

Research on the Formation Path of Professional Skills among Vocational College Teachers

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How to cite this paper: Ma, D. (2026). Research on the Formation Path of Professional Skills among Vocational College Teachers. *Open Journal of Social Sciences*, 14, 107-125.

<https://doi.org/10.4236/jss.2026.146005>

Received: May 10, 2026

Accepted: June 2, 2026

Published: June 5, 2026

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Abstract

Based on Human Capital Theory and Technical Skill Accumulation Theory, this study constructs a structural equation model to analyze the formation path of professional skills among vocational college teachers. Through an analysis of 1445 questionnaire samples, the findings indicate that the institutional environment is a significant external driving factor that positively influences school organizational support as well as teachers' participation in enterprise practice and skills training, while indirectly promoting teachers' professional skills through the school organization. Participation in enterprise practice and skills training is identified as the core pathway variable with the strongest effect on professional skills development. School organization and professional community interaction also exert direct positive effects on teachers' professional skills. Individual factors indirectly contribute to professional skill improvement by promoting participation in enterprise practice and skills training. The findings suggest that the professional skills of vocational college teachers are shaped by the synergistic effects of the institutional environment, school organization, enterprise practice and skills training participation, and professional community interaction.

Keywords

Vocational Colleges, Teachers, Professional Skills, Structural Equation Modeling

1. Introduction

The reform of several teaching elements, such as majors, curriculum systems, teaching materials, teachers, and practical training, has become an important basis for the development of a modern vocational education system and the cultivation of skilled talents. Among these elements, vocational college teachers are an

important part, because their professional competence can directly influence the quality of technical talent training. Some previous studies have pointed out that the professional ability of vocational teachers is closely related to teaching effectiveness, students' employment ability, and the connection between vocational education and industrial development (Antera, 2021; Triyono et al., 2020; Zhang et al., 2022).

In recent years, industrial transformation and technological upgrading have developed quickly in many countries, and vocational education systems have also faced greater pressure, especially in improving teachers' technical skills and practical abilities (Kovalchuk et al., 2022; McGrath & Yamada, 2023). At the same time, vocational teachers are also expected to adapt to the requirements of 21st-century skills, which has gradually become a difficult issue in vocational education development (Mutohhari et al., 2021). However, because of different factors, such as teacher recruitment channels, professional development systems, and teacher evaluation standards, many vocational college teachers still have problems with practical ability and skill updating; therefore, some teachers cannot fully meet the actual skill needs of enterprises.

In this study, "professional skills" mainly refer to vocational college teachers' practical operational abilities, technical application capabilities, process understanding, and the ability to transform industrial practices into teaching activities. Compared with the broader concept of "professional competence", which usually includes pedagogical knowledge, communication ability, professional ethics, and organizational capacity, professional skills in this research specifically emphasize practice-oriented and technically related abilities associated with vocational teaching contexts. This distinction is important because vocational education places particular emphasis on teachers' capacity to connect industrial technologies, workplace practices, and instructional activities.

Previous research has shown that teachers' professional skills are affected by many aspects, including personal characteristics, teaching activities, and external environmental conditions. Some researchers have discussed vocational teachers' competence and related influencing factors, but the formation process of professional skills is still not clearly explained. In particular, research focusing on the relationships among institutional factors, organizational support, and individual factors is still relatively limited, and the internal path of professional skill formation needs further discussion (Antera, 2021; Zhang et al., 2022). Some studies have focused on the effects of enterprise practice, school-enterprise cooperation, and technical skill accumulation on teachers' professional development. However, most existing studies remain at the level of policy analysis and experience summaries, while quantitative research on the formation path of professional skills is relatively limited.

Therefore, based on Human Capital Theory and Technical Skill Accumulation Theory, this study constructs a structural equation model to examine the effects of institutional environment, individual factors, school organization, participa-

tion in enterprise practice and skills training, and professional community interaction on the professional skills of vocational college teachers. The study aims to reveal the internal mechanisms of teachers' professional skill formation and to provide theoretical and practical implications for the professional development of vocational college teachers.

2. Theoretical Basis and Research Hypotheses

2.1. Theoretical Basis

2.1.1. Human Capital Theory

Human Capital Theory explains that the knowledge and skills people gain from education, training, and practical activities can be regarded as an important kind of capital, and this kind of capital can continue to increase over time, which may help improve personal ability and career development. For vocational college teachers, professional skills do not only come from academic education received in schools; they are also related to continuous technical learning, practical experience, and long-term professional development activities.

