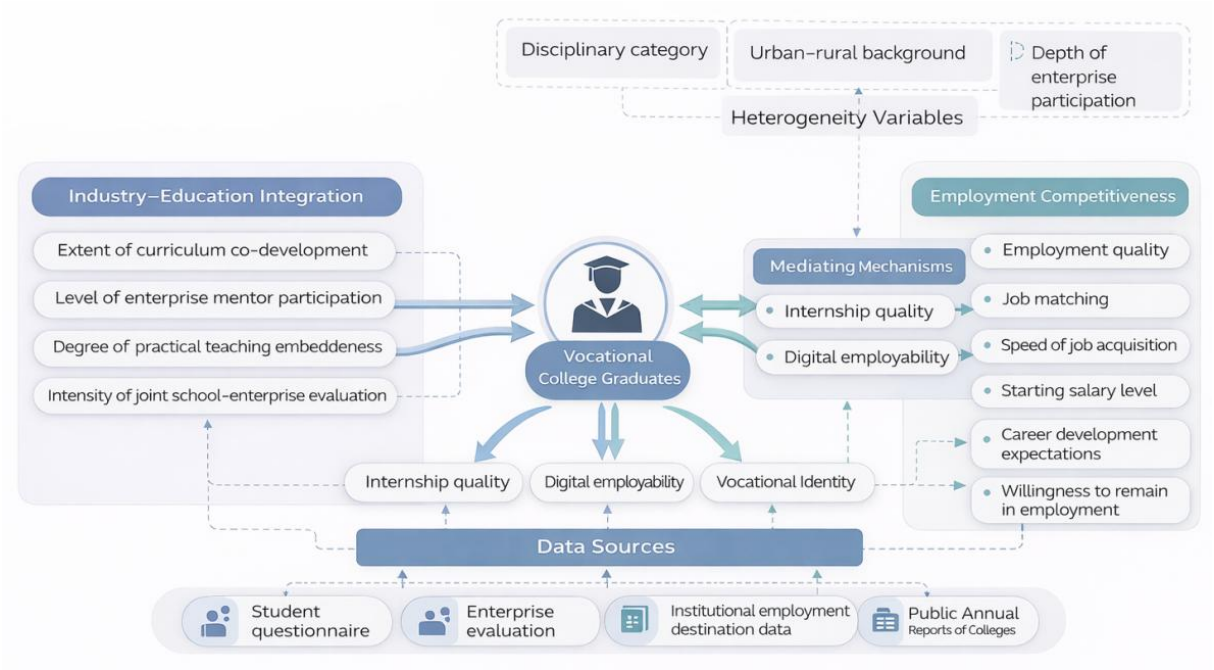

Figure 2: Framework of Variable Relationships and Measurement

The combination of industry and education is the core explanation variable. For manifesting both teaching design and organization coordination, it is measured by four five-point Likert dimensions: curriculum co-building, enterprise tutor participation, practice teaching embedding, and joint school-enterprise assessment. These aspects show that enterprises take part in making course and project plans, giving guidance to teaching and practice, making training contents match what actual work needs, and joining in evaluation at various stages. Higher scoring marks represent stronger perceived degree of integration. In the regression models, we take the mean value of the four dimensions as the combined measurement indicator, while in SEM, the construction can be set as a second-order hidden variable.

Employment competition ability is the result variable. Instead of depending only on employment rate, this research appraises early labor-market behavior and development possibility by use of employment quality, work matching, how fast people get a job, initial salary, occupation expectation, and willing to keep working. Continuous measuring indexes are carried out standardization before they are combined into one comprehensive index. In the experiments of result stability, this index is changed to onefold indicators like the beginning wage, work matching, or work quality.

