

## Article

# Factors Influencing Vocational Education and Training Teachers' Professional Competence Based on a Large-Scale Diagnostic Method: A Decade of Data from China

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**Abstract:** China has the world's most extensive vocational education and training (VET) system, and VET teachers are central to training high-quality technical and skilled workers. This study aimed to explore the factors influencing VET teachers' professional competence based on empirical research. We used a large-scale diagnostic method based on the competence measurement of VET, the teachers' professional competence model. Comprehensive diagnostic tasks, assessment criteria, and test protocols jointly developed by Chinese and German researchers were used to diagnose professional competence. Background questionnaires were collected from 601 VET teachers in 39 vocational colleges and schools in China over ten years. Path analysis was used to explore factors influencing the professional competence of VET teachers. The study found that skill awards, highest academic degree, course type (practical over theoretical), highest level of professional qualification, and enterprise support positively influenced professional competence. School support negatively influenced VET teachers' professional competence. Organizational identification mediated the relationship between enterprise support, school support, and professional competence. However, professional identity or learning strategy aren't mediated the relationship between enterprise support, school support, and professional competence. This study provides an empirical basis for enhancing VET teachers' professional competence and facilitating further development of theories regarding the professional competence of VET teachers.

**Keywords:** vocational education and training; large-scale diagnostic method; VET teachers; professional competence; influencing factors



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## 1. Introduction

Vocational education and training (VET) in China has grown considerably in recent years. In 2022, more than 29.15 million students were enrolled in vocational colleges and schools (VCSs); China has developed the world's largest VET system [1]. However, the *Planning Guide for the Development of Manufacturing Workers*—jointly issued by the Ministry of Education, the Ministry of Human Resources and Social Security, and the Ministry of Industry and Information Technology of the People's Republic of China—anticipated a shortage of 30 million workers in several critical areas of manufacturing by 2025 [2]. At the same time, economic transformation and industrial upgrading have led to demands for a higher caliber of VET student. Therefore, cultivating technical and skilled workers with higher comprehensive professional competence has become urgent. Furthermore, for historical reasons, China has developed a schooling model in which

VCSs are the mainstays of education. Therefore, professional course teachers in VCSs are vital in determining the quality of technical and skilled workers. Thus, it is imperative to gain a profound understanding of the level of development and factors influencing the professional competence of professional course teachers in VCS.

Increasingly, countries have emphasized diagnosing learner competence. The Binet–Simon measuring scale of intelligence is an example of an early diagnostic psychological instrument to distinguish children with learning difficulties from the general population, ensuring they could receive special education. The general aptitude test battery was developed by the United States Department of Labor using job and factor analysis. The results guide secondary school students to higher education or employment. In Britain, the National Council for Vocational Qualifications was established to standardize professional competence diagnosis by specifying all professional qualifications in the form of regulations. In Japan, the Ministry of Labor promotes the professional competence evaluation system [3], which evaluates workers' competence through a competence assessment system, an in-house competence assessment, and a competence recognition system [4]. These instruments are aimed at children, young people, or adults. However, for many years we lacked an instrument developed specifically to diagnose VCS students' competence. Germany was one of the first countries to develop professional competence diagnostic instruments for VCS students. The ASCOT project (technology-based assessment of skills and competences in VET), implemented in 2011, developed a model and diagnostic instrument for students' professional competence. The project's innovations included the development of a methodology to identify common tasks for the same occupation in different countries, a competence and diagnostic model for students in VET, and virtual test situations for diagnosis. However, some limitations, such as low occupational validity, make it difficult to fully diagnose students' professional competence to solve complex professional problems in real-life situations [5].