From the perspective of Human Capital Theory, when teachers participate in enterprise practice, skills training, and professional learning activities, these activities can be seen as a process of human capital investment. Therefore, the development of teachers' professional skills is connected not only with their own learning motivation and development awareness, but also with external support conditions such as the institutional environment and school organizational support. Some studies have pointed out that investment in education, training, and professional development can help improve individual ability and support long-term career growth (Hooley, 2021). In the fields of vocational education and higher education, the development of human capital is also closely related to teachers' professional competence and institutional development (Sebola, 2023).

2.1.2. Technical Skill Accumulation Theory

Technical Skill Accumulation Theory suggests that skills are not formed in a short time; instead, they are gradually developed through long-term practice, repeated application, and continuous learning. In vocational education, teachers' professional skills usually have strong practical characteristics; therefore, these skills often need to be accumulated continuously through enterprise practice, skills training, and interaction within professional communities.

Some researchers explained that technical skill accumulation is a continuous learning process, and this process is often achieved through workplace participation, experiential learning, and reflective practice (Fergusson, 2022). Under the background of global economic transformation, vocational education increasingly depends on work-based learning and closer connections with industry development (McGrath & Yamada, 2023).

As industrial technology continues to upgrade, vocational college teachers also need to update their professional knowledge and practical skills continuously so that they can better meet enterprise needs. Because of this, the formation of teach-

ers' professional skills is influenced not only by personal factors, but also by external support conditions, including the institutional environment, school organization, and training opportunities. In addition, when teachers participate in professional communities, they may share practical experience and technical knowledge with others, which can further support the improvement of professional skills.

Based on Human Capital Theory and Technical Skill Accumulation Theory, this study considers that the professional skills of vocational college teachers are influenced by several factors together, including institutional environment, school organization, individual factors, participation in enterprise practice and skills training, and professional community interaction. Among these factors, participation in enterprise practice and skills training is regarded as an important intermediary factor, while institutional environment and school organization are treated as important external conditions affecting teachers' professional skills.

2.2. Research Hypotheses

2.2.1. Institutional Environment and School Organization

The institutional environment is an important external condition influencing school organizational operation. The improvement of vocational college teachers' professional skills does not depend only on teachers' own efforts; it is also related to policy support, teacher development systems, and school-enterprise cooperation mechanisms. When the institutional environment is relatively supportive, schools are more likely to establish better support systems for teacher training, enterprise practice, and professional development activities, which may help teachers improve their professional skills.

H1: The institutional environment has a significant positive effect on school organization.

2.2.2. Institutional Environment and Participation in Enterprise Practice and Skills Training

Previous studies showed that institutional and organizational support can affect teachers' opportunities to participate in work-based learning and enterprise practice activities (Rooney-Kron & Dymond, 2021). Some research has also found that industrial apprenticeship and workplace learning models are useful for improving vocational teachers' practical abilities (Suyitno et al., 2022).

Human Capital Theory explains that participation in training and practical activities can be regarded as a kind of human capital investment, and this type of investment is often influenced by the surrounding institutional environment. When schools and policies provide more support, teachers may have more opportunities to participate in enterprise practice, skills training, and professional learning activities, which can also increase their willingness to join these activities.

H2: The institutional environment has a significant positive effect on participation in enterprise practice and skills training.

2.2.3. Individual Factors and Participation in Enterprise Practice and Skills Training

Some previous studies suggested that teachers' professional identity, autonomy, and internal motivation are important factors influencing their participation in professional learning and workplace practice (Derakhshan et al., 2020). Mentoring, supervision, and coaching activities may also help teachers strengthen their professional identity and continue professional development (Toh et al., 2022).

Individual factors are considered important internal reasons influencing teachers' participation in practical activities. Usually, teachers who have stronger professional development motivation and learning willingness are more likely to participate actively in enterprise practice, technical learning, and skills training activities. Human Capital Theory also suggests that individuals who are more willing to invest in skills are generally more active in training and practical learning activities.

H3: Individual factors have a significant positive effect on participation in enterprise practice and skills training.

2.2.4. School Organization and Teachers' Professional Skills

Previous research found that organizational support is related to teachers' professional performance, career satisfaction, and professional development (Purwanto, 2020; Oubibi et al., 2022). Some studies also pointed out that capacity building, mentoring systems, and institutional support mechanisms may help improve teachers' competence and work performance (Putra et al., 2024).

School organization may influence teachers' professional skills both directly and indirectly. For example, when schools pay more attention to practical ability development and provide teachers with funding support, training opportunities, and sufficient time for skill improvement, teachers may improve their professional skills more effectively.

H4: School organization has a significant positive effect on teachers' professional skills.