The mechanism research puts the focus on two variables. The first one is Internship Quality, which is measured via task true degree, depth that task participates in, time property that mentor gives feedback, and the internship gains people can feel. This variant catches whether practice training is inserted into actual work flows and whether it aids skill building and work place adjustment. The second one is the Digital Employability, which contains information getting, office software utilization, data dealing, platform-based cooperation, and digital contact. This dimension shows students' ability that they work in settings with much technology and give reaction to increasing digital requirements which exist in work market. In Figure 2, two variables are put between industry-education integration and employment competitiveness, for testing how cooperative training is transformed into capability promotion, and then into employment results. If the space has allowance, vocational identity can be put in as one extra mechanism variable. However, the analysis of main mechanism, therefore, still

concentrates on Internship Quality and Digital Employability, for the purpose of letting the model maintain parsimony.

For heterogeneity analysis, three variables are included: disciplinary category, urban-rural background, and depth of enterprise participation. Disciplinary category is divided into manufacturing, information technology, finance and business, and public services. Urban-rural background is coded by students' place of origin. Depth of enterprise participation is grouped according to enterprise involvement in curriculum, internships, and evaluation. In Figure 2, these background conditions are positioned around the main analytical path to test whether the effect of industry-education integration varies across groups. Control variables include gender, family socioeconomic background, academic performance, number of certificates obtained, internship experience, and regional economic level. These variables are included to account for individual resources, family background, and contextual conditions, thereby improving the stability of model estimation.

2.3 Empirical Model and Robustness Tests

This research adopts an empirical method that takes regression as the core, and structural equation modeling is utilized by us to carry out supplementary verification. This selection is conducted by two thinking points. Firstly, key variables for instance employment competition ability, practice quality, and digital employment ability include both observable indices and potential dimensions which are measured by many items, therefore depending on one single method would weaken either interpretability or measurement strictness. Second, the study examines not only whether industry-education integration affects the employment competitiveness of vocational college graduates, but also how this effect is transmitted and whether it varies across groups and institutional settings. Existing studies support this combined approach. The group of Chen and other authors have taken university-industry connections as a regulating variable in the study of graduates' employment ability, thus indicating that regression models are efficacious for recognizing heterogeneous marginal effects [14].Kholifah and other persons utilized PLS-SEM to conduct examination on the connection between digital employability abilities and work preparation among vocational education graduating students, hence indicating that structural models possess usability for verifying measurement quality and overall path connections [15]. Chen et al. investigated the link between industry-education integration and employment quality in higher vocational colleges and further tested moderating factors [16]. Suyatmo et al. analyzed the transmission relationship among lecturer behavior, self-motivation, and soft skill development in vocational education, providing a useful reference for the mechanism analysis in this study [17]. Liu's work on university-industry collaboration and enterprise participation further suggests that school-enterprise collaboration variables can be examined within a common framework that accounts for both mediating mechanisms and contextual heterogeneity [18].

The first step is to test the baseline effect of industry-education integration on employment competitiveness through multiple regression. The dependent variable is the composite score of graduate employment competitiveness, and the core explanatory variable is the composite index of industry-education integration. Control variables include gender, family socioeconomic background, academic performance, number of certificates obtained, internship experience, and regional economic level. School fixed effects and regional fixed effects are also included to control for systematic differences across institutions and regions. The baseline model is written as:

$$EC_i = \alpha_0 + \alpha_1 IEI_i + \alpha_2{}' C_i + \mu_s + \lambda_r + \varepsilon_i \quad (1)$$

where EC_i denotes the composite score of employment competitiveness for graduate i, IEI_i denotes the level of industry-education integration, C_i is the vector of control variables,μ_s represents school fixed effects, λ_r represents regional fixed effects, and ε_i is the random disturbance term. The sign and statistical significance of α_1 indicate the overall direction and magnitude of the effect of industry-education integration on employment competitiveness.