Recently, Chinese researchers have undertaken preliminary explorations regarding VET teachers' professional competence and competence evaluation, e.g., constructing a professional competence model for professional course teachers in higher vocational schools based on management and teacher professional development theories [6]. The framework is relatively simple, focused on 'backbone' teachers (those with a richer educational experience and a specific demonstration and driving effect on general teachers), and is narrowly applicable. Some researchers have integrated the literature to generate a list of the characteristics of VET teachers' professional competence and designed a questionnaire for teachers in higher education schools for self-evaluation [7]. However, the questionnaire has not been systematically tested, and its reliability and validity cannot be guaranteed. Other studies have used interviews and questionnaires to survey students, professional course teachers, and principals in secondary vocational schools to determine the quality of VET teachers [8], but the theoretical basis of the research remains weak. A synthesis of research and practice in this area found that students' professional competence diagnosis based on a large-scale diagnostic method has attracted widespread attention from the international VET community [9]. However, there are still relatively few studies conducted on VET teachers' professional competence using large-scale diagnostic methods, professional competence models, and testing instruments that meet scientific standards and practical needs.

Assessing the level of VET teachers' professional competence requires scientifically sound measurement instruments and methods following the logic of empirical research in educational statistics and psychometrics. The vocational competence and professional identity assessment (competence measurement (COMET), also known as the PISA) is the first international comparative project to use a rigorous psycho-diagnostic method to diagnose professional competence development and the professional commitment of students in vocational education [10]. Its theoretical basis includes advanced vocational education ideas and theories, such as shaping-oriented vocational education, action-oriented teaching, contextual learning, developmental tasks, logical laws of career growth, and work process knowledge [11]. COMET has been shown to lay the scientific foundation for the evaluation

and interpretation of professional competence. It provides a theoretical and technical basis for the study of professional competence diagnosis for professional course teachers of VET [12]. The COMET professional competence diagnostic model for professional course teachers and the corresponding test instrument were developed within the framework of COMET students' professional competence evaluation project research [13,14]. Then, systematic reliability, validity, difficulty, and discrimination tests were conducted. This study aimed to explore the main factors influencing the professional competence development of Chinese VET teachers based on a large-scale diagnostic method.

## 2. Conceptual Clarifications and Research Hypothesis

### 2.1. Conceptual Clarifications

#### 2.1.1. Professional Competence

Professional competence refers to the cognitive–psychological characteristics and developmental potential within a given occupational field; the ability to understand, reflect on, evaluate, and perform occupational tasks required for individual employment and lifelong development; and to participate jointly in the design of technological and social development in the context of social, economic, and ecological responsibility [15]. The occupational tasks here are identified using occupational description rather than specific job tasks. Professional competence emphasizes cognitive–psychological traits or potential rather than occupational action competence and skills [16]. It also emphasizes competence to solve practical problems in real work situations.

#### 2.1.2. Vocational Education and Training Teacher

Typically, the courses in Chinese VCSs are divided into professional core courses (PCCs) (e.g., Automotive Engine Maintenance), professional basic courses (PBCs) (e.g., Mechanical Drawing), and cultural basic courses (CBCs) (e.g., Mathematics, English). Accordingly, teachers in VCS are also divided into PCC, PBC, and CBC teachers. The content taught by PBC and CBC teachers is mainly basic theoretical knowledge or skills. In contrast, PCC teachers teach more specialized knowledge and skills closely related to business practice. Therefore, PCC teachers may differ from PBC and CBC teachers in terms of professional competence. Thus, this study specifies VET teachers as PCC teachers in VCSs. Still, some PBC teachers were included as diagnostic objects to facilitate the comparative analysis of diagnostic results and practical operation. Therefore, the terms 'VET teachers' or 'teachers' are used in this paper to refer to these teaching groups collectively.

#### 2.1.3. Large-Scale Diagnostic Method

Large-scale diagnostic methods are designed and organized by professional examination bodies and implemented on a large scale for screening, detection, and evaluation [17]. In educational research, large-scale diagnosis requires instruments that are fair, reliable, and valid [17]. The approach unifies diagnostic criteria and enables cross-district or cross-national comparisons of the results of many teachers' (or students') diagnoses. Importantly, the results obtained through large-scale diagnostics can reflect problems at the macro level of education and help educational stakeholders gain insights from them [18].