2.2.5. Participation in Enterprise Practice and Skills Training and Teachers' Professional Skills

Work-based learning and enterprise practice can provide teachers with opportunities to gain practical knowledge and improve professional skills through experiential learning processes (Fergusson, 2022). Some studies have also shown that industrial apprenticeship models are helpful for improving vocational teachers' technical competence and practical ability (Suyitno et al., 2022).

Technical Skill Accumulation Theory explains that skill formation depends on long-term practical processes. For vocational college teachers, the improvement of professional skills is closely related to enterprise practice and skills training activities. Teachers who participate in practical activities more regularly may have more chances to improve their professional skills. During enterprise practice and training activities, teachers can gradually gain practical experience, and their operational abilities may also improve through repeated learning and practice.

H5: Participation in enterprise practice and skills training has a significant positive effect on teachers' professional skills.

2.2.6. Individual Factors and Teachers' Professional Skills

Human Capital Theory suggests that some personal factors, such as professional identity, development willingness, and learning initiative, may influence teachers' participation in teaching and practical activities. In many situations, teachers who have stronger motivation for self-improvement are more willing to participate in technical learning, teaching reflection, and independent practice activities. Through these activities, their professional skills may gradually improve over time.

Technical Skill Accumulation Theory also explains that skill development does not depend solely on external practical opportunities. Teachers' own learning attitudes, willingness to participate, and reflective learning during practical activities may also influence the process of professional skill improvement.

H6: Individual factors have a significant positive effect on teachers' professional skills.

2.2.7. Professional Community Interaction and Teachers' Professional Skills

Some previous studies mentioned that professional learning communities may support teachers' collaborative learning, reflective communication, and knowledge-sharing activities, and these activities can help improve teacher competence to some extent (Khasawneh et al., 2023). Other researchers have also found that peer interaction and shared learning activities are helpful for teachers' professional development and competence improvement (Ramos et al., 2022).

Professional communities can also provide teachers with opportunities for communication and the exchange of experiences. During these activities, teachers may discuss teaching problems, share technical experiences, and learn from each other through communication and reflection. These activities may gradually support the improvement of teachers' professional skills and practical abilities.

H7: Professional community interaction has a significant positive effect on teachers' professional skills.

3. Research Design

3.1. Research Instrument

This study employed a questionnaire survey to collect research data. The questionnaire mainly consisted of six latent variables: institutional environment, individual factors, school organization, participation in enterprise practice and skills training, professional community interaction, and teachers' professional skills. The latent variables and their corresponding observed variables are presented in **Table 1**.

A five-point Likert scale was adopted for measurement, including five response categories ranging from "strongly disagree" to "strongly agree", assigned values

Table 1. Influencing factors of teachers' professional skills.

Latent Variable	Observed Variable	Description of Observed Variable
Institutional Environment (ZD)	Policy Support (ZD1)	Local education and human resources authorities provide clear policy or project support for improving teachers' practical abilities.
	Enterprise Incentives (ZD2)	Local enterprises are motivated to participate in talent cultivation and to receive teachers for enterprise practice, supported by government incentive or compensation mechanisms.
	Evaluation Orientation (ZD3)	Professional practical competence and enterprise experience are important criteria in teacher promotion and professional title evaluation.
Individual Factors (GY)	Professional Identity (GY1)	I believe that being a "dual-qualified" teacher (integrating theory and practice) is the ideal competency model for vocational college teachers.
	Development Motivation (GY2)	I have a strong willingness to improve my practical operational skills.
	Initiative (GY3)	Even without mandatory requirements, I actively seek opportunities to improve my practical competence.
School Organization (XX)	Strategic Emphasis (XX1)	The school regards improving teachers' practical competence as a key task.
	Institutional Support (XX2)	The school has systematic management and incentive mechanisms for teachers' enterprise practices.
	Resource Investment (XX3)	The school provides special funding to support teachers' participation in enterprise practice or practical skills training.
	Cooperative Foundation (XX4)	The school maintains stable and in-depth partnerships with enterprises that can provide high-quality practical opportunities for teachers.
Participation in Enterprise Practice and Skills Training (QP)	Duration of Enterprise Practice (QP1)	During the past two years, I have participated in more than one month of full-time or part-time enterprise practice.
	Relevance of Practice (QP2)	The enterprise practice I participated in was highly relevant to the core skills of my teaching discipline, and enterprise mentors provided guidance during the practicum process.
	Participation in Skills Training (QP3)	I have participated in skills training organized by leading enterprises or municipal-level vocational training centers.
Professional Community Interaction (ZY)	Team Culture (ZY1)	My teaching team has developed a culture that values practical competence and the sharing of experience.
	Internal Teaching Collaboration (ZY2)	Our teaching and research office frequently discusses how enterprise standards and technical documents can be transformed into teaching projects.
	School-Enterprise Interaction (ZY3)	Through industry-education integration platforms, I can conveniently access the latest industry technologies and maintain communication with enterprise experts and technicians.
Teachers' Professional Skills (JS)	Operational Competence (JS1)	I can independently and properly operate the major equipment, tools, or software related to my discipline.
	Process Understanding Ability (JS2)	I am familiar with the typical production processes or work procedures related to my teaching discipline.
	Professional Qualification Ability (JS3)	I possess industry qualification certificates or skill-level certificates related to my discipline.