After establishing the baseline effect, the study proceeds to examine whether internship quality and digital employability function as transmission mechanisms. The mechanism analysis is conducted in two steps. First, the effect of industry-education integration on each mediator is estimated separately. Second, the mediators are entered into the employment competitiveness equation, and changes in the coefficient of the core explanatory variable, together with the significance of the mediators themselves, are examined. The internship quality equation is specified as:

$$M_{1i} = \beta_0 + \beta_1 IEI_i + \beta_2{}' C_i + \mu_s + \lambda_r + u_i \tag{2}$$

The digital employability equation is specified as:

$$M_{2i} = \gamma_0 + \gamma_1 IEI_i + \gamma_2{}' C_i + \mu_s + \lambda_r + v_i \tag{3}$$

where M_{1i} denotes the internship quality score of graduate i, M_{2i} denotes the digital employability score of graduate i, and u_i and v_i are random disturbance terms. If β_1 or γ_1 is significant, this indicates that industry-education integration has a significant effect on the corresponding mechanism variable. The two mediators are then simultaneously included in the employment competitiveness equation:

$$EC_i = \delta_0 + \delta_1 IEI_i + \delta_2 M_{1i} + \delta_3 M_{2i} + \delta_4{}' C_i + \mu_s + \lambda_r + \eta_i \tag{4}$$

where η_i is the random disturbance term. If the coefficient of IEI_i declines noticeably after the mediators are introduced, while δ_2 or δ_3 remains significant, internship quality or digital employability can be regarded as carrying part of the transmission effect. To strengthen the inference, Bootstrap resampling is further used to calculate confidence intervals for the indirect effects; when the interval does not include zero, the corresponding mechanism is considered to be supported. If vocational identity is added in the extended model, it is handled in the same way as the two mediators above, although the main model still centers on internship quality and digital employability in order to control model complexity.

The heterogeneity analysis is designed to determine whether the marginal effect of industry-education integration varies systematically across subgroups. Priority is given to three dimensions: disciplinary category, urban-rural background, and depth of enterprise participation. On the one hand, interaction terms are introduced into the full sample model to directly observe the joint effect between industry-education integration and the heterogeneity variables. On the other hand, subgroup regressions are used to compare coefficient size and direction across groups. The interaction model is written as:

$$EC_i = \theta_0 + \theta_1 IEI_i + \theta_2 Z_i + \theta_3 (IEI_i \times Z_i) + \theta_4{}' C_i + \mu_s + \lambda_r + \omega_i \tag{5}$$

where Z_i denotes the heterogeneity variable, which can be replaced in turn by disciplinary category, urban-rural background, or depth of enterprise participation, and ω_i is the random disturbance term. If the interaction coefficient θ_3 is significant, the effect of industry-education integration is interpreted as varying across contextual conditions.

Sub-group regression analyses are utilized by us to exhibit how effects differ among diverse groups. SEM only acts as a validation instrument, it examines the potential mediation paths and the quality of measurement, while regression therefore is still the foundation for identification. Robustness is evaluated through substitute result and explanatory indexes, collinearity and range examinations, and sub-group inspections by institutional level and firm involvement.

3 Results and Discussion

3.1 Descriptive Statistics and Measurement Quality

Just like what Table 3 has displayed, the final sample that we got includes 836 cases which are valid. The distributions of gender and region were comparatively uniform, with China's eastern part, central part and western part taking up 35.6%, 33.1% and 31.2%, separately. In the sample, manufacturing industry and information technology account for 54.6 percent, 40.8 percent are from Double-High colleges, and 74.2 percent have medium or high level enterprise participation. On the whole, the sample can give a usable foundation for conducting comparison among different regions, different subject fields, and different school-enterprise cooperation situations. This pattern is also consistent with recent research showing that the sustainability of university-industry collaboration depends on both multi-actor coordination and contextual compatibility [19].

Table 3: Descriptive Statistics and Measurement Quality

Category	Group	n	%
Gender	Male	390	46.7
	Female	446	53.3
Region	Eastern China	298	35.6
	Central China	277	33.1
	Western China	261	31.2
Major cluster	Manufacturing	246	29.4
	Information technology	211	25.2
	Finance and business	197	23.6
	Public services	182	21.8
Institutional type	Double-High colleges	341	40.8
	Non-Double-High colleges	495	59.2
Enterprise participation	High	279	33.4
	Medium	341	40.8
	Low	216	25.8