### 2.2. Research Hypothesis

Scientific assessment of VET teachers' professional competence is a challenging and complex project attempted by many scholars. Qualitative researchers believe that individuals, VCSs, and society are the main factors influencing VET teachers' professional competence. Specifically, at the individual level, teachers' preservice learning and work experience, age, education, position, job structure [19], professional theoretical knowledge, practical operation skills for the job, teaching and research competence [20], and work happiness [21] are influential factors affecting teachers' professional competence. At the school level, teachers' working environment [22] and management level [23,24] influence professional competence, while the school's lack of competence to participate in school–enterprise

cooperation is a factor limiting teachers' professional development [25]. At the social level, reasons that limit the improvement of teachers' professional competence include prejudice against vocational education, low levels of enterprise participation and insufficient public financial investment in school–enterprise cooperation, lack of a long-term operating mechanism for school–enterprise cooperation, and the lack of in-depth cooperation between schools and enterprises in teaching and learning [26,27]. In addition, Antera used the conceptual analysis method (CAM) to analyze 45 articles about VET teachers' professional competence and found a significant correlation between professional qualifications and professional competence [28].

In quantitative research, Gao used the DACUM (develop a curriculum) job analysis technique to develop a questionnaire to survey 628 VCS teachers and found that teachers who were awarded professional honors (e.g., teaching expert, backbone teacher) were significantly more qualified than ordinary teachers in six areas: teaching, professional development, student and school management, scientific research, school–enterprise cooperation and social service, and career improvement [29]. This finding suggests that professional honors or titles predict teachers' professional competence to some extent.

Role conflict is a factor affecting the development of teachers' professional competence [30]. VET teachers play the role of teachers at work and family members at home, and role conflict arises when the two roles cannot be balanced. Fu's study found that the higher the social workers' family moral support, the longer they will be engaged in social work [31]. Therefore, this study argues that VET teachers' degree of family moral support affects their professional competence level.

In summary, current research on the factors influencing VET teachers' professional competence mainly focuses on individual, school, or societal factors, and very few empirical studies have systematically studied the influencing factors. There is a great need to fill this knowledge gap and systematically study the factors influencing VET teachers' professional competence. Combined with the above research review, this study proposed the following hypotheses:

- H1.** *Skill awards affect teachers' professional competence.*
- H2.** *The highest academic degree affects teachers' professional competence.*
- H3.** *Whether a teacher has obtained a teacher qualification affects teachers' professional competence.*
- H4.** *The maximum number of professional qualifications affects teachers' professional competence.*
- H5.** *The highest level of professional qualifications affects teachers' professional competence.*
- H6.** *School (or college) support affects teachers' professional competence.*
- H7.** *Enterprise support affects teachers' professional competence.*
- H8.** *Family moral support affects teachers' professional competence.*
- H9.** *Course type 1 (practical over theoretical) affects teachers' professional competence.*
- H10.** *Course type 2 (integrated theoretical–practical over theoretical) affects teachers' professional competence.*

Multiple factors influence VET teachers' professional competence. Organizational identification is uniquely valuable in explaining the attitudes and behavioral outcomes of individuals in organizations. The social, professional, or personal support an organization shows its members can effectively promote their organizational identification [32]. Members' perceptions of the organization's efforts to support their professionalization and career development can also enhance employees' organizational identification. Lee et al. found that organizational identification is a prerequisite for achieving work outcomes [33]. People with strong organizational identification are more likely to work hard to achieve organizational goals, which translates into motivation at work, thus improving job performance [34]. COMET professional competence diagnostic scores tend to be strongly

correlated with job performance [35]. Therefore, combining the literature review on the antecedent and outcome variables of organizational identification, we hypothesized that:

**H11.** *Organizational identification mediates the relationship between school support and VET teachers' professional competence.*

When considering the organizational identification of VET teachers, the influence of national culture must be taken into account [33]. In China, teachers' access to enterprise support is generally provided by schools. VET teachers are usually tasked with guiding practice with theory [36], which requires them to be competent to complete tasks in real work situations (i.e., meet occupational requirements). However, VET teachers in China often have rich theoretical knowledge but limited enterprise work and practical experience because of the origin and preservice training of VET teachers. Therefore, they need more post-service enterprise support to enhance their professional competence. Enterprise support is usually the most effective way to heighten the practice skills of VET teachers. Hence, combining the literature review on the antecedent and outcome variables of organizational identification, we hypothesized that:

**H12.** *Organizational identification mediates the relationship between enterprise support and VET teachers' professional competence.*

Professional identity is closely linked to organizational identification. Professional identity is an individual's self-concept in the professional world, gradually derived from growth experiences and leading to an individual's orientation in the professional world [37]. The factors that influence professional identity include personal characteristics, environmental factors [38], school support [39], and social support, especially support provided by the enterprise [40]. Generally, teachers with high professional identity are more resistant to professional stress [41], have high career satisfaction [42], enjoy their job, and are therefore able to devote themselves to their work [43,44] and improve their job performance [45]. Moreover, their COMET professional competence diagnostic scores tend to be strongly correlated with job performance [35]. Therefore, in conjunction with the literature review on professional identity's antecedent and outcome variables, we hypothesized that:

**H13.** *Professional identity mediates the relationship between school support and VET teachers' professional competence.*

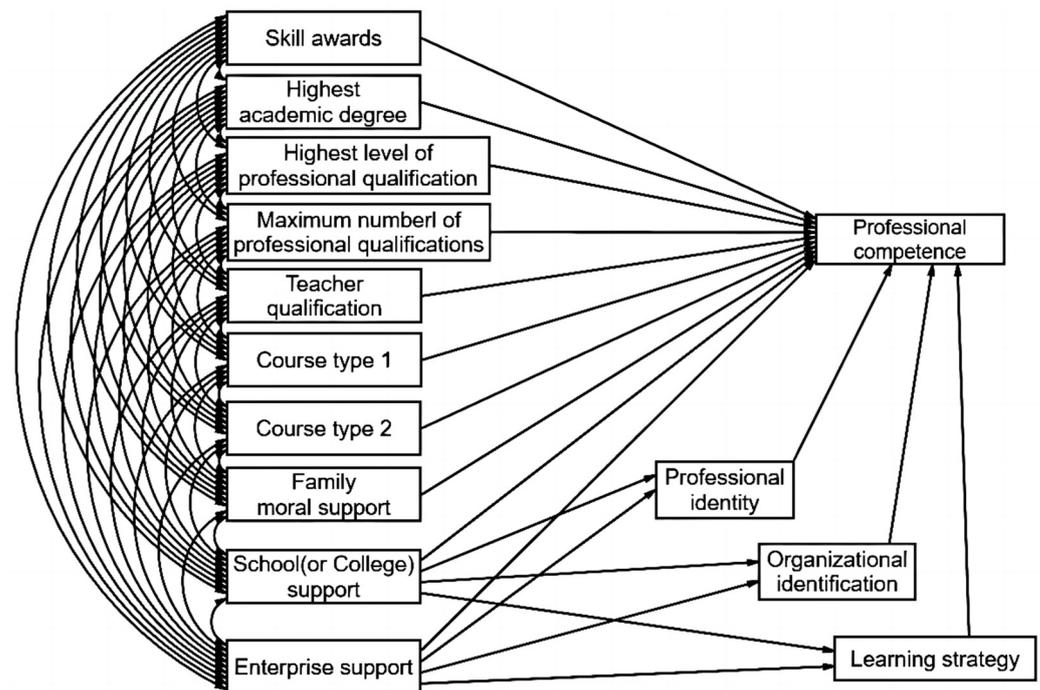
**H14.** *Professional identity mediates the relationship between enterprise support and VET teachers' professional competence.*