Continued

Teaching Transformation Ability (JS4)	I can effectively transform real enterprise projects, cases, or problems into teaching tasks or learning scenarios.
Technology Updating Ability (JS5)	I can promptly incorporate new technologies, processes, and standards into my teaching practices.

from 1 to 5, respectively. The questionnaire items were designed around factors influencing the formation of teachers' professional skills and were able to comprehensively reflect the actual conditions of professional skill development among vocational college teachers.

In developing the questionnaire, several measurement items were adapted from constructs and dimensions commonly discussed in previous studies on vocational teacher competence, organizational support, work-based learning, and professional development. At the same time, some items were further refined according to the research context of vocational colleges in China and the characteristics of teachers' professional skills development. Before the formal survey was conducted, the questionnaire was reviewed by five experts in vocational education and educational management to examine the clarity, content relevance, and wording of the items. Based on their feedback, several expressions and item descriptions were adjusted to improve readability and contextual appropriateness. A pilot survey was subsequently conducted with a small group of vocational college teachers to assess the comprehensibility and overall structure of the questionnaire. Minor revisions were made after the pilot test to improve item clarity and response consistency before the large-scale data collection was carried out.

3.2. Research Participants and Data Collection

The data for this study were collected through both online and paper-based questionnaire surveys administered to teachers working in higher vocational institutions in China. To obtain samples from different institutional contexts, a stratified purposive sampling approach was adopted. Fifty vocational colleges were selected from the eastern, central, and western regions of China, including vocational undergraduate institutions and higher vocational colleges. The participating institutions were generally characterized by relatively active engagement in school-enterprise cooperation, practice-oriented professional programs, or industry-education integration projects.

The survey targeted in-service teachers involved in vocational and technical education. Respondents were included in the study if they met the following conditions: 1) they had more than one year of teaching experience in vocational education; 2) they were responsible for professional or technical course teaching; and 3) they had participated in activities related to practical teaching, enterprise cooperation, or vocational skills training.

Questionnaire distribution was conducted between March and June 2025 with assistance from institutional contacts at the participating colleges. A total of 1500

questionnaires were distributed. After data screening, 1445 questionnaires were retained for analysis, resulting in a valid response rate of 96.3%.

Several procedures were applied during the data screening process to improve data quality. Questionnaires with substantial missing information were excluded. Responses showing obvious regular answering patterns, such as selecting identical options throughout the questionnaire, were also removed. In addition, questionnaires completed within an unusually short period of time were treated as invalid because they were considered unlikely to reflect careful responses.

The final sample included teachers from different age groups, professional title levels, and institutional types, providing coverage of multiple vocational education contexts. Detailed demographic information on the respondents is presented in **Table 2**.

Table 2. Demographic Information of Respondents.

Category	Option	Frequency	Percentage (%)
Professional Title	Junior	476	32.9
	Intermediate	504	34.9
	Associate Senior and Above	465	32.2
Age Group	25 - 30	321	22.2
	31 - 40	371	25.7
	41 - 50	386	26.7
	51 - 60	367	25.4
Type of Institution	Vocational Undergraduate Institutions	15	30
	Higher Vocational Colleges	35	70

3.3. Data Analysis Methods

SPSS and AMOS software were used for data analysis. First, SPSS was employed to conduct reliability and validity tests of the questionnaire data. Second, based on the hypothesized relationships among the latent variables, AMOS was used to construct a structural equation model (SEM) and perform confirmatory factor analysis (CFA).

The structural equation model of the professional skill formation path for vocational college teachers is illustrated in **Figure 1**.