Table 4 has carried out the report on the descriptive statistics and measurement quality of the main constructs. Mean values for industry-school combination, practice quality, digital employment ability, professional self-identification, and job competition ability were 3.87, 3.79, 3.71, 3.68, and 3.76, respectively, with standard deviation values that range from 0.61 to 0.67.This distributing condition gives a reasonable extent of change among all persons who answered, and therefore it offers enough support for the analysis that will be carried out afterward. Cronbach's alpha has a scope from 0.846 to 0.903, composite reliability from 0.886 to 0.928, and average variance extracted from 0.567 to 0.683, which therefore shows that internal consistency and convergent validity are acceptable. The KMO numerical value was

0.918, and Bartlett's sphericity test obtained a significant result, which therefore confirms that the present data possessed suitability for being processed via factor analysis. Correlation analysis further makes known that industry-education integration has positive connection with employment competitiveness, its coefficient is 0.54. Among the variables of mechanism, digital employability has the most strong correlation with employment competitiveness (0.63), and internship quality is followed next (0.57). This type of arrangement accords with the latest proof that, under recruitment conditions which are increasingly oriented toward skills, observable and transmittable capabilities bear increasing importance in forming the labor-market superiority of graduates.

Table 4: Descriptive Statistics, Reliability, Validity, and Correlation Matrix

Variable	Mean	SD	Cronbach's α	CR	AVE	1	2	3	4	5
1. Industry- Education Integration	3.87	0.63	0.891	0.915	0.659	1.000	\	\	\	\
2. Internship Quality	3.79	0.67	0.874	0.905	0.614	0.610	1.000	\	\	\
3. Digital Employability	3.71	0.64	0.882	0.911	0.631	0.580	0.490	1.000	\	\
4. Vocational Identity	3.68	0.66	0.846	0.886	0.567	0.460	0.430	0.520	1.000	\
5. Employment Competitiveness	3.76	0.61	0.903	0.928	0.683	0.540	0.570	0.630	0.480	1.000

Note: KMO = 0.918; Bartlett's test χ^2 = 4126.37, df = 120, $p < 0.001$. All correlations are significant at $p < 0.01$.

Figure 3 gathers together the standardized mean, Cronbach's alpha, composite reliability, and average variance extracted in one coordinate system, thus making it more convenient to compare both construct levels and measurement quality. Just like what Figure 3 has displayed, employment competitive ability has obtained the highest compound reliability with value 0.928, hence professional identity has the lowest AVE. However, Its AVE still stays higher than the generally recognized threshold which is 0.50, hence it shows that the convergent validity is acceptable. The integration between industry and education and digital employability have shown comparatively balanced profiles, which combine medium-to-high average levels with reliable measurement effects. On the whole, the main constructs meet traditional statistical standards and thus supply a reliable foundation for the following regression and structure analyses. It is also worthy of notice that digital employability possessed a little lower average value than industry-education combination and practice quality, hence it displayed a stronger connection with employment competitive ability. This type indicates that digital adjustment is having a more and more obvious effect on result of graduates getting jobs, which accords with the latest proof connecting AI-relevant reading and writing ability to felt employment ability in higher education environments.