The development of learning strategy research has led to increased recognition that learning effectiveness often depends on combining multiple strategies [46]. A learning strategy in this study refers to VET teachers' specific behaviors and actions to improve their individual and organizational competence in workplace learning. We focus on a socioecological system that facilitates teachers' workplace learning [47]. For VET teachers, the acquisition of practical knowledge is inseparable from real work experience, and the environmental support provided by schools and enterprises is a precondition for selecting and using learning strategies. Learning strategies, as a kind of psychological operation that points to a cognitive goal, are a critical part of learners' problem-solving ability, which is the original driving force for the development of professional competence [48]. Problem-solving skills are the original motivation for professional competence development [49], following the concept of lifelong learning. Therefore, based on our literature review, we hypothesized that:

**H15.** *Learning strategies mediate the relationship between school support and VET teachers' professional competence.*

**H16.** *Learning strategies mediate the relationship between enterprise support and VET teachers' professional competence.*

In summary, most current research on the factors influencing the professional competence of VET teachers is qualitative, and little quantitative research has been undertaken in this area to date. A few large-scale quantitative studies have been conducted concerning VCS students, such as the competence and professional identity assessment, developed collaboratively in Germany, China, and South Africa [50,51], and the 'ASCOT+' project in Germany. However, few studies have elucidated VET teachers' professional competence. Thus, the hypothesis model in this study focuses on the effects of VET teachers' skill awards, education, qualifications, course types, school, enterprise, family moral support, professional identity, and organizational identification on professional competence (Figure 1).



**Figure 1.** Hypothetical model of factors influencing PC of VET teachers.

### 3. Materials and Methods

This study consisted of a pretest and a formal test. The purpose of the pretest was to revise the comprehensive diagnostic tasks (CDTs), assessment criteria, and questionnaires, and examine the difficulty, discrimination, and empirical validity of the CDTs. The purpose of the formal test was to analyze the factors affecting VET teachers' professional competence.