4. Results and Analysis

4.1. Reliability Analysis

Cronbach's Alpha coefficients were used to test the reliability of the measurement model. The results are shown in **Table 3**. All latent variables had Cronbach's Alpha coefficients greater than 0.70, while the overall Cronbach's Alpha coefficient of the model reached 0.907, indicating high internal consistency and satisfactory

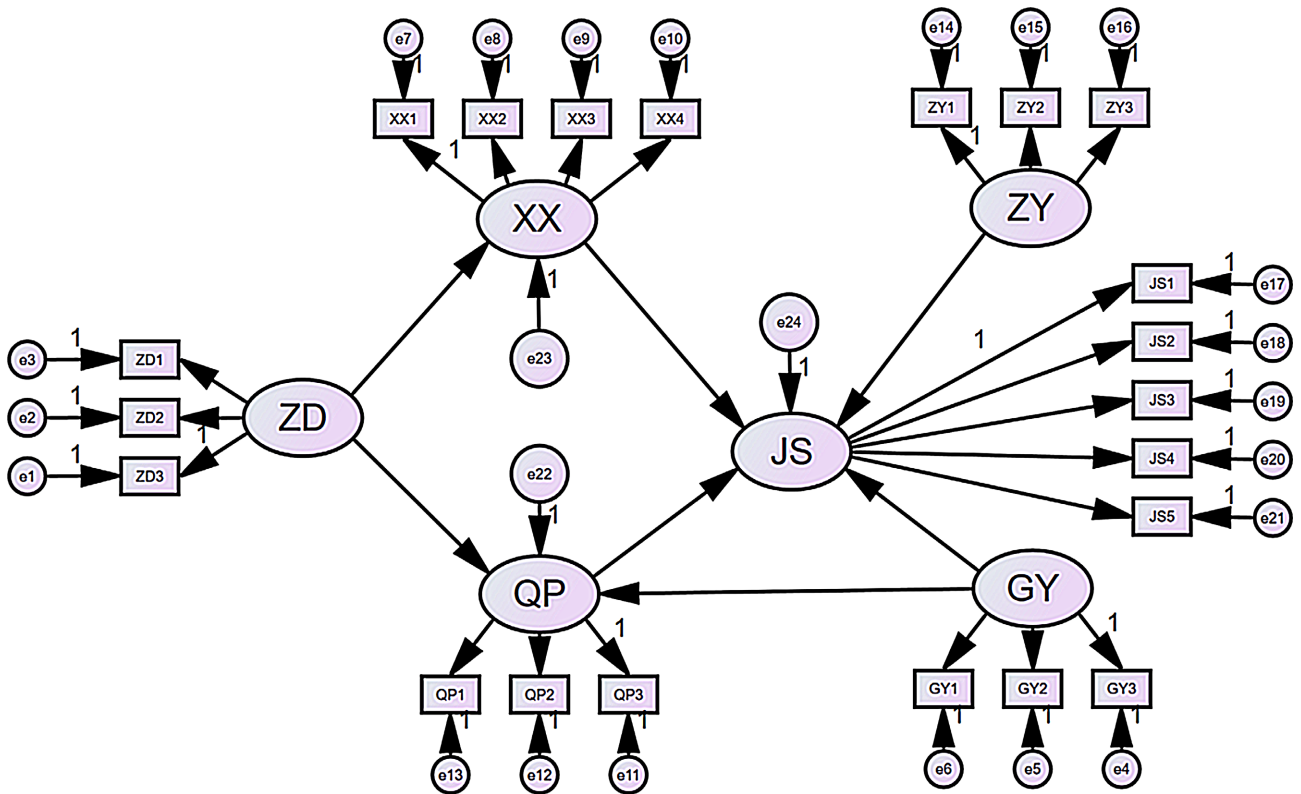


Figure 1. Structural model of professional skills development pathways for vocational college teachers.

Table 3. Reliability analysis results (N = 1445).

Influencing Factor	Cronbach's Alpha	Reference Value	Number of Items
Institutional Environment	0.808	>0.7	3
Individual Factors	0.793	>0.7	3
School Organization	0.828	>0.7	4
Participation in Enterprise Practice and Skills Training	0.850	>0.7	3
Professional Community Interaction	0.753	>0.7	3
Teachers' Professional Skills	0.923	>0.7	5
Overall Cronbach's Alpha	0.907	>0.7	21

reliability of the questionnaire data.

4.2. Structural Validity Analysis

The Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity were conducted to evaluate the validity of the questionnaire. As shown in **Table 4**, the KMO value was 0.936, exceeding the recommended threshold of 0.90, while the significance level of Bartlett's Test was less than 0.001. These results indicate that the data were suitable for factor analysis and demonstrated good structural validity.

Table 4. KMO and Bartlett's test results.