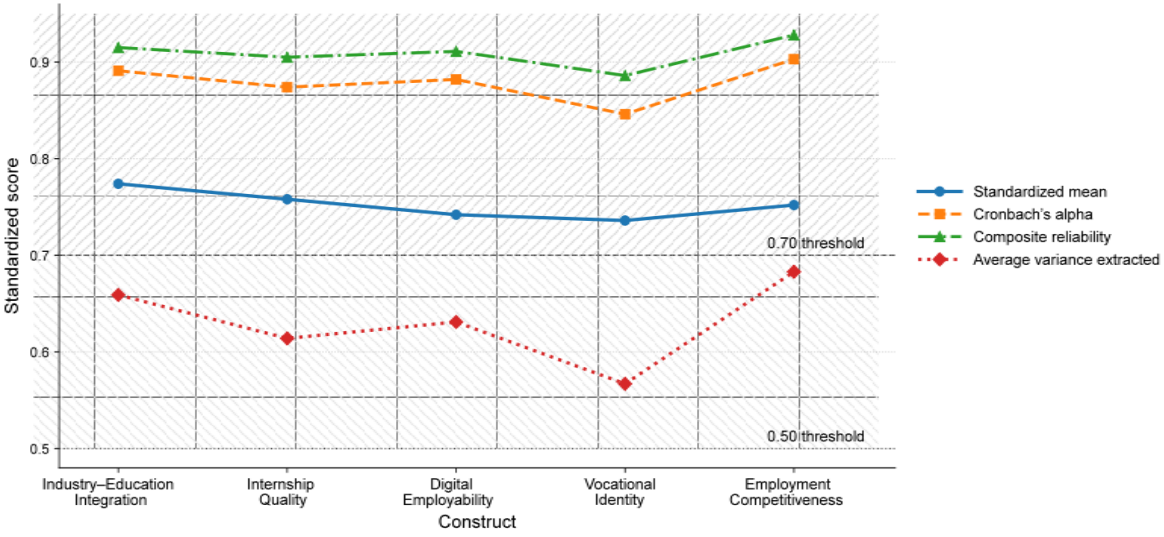

Figure 3. Measurement Quality Profile of Key Constructs

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3.2 Main Effects and Mechanism Analysis

The regression outcomes from the benchmark show that the combination of industry and education brings a stable and statistically remarkable positive influence to the employment competition ability of vocational college graduating students. When control variables are added one by one, the coefficient value of the core explanation variable decreases from 0.412 in Model 1 to 0.284 in Model 4, hence it still keeps significance under the 1% level all the time.This mode lets us know that one part of the starting effect is connected with disparities in personal and organizational features, but the core connection still keeps obvious after these elements are put into consideration. After we make control for individual characteristics, family background, school fixed effects, and regional fixed effects, the integration of industry and education still holds quite a large amount of explanatory strength. Therefore, this result indicates that there exists a comparatively stable connection between cooperative training schemes and the employment results of graduates. This outcome is also in accordance with previous proof that work-connected learning assists graduates to enter labor market more smoothly through changing training experience into advantages in the early stage of employment[22].For the clearer exhibition of baseline effect, mechanism roads, and result stability, Figure 4 gives a summary of hierarchical regression coefficients, Bootstrap indirect effects, effect decomposition, and robustness checks which are based on substituted dependent variables.