KMO Measure of Sampling Adequacy		0.936
Bartlett's test of sphericity	Approximate Chi-square	15,728.471
	Degrees of Freedom	210
	Significance	0.000

4.3. Model Fit Analysis

AMOS software was used to examine the goodness-of-fit of the structural equation model. The results presented in **Table 5** indicate that all model fit indices meet acceptable standards, suggesting that the model adequately explains the formation path of professional skills among vocational college teachers.

Table 5. Model fit indices.

Fit Index	GFI	AGFI	NFI	TLI	RMSEA	χ^2/df
Statistical Value	0.967	0.957	0.97	0.977	0.034	2.678
Recommended Value	>0.9	>0.9	>0.9	>0.9	<0.08	<3

4.4. Measurement Model Results

Confirmatory factor analysis was conducted to evaluate the measurement model. As shown in **Table 6**, all standardized factor loadings exceeded the recommended threshold of 0.60 and were statistically significant ($p < 0.001$), indicating satisfactory convergent validity of the measurement model.

In addition, the composite reliability (CR) values of all latent constructs exceeded 0.70, while the average variance extracted (AVE) values were above the recommended threshold of 0.50. These results suggest that the measurement model demonstrates acceptable reliability and convergent validity.

Table 6. Standardized factor loadings of the measurement model.

Construct	Indicator	Standardized Loading	S.E.	C.R.	P
Institutional Environment	ZD1	0.756			
	ZD2	0.721	0.038	25.302	*
	ZD3	0.74	0.038	25.897	*
Individual Factors	GY1	0.773			
	GY2	0.725	0.04	23.523	*
	GY3	0.748	0.041	23.865	*
School Organization	XX1	0.736			
	XX2	0.735	0.039	25.578	*
	XX3	0.751	0.039	26.067	*
	XX4	0.741	0.039	25.75	*

Continued

Participation in Enterprise Practice and Skills Training	QP1	0.799			
	QP2	0.806	0.031	32.209	*
	QP3	0.828	0.031	33.198	*
Professional Community Interaction	ZY1	0.702			
	ZY2	0.73	0.05	20.757	*
	ZY3	0.701	0.049	20.466	*
Teachers' Professional Skills	JS1	0.824			
	JS2	0.828	0.027	37.325	*
	JS3	0.842	0.027	38.251	*
	JS4	0.842	0.027	38.209	*
	JS5	0.829	0.027	37.362	*

4.5. Structural Model and Hypothesis Testing

The structural model was further examined to test the proposed hypotheses. The results of the structural path analysis are presented in **Table 7**.

The institutional environment was positively associated with school organization ($\beta = 0.690$, $p < 0.001$), supporting H1. The institutional environment also showed a significant positive relationship with participation in enterprise practice and skills training ($\beta = 0.676$, $p < 0.001$), supporting H2.

Individual factors were positively associated with participation in enterprise practice and skills training ($\beta = 0.383$, $p < 0.001$), providing support for H3. School organization demonstrated a significant positive relationship with teachers'

Table 7. Structural path results and hypothesis testing.

Hypothesis	Path Relationship	Standardized Path Coefficient	S.E.	C.R.	P	Result
H1	Participation in Skills Training \leftarrow Participation in Enterprise Practice and Skills Training	0.69	0.035	19.513	*	Supported
H2	Practice Relevance \leftarrow Participation in Enterprise Practice and Skills Training	0.676	0.034	21.251	*	Supported
H3	Duration of Enterprise Practice \leftarrow Participation in Enterprise Practice and Skills Training	0.383	0.029	13.916	*	Supported
H4	Team Culture \leftarrow Professional Community Interaction	0.26	0.029	9.814	*	Supported
H5	Internal Teaching Collaboration \leftarrow Professional Community Interaction	0.529	0.032	16.787	*	Supported
H6	School-Enterprise Cooperative Interaction \leftarrow Professional Community Interaction	0.034	0.026	1.381	0.167	Not Supported
H7	Operational Competence \leftarrow Teachers' Professional Skills	0.267	0.029	10.715	*	Supported

professional skills ($\beta = 0.260, p < 0.001$), supporting H4.

Participation in enterprise practice and skills training showed the strongest positive association with teachers' professional skills ($\beta = 0.529, p < 0.001$), supporting H5. However, the direct relationship between individual factors and teachers' professional skills was not statistically significant ($\beta = 0.034, p = 0.167$), and therefore H6 was not supported.

Finally, professional community interaction was positively associated with teachers' professional skills ($\beta = 0.267, p < 0.001$), supporting H7.

4.6. Discriminant Validity Analysis

Discriminant validity was examined by comparing the square roots of the Average Variance Extracted (AVE) values for each latent variable with the absolute values of the correlations among latent variables. According to the results in **Table 8**, the square root of the AVE for each latent variable was greater than the corresponding inter-variable correlation coefficients, indicating satisfactory discriminant validity among the latent constructs.

Table 8. Comparison of AVE square roots and correlation coefficients.

Construct	Professional Community Interaction	Individual Factors	Institutional Environment	Enterprise Practice and Skills Training Participation	School Organization	Teachers' Professional Skills
Professional Community Interaction	0.711126					
Individual Factors	0.033	0.748933				
Institutional Environment	0.418	0.015	0.739121			
Enterprise Practice and Skills Training Participation	0.27	0.393	0.682	0.8111		
School Organization	0.288	0.01	0.69	0.47	0.74081	
Teachers' Professional Skills	0.483	0.236	0.652	0.736	0.586	0.833007

Note: Diagonal values represent the square roots of the AVE.

4.7. Mediation Effect Analysis

To further examine the mediating relationships in the proposed model, bootstrap analysis was conducted in AMOS using 5000 resamples and bias-corrected 95% confidence intervals. The indirect and total effects of the main mediating paths are presented in **Table 9**.

The findings indicated that the institutional environment exerted significant indirect effects on teachers' professional skills through both school organization and participation in enterprise practice and skills training. Specifically, the indirect effect through school organization was 0.275, and the corresponding 95% confidence interval did not include zero, indicating that the mediation effect was

Table 9. Bootstrap mediation effect analysis.

Mediating Path	Indirect Effect	Total Effect	95% CI Lower	95% CI Upper	Result
Institutional Environment → School Organization → Teachers' Professional Skills	0.275	0.275	0.499	0.576	Supported
Institutional Environment → Enterprise Practice and Skills Training → Teachers' Professional Skills	0.262	0.262	0.384	0.491	Supported
Individual Factors → Enterprise Practice and Skills Training → Teachers' Professional Skills	0.203	0.237	0.167	0.239	Supported

statistically significant. Similarly, participation in enterprise practice and skills training also mediated the relationship between the institutional environment and teachers' professional skills, with an indirect effect value of 0.262. The bootstrap confidence interval for this path likewise excluded zero, supporting the existence of the mediation effect.

In addition, individual factors demonstrated a significant indirect effect on teachers' professional skills through participation in enterprise practice and skills training. The indirect effect value was 0.203, while the total effect reached 0.237. Since the confidence interval did not include zero, the mediation relationship was considered statistically significant. Combined with the previous structural path results, this finding suggests that individual factors were associated with teachers' professional skills mainly through increased participation in enterprise practice and skills training activities, rather than through a direct relationship.

Overall, the mediation analysis further supports the intermediary role of enterprise practice and skills training participation in the development of vocational college teachers' professional skills. The results also suggest that institutional support may be associated with teachers' professional skills indirectly through organizational support mechanisms and practical training opportunities.

4.8. Common Method Bias Test

Because all variables in this study were collected through self-report questionnaires at a single time point, common method bias may potentially affect the relationships among variables. Therefore, Harman's single-factor test was conducted to examine the possible influence of common method variance.

All measurement items were entered into an unrotated exploratory factor analysis using SPSS. The results showed that multiple factors with eigenvalues greater than 1 were extracted. The first factor explained 32.4% of the total variance, which was below the commonly recommended threshold of 40%. This result suggests that no single factor accounted for the majority of the covariance among the variables, indicating that common method bias was unlikely to pose a serious threat to the findings of this study.

In addition, several procedural measures were adopted during the question-

naire design and data collection process to reduce potential common method bias. For example, respondents were informed that the survey was anonymous and intended only for academic research purposes. The wording of questionnaire items was also adjusted to improve clarity and reduce evaluation apprehension.

5. Conclusion and Recommendations

5.1. Conclusion

This study used Human Capital Theory and Technical Skill Accumulation Theory as the main theoretical basis, and a structural equation model was built to analyze the formation path of vocational college teachers' professional skills. According to the data analysis results, several conclusions were obtained.

First, the institutional environment has an obvious influence on teachers' professional skill development. When schools receive stronger policy support and better external conditions, school organizations are more likely to improve related support systems for teachers. At the same time, teachers may also have more chances to join enterprise practice and skills training activities. Because of this, teachers' professional skills can be improved to some extent through these external conditions.

Second, school organization also has an important influence on teachers' professional skills. Some earlier studies reached similar conclusions and pointed out that organizational support is related to teachers' professional development and job satisfaction (Putra et al., 2024; Oubibi et al., 2022). In this study, school support mainly included institutional arrangements, financial support, and school-enterprise cooperation. These conditions can provide teachers with more opportunities for practical learning and skill improvement. In addition, school organization also showed an indirect connection between the institutional environment and teachers' professional skills.