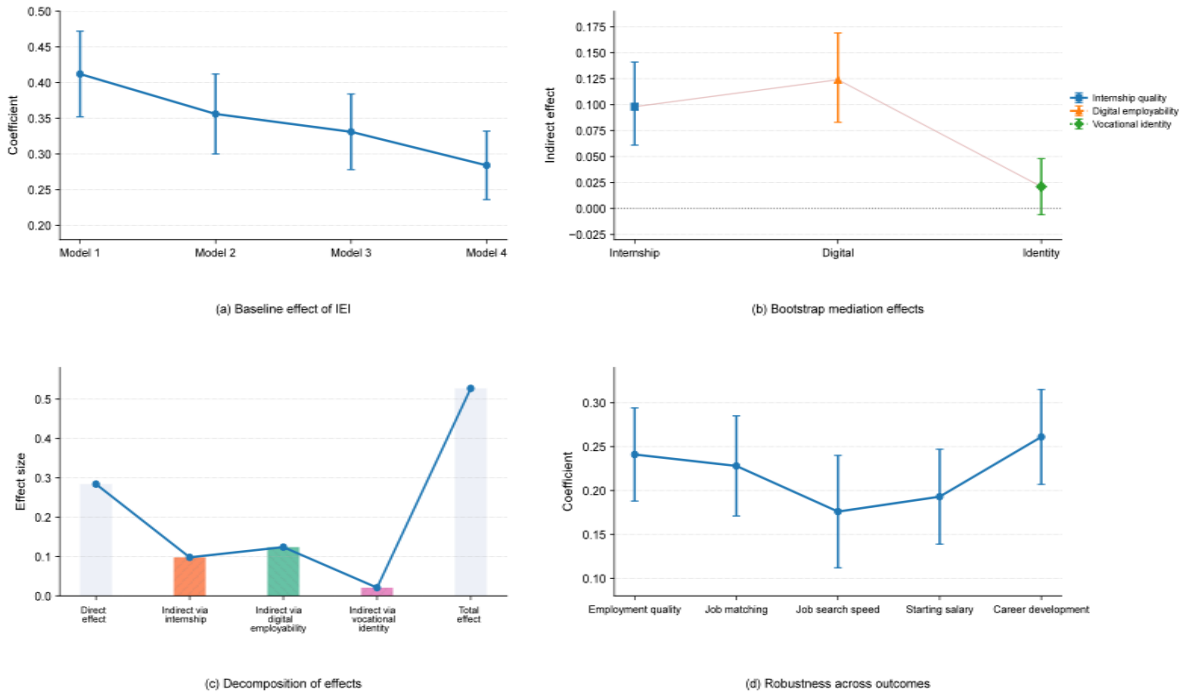

Figure 4: Main Effects and Mechanism Analysis

The result of benchmark regression has confirmed that there is a stable and statistically significant positive connection between the combination of industry and education and the employment competitive ability of graduates from vocational colleges. When control variables are brought in one by one, the coefficient of the core explaining variable drops from 0.412 in Model 1 to 0.284 in Model 4, hence it still keeps significant at the 1% level. This change shows that a part of the starting effect is connected with differences between individual and institutional features, while the central connection still keeps strong after these factors are put into the model. Even after we carry out control for individual characteristics, family background, school fixed effects, and regional fixed effects, the combination of industry and education still possesses quite great explanation ability. This result indicates a firm linkage between cooperative training schemes and postgraduate job results, and it accords with previous proof that work-combined study helps a more gentle change into the work market via assisting graduates turn training experience into early job benefits.

Digital employment ability is the main leading path, thus internship quality is placed in the second position. This kind of rule conforms to nowadays employing standards, which more and more give reward to proved digital abilities, cooperation capacity, and fast work finishing, especially in information, making production, and modern service work posts. Just like what Figure 4(c) has displayed, the direct effect value is 0.284, while as for the indirect effects which pass through internship quality and digital employability they are 0.098 and 0.124 respectively. The comprehensive size of these effects shows that the combination of industry and education promotes employment competitive ability, mainly by means of ability construction in the training process.

The intermediary function of professional self-recognition is not notable. A possible explanation is that vocational identity grows in a slower way, therefore its function in the early stage of school-to-work change is not as direct as that of observable skills or experience coming from internships. Compared with competencies that can be more readily translated into job performance, the effect of vocational identity may require a longer period to emerge. Second, substantial differences remain among students in career planning, learning

accumulation, and transition readiness, which means that the relationship between competency structure and early employment outcomes is not entirely consistent across individuals. Under such conditions, the explanatory role of vocational identity in short-term employment outcomes is relatively limited.At the same time, Figure 4(d) shows that when the dependent variable is successively replaced by employment quality, job matching, job search speed, starting salary, and career development expectations, the coefficient of industry-education integration remains within the range of 0.176 to 0.261. This result suggests that the main effect is not sensitive to a particular indicator definition, but remains stable across different dimensions of employment outcomes. In other words, the positive contribution of industry-education integration can still be observed whether employment competitiveness is captured from immediate job acquisition, matching quality, or forward-looking development expectations. This finding is also consistent with recent evidence that career competency profiles influence school-to-work transition performance in differentiated ways, and that employment advantages are more strongly associated with actionable and transferable capability combinations than with a single psychological orientation [23].

3.3 Heterogeneity Analysis and Practical Pathways

The heterogeneous outcome results show that the influence of industry-education combination on employment competition ability changes greatly among different subject groups, different areas, and different levels of school-enterprise cooperation depth. For making these differences among groups more convenient to compare, Figure 5 gives the regression results of subgroups inside a unified visual frame structure. The three picture blocks use the identical coefficient that has confidence interval form, therefore this makes it have possibility to compare both the size of the estimated influences and the breadth of the confidence intervals between different groups.