Third, participation in enterprise practice and skills training showed the strongest effect among all variables in this study. Similar viewpoints can also be found in previous studies, which explained that work-based learning and enterprise practice are important ways for vocational teachers to improve professional competence (Fergusson, 2022; Suyitno et al., 2022). The results of this study further showed that teachers who participate more in practical training activities usually have better professional skill performance. This finding also supports the basic idea of Technical Skill Accumulation Theory, that is, skills are gradually improved through long-term practice and repeated learning activities.

Fourth, individual factors did not directly affect teachers' professional skills in this study, but these factors still had some indirect influence. Teachers with stronger professional identity, learning willingness, and development motivation were more likely to participate in enterprise practice and training activities. After taking part in these practical activities, teachers' professional skills could then be improved gradually.

Fifth, professional community interaction also had a positive effect on teachers'

professional skills. Some previous studies also mentioned that collaborative learning and reflective communication are useful for teacher competence development (Ramos et al., 2022; Khasawneh et al., 2023). In this study, teachers could exchange technical experience, discuss teaching problems, and share practical knowledge through professional community activities, which may help improve their practical abilities and professional skills over time.

Overall, the formation of vocational college teachers' professional skills is affected by different factors together, including the institutional environment, school organization, individual factors, participation in enterprise practice and skills training, and professional community interaction. Among these factors, participation in enterprise practice and skills training appears to play the most important role in the whole formation process.

5.2. Recommendations

Based on the research findings, several suggestions are proposed from the aspects of policy support, school organization, and teacher development.

5.2.1. Improving Institutional Environment and Policy Support

Relevant departments may further improve policies related to vocational education so that enterprises become more willing to provide practice opportunities for teachers. At the same time, support systems for teachers' professional skill development should also continue to be improved. In teacher evaluation and promotion systems, more attention can be given to practical competence and enterprise practice experience, instead of focusing mainly on academic indicators.

5.2.2. Strengthening School Organizational Support

Vocational colleges may strengthen organizational support for teachers and improve professional development systems gradually. Schools can encourage teachers to participate regularly in enterprise practice activities and improve related management arrangements. In addition, schools may provide more financial support for skills training and practical learning activities. Stable cooperation with enterprises is also important because it can provide teachers with more long-term practical opportunities.

5.2.3. Improving Practice-Oriented Teacher Training

Teacher training systems in vocational colleges may place more emphasis on practical ability improvement. Through enterprise practice, project participation, and vocational skills competitions, teachers can gradually improve their operational skills and practical experience. At the same time, different disciplines may need different training methods; therefore, schools can adjust training content according to disciplinary characteristics and actual teaching needs.

5.2.4. Strengthening Professional Community Communication

Vocational colleges can further support the development of professional communities and provide teachers with more opportunities for communication and

shared learning. Teachers from similar professional fields may exchange teaching experiences and practical skills through these activities. Schools can also invite enterprise technicians to participate in teaching discussions and training activities, which may help strengthen cooperation between schools and enterprises and support the sharing of practical knowledge and technical experience.

5.3. Limitations and Future Research

Several limitations should be considered when interpreting the findings of this study. First, the research adopted a cross-sectional survey design, and the data were collected at a single point in time. Although the structural equation model helped identify statistically significant relationships among the variables, the results cannot be interpreted as conclusive evidence of causal relationships. Therefore, the findings should be understood primarily as reflecting structural associations among the institutional environment, organizational support, practical participation, and teachers' professional skills.

Second, all variables were measured using self-reported questionnaire data, which may be influenced by individual perceptions and response tendencies. Although anonymity procedures and common method bias tests were applied during the research process, potential measurement bias cannot be entirely ruled out.

Third, the sample was drawn from vocational colleges in China, where vocational education systems, institutional arrangements, and school-enterprise cooperation mechanisms may differ from those in other national contexts. As a result, caution is needed when extending the findings to different educational systems or cultural settings.

Future research may further examine the development of vocational teachers' professional skills through longitudinal research designs, multi-source data collection, or mixed-method approaches. Such efforts may provide a more comprehensive understanding of how institutional support, workplace participation, and professional interaction are associated with teachers' professional skill development over time.

Funding

The research is supported by the grant of the Office of the Guangdong Provincial Education Science Planning Leading Group No. 2024GXJK857 "Research on the Adaptability of Rail Transit Major Structure and Industrial Structure in Guangdong Vocational Colleges from the Perspective of Regional Economic Development Theory".

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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