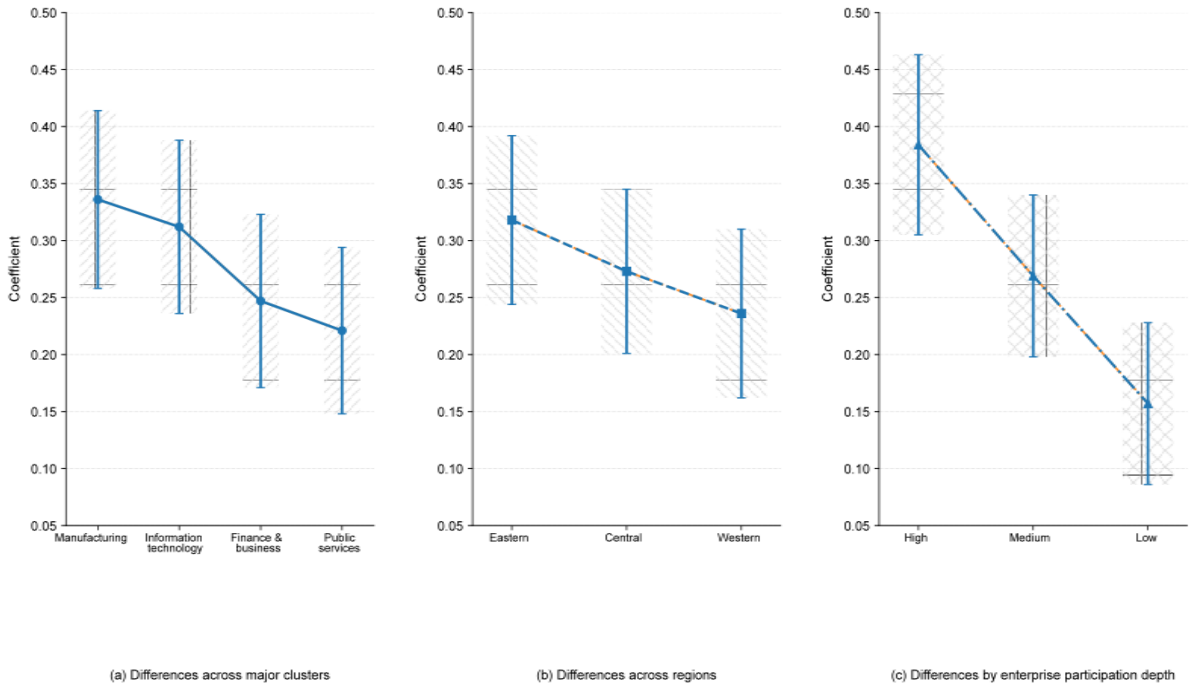

Figure 5: Heterogeneity Analysis and Practical Pathways

With regard to disciplinary differences, the coefficients for manufacturing-related and information-technology-related majors reach 0.336 and 0.312, respectively, both of which are

clearly higher than those for finance and business at 0.247 and public services at 0.221. As shown in Figure 5(a), this pattern suggests that industry-education integration is more readily translated into employment advantages in disciplinary clusters where task requirements are more explicit and workplace coordination is more central. In the manufacturing and information-linked projects, students have a higher possibility to contact with real projects, enterprise tutors and practice assignments which are embedded in actual work flows. As the consequence, the link between curriculum and job demands becomes closer, and practice experiences are more easily changed into recognizable proof of ability when people look for jobs and recruit workers. This finding is consistent with the argument that high-impact practices can strengthen vocational students' non-cognitive skills through teacher-student and student-student interactions, thereby improving the broader conditions that support employability development [24].

Regional difference in different areas also can be clearly seen. As what is displayed in Figure 5(b), the computed coefficient of industry-education integration is 0.318 in the eastern area, while for the central region it is 0.273, and for the western region it is 0.236. The influence still keeps positive and statistically meaningful in all the three regions, but its size becomes smaller from the east to the west.This mode indicates that the worth of industry-education combination is widely shared, therefore its strength is decided by local circumstances. Differences in industrial composition, business resource aggregation, and the ripeness of university-industry cooperation are probably to explain this difference. In the area of east, industry chains are on the whole more advanced, and enterprises have the tendency to participate more in substance into course making, practice overseeing, and together assessing. Under these situations, students have a higher possibility to participate in real work place tasks and latest work demands, hence letting the advantages of training translate more directly into results of getting jobs. In the middle and west areas, the influence still stays positive but is weaker, this may reflect lower business density, less steady cooperation systems, and more restricted access to high-quality practice training resources.

The strongest comparison appears among levels of firm participation depth. In Figure 5(c), the coefficient value gets 0.384 in the high-depth group, 0.269 in the medium-depth group, and 0.157 in the low-depth group. This trend is extremely clear: the deeper that cooperation goes, the more powerful the enhancement of ability that one can get.Under this situation, the depth is not so much decided by the number of cooperative items as by the extent to which enterprises participate in the co-building of courses, the putting of work post tasks into cultivation, the continuity of direction from tutors, and the being of common evaluation in the training process. The research on work outcomes likewise shows that both cognitive and non-cognitive capabilities constitute labor market conduct, and that their benefits become more distinct when learning experiences are transformed into long-term, practice-oriented capability construction [25].

These dissimilar results point out four feasible paths. The first item is the joint development of teaching program. The more strong effects found in making and information-linked majors show that when course content is updated follow company projects and work standards, students have more capacity to build capabilities which are clear and useful in the job market. The second aspect just is located in the provision of high-quality practice chances. Arrangements of student internships need higher truthfulness of tasks, deeper participation, and more frequent feedbacks, hence students are able to adapt to work rhythms and occupation rules before they enter full-time work. The third project is the implantation of digital abilities.Both region difference and subject difference show that digital cooperation and work ability which are based on platforms have become core for employment competition, hence hence making data handling, platform cooperation and digital

communication the necessary compositions of daily teaching. The fourth item is the cooperation between double-qualification teachers and enterprise guidance teachers. The steep incline in Figure 5(c) shows that closer cooperation between teachers and enterprise instructors in course design, practical training, and evaluation hence can bring more stable and persistent employment advantages in student populations.

4 Conclusion

Putting all together, the combination of industry and education has quite strong explanation ability in promoting the employment competitive power of vocational college graduates, and the main research conclusions keep consistent under different model settings and sample situations. The regression result outcomes, mechanism inspection works, and subgroup analysis works all point to the same direction: deeper school-enterprise cooperation is associated with more explicit superiority on job acquisition, working place adaptation, and career development anticipation. This indicates that the combination of industry and education has already gone beyond the cultivation stage, and is increasingly manifested in measurable employment benefits.

(1) the main effect demonstrates strong stability. In the baseline models, the coefficient of industry-education integration declines from 0.412 to 0.284 but remains significant at the 1% level. When the dependent variable is replaced by employment quality, job matching, and starting salary, the direction of the coefficients remains unchanged, indicating a high degree of consistency in the results.

(2) the transmission paths are relatively well defined.Digital employability and internship quality emerge as the two main channels through which industry-education integration affects employment competitiveness, with indirect effects of 0.124 and 0.098, respectively. This result indicates that the effect of industry-education integration is mainly realized through two closely related dimensions: the strengthening of students' capability base and the improvement of practice-based learning quality. In other words, collaborative training does not influence employment outcomes only at the level of institutional arrangement, but is further translated into measurable employment advantages through competence development and more substantive workplace experience. By contrast, the indirect effect associated with vocational identity is 0.021, and the corresponding statistical support is relatively weak. This suggests that, although vocational identity may still play a role in students' longer-term development, its explanatory power for short-term employment competitiveness is comparatively limited in the present analytical framework.

(3) group differences deserve further attention. The promoting effect is stronger among manufacturing and information-related majors, in the eastern region, and in institutions with deeper levels of school-enterprise collaboration. At the same time, the sample is still concentrated in several regions, and the measurement of employment competitiveness retains a certain subjective component. Future studies may therefore combine follow-up data or multi-wave panel data to examine its longer-term effects on graduates' career development.

About the Author

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