#### 3.1. Participants

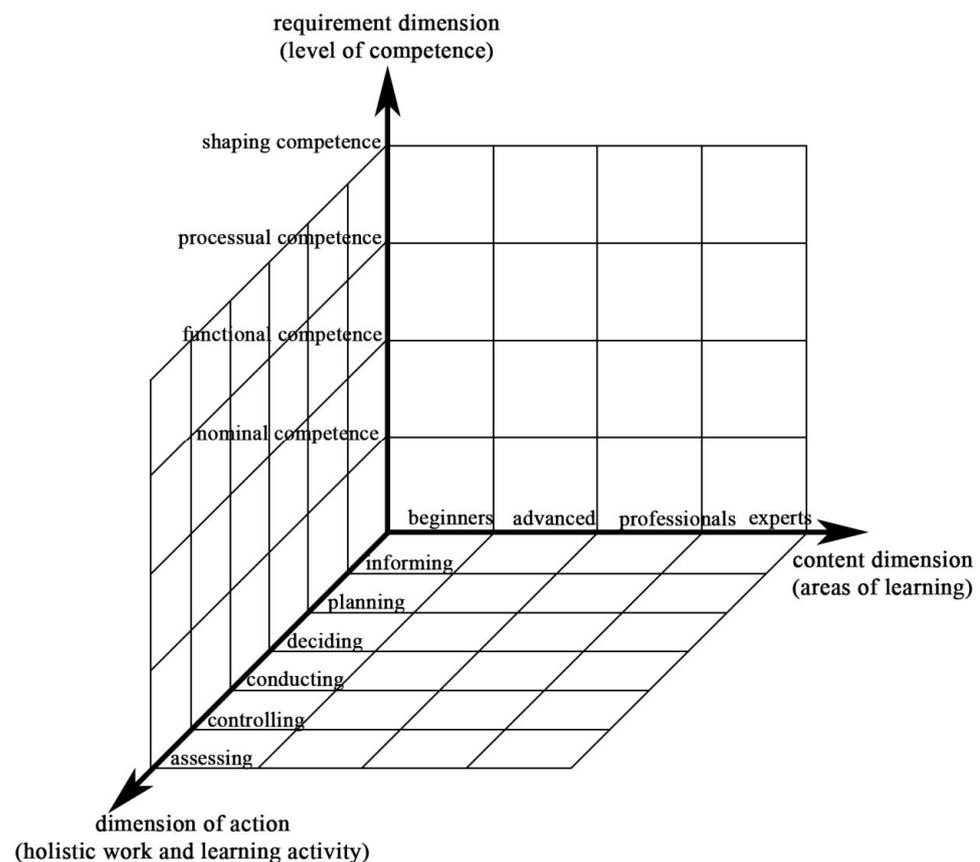
A total of 167 VET teachers from Beijing, Jiangsu, Zhejiang, and Sichuan provinces were selected for the pre-test, and 140 valid samples were obtained. Results showed that the difficulty, discrimination, and empirical validity of the CDTs were acceptable [16]. We drew on stratified and whole-group sampling principles for the formal test. Background questionnaires and professional competence diagnoses were given to 601 VET teachers of Mechanical Engineering (ME), Automobile Maintenance (AM), Architecture, Information Technology (IT), and Preschool Education (PE). Participants were based in 39 VCSs distributed across seven provinces (cities) in five major administrative regions of Northeast, North, East, South, and Southwest China. A total of 578 valid samples were obtained (356 males, 212 females, and 10 with no gender indicated). Of these, 212 were in ME, 250 in AM, 65 in IT, 30 in PE, and 21 in Architecture.

### 3.2. Instruments

Professional competence diagnosis usually requires three steps: establishing a competence model, transforming the competence model into a diagnostic index system, and determining the specific diagnostic content [52].

#### 3.2.1. Professional Competence Model and Assessment Criteria for VET Teachers

The professional competence model should distinguish between teachers' levels of competence and include content dimensions relevant to their professional work contexts and action dimensions that follow the rules of teaching and learning activities. The German COMET subproject developed a model of professional competence (theoretical model) for VET teachers and assessment criteria (4 levels of competence, 9 indicators, and 45 scoring points) that have been translated from this model. However, it was challenging to complete the empirical test with a large sample for cultural reasons. The theoretical model and assessment criteria were rigorously revised back-to-back in three rounds using the Delphi method in China, and finally agreed upon in a joint workshop. The tested competence model is shown in Figure 2.



**Figure 2.** Professional competence model for VET teachers.

#### 3.2.2. Comprehensive Diagnostic Tasks

The COMET international project team designed the two original CDTs, teaching scheme design (TSD) and learning environment design (LED), with slight differences between the majors for the two tasks. Taking cultural backgrounds into account, the project team repeatedly cross-referenced and modified the expressions in different languages and combined the findings of Chinese industry experts, test experts, and front-line teachers to develop the technical requirements of the Chinese version of the test. The professional competence diagnostic test for VET teachers was finally created based on the guiding

principles of the comprehensive project. The total time spent on the tasks was 6 h, with an average of about 4.5 h.

### 3.2.3. Questionnaires

We designed the professional competence development influencing factors questionnaire for VET teachers (IFQ) and the professional competence background questionnaire for VET teachers (BQ). The development process for the two questionnaires was as follows. First, the IFQ (first draft) was developed based on literature analysis and interviews with experts in VCSs, drawing on previous research findings, PISA experience, and consultation with education experts. This was followed by a small-scale pilot test (sample = 4), a larger-scale pre-test (sample = 140), and the formal test. The conceptual validity of the scale was retested using the extensive sample data from the formal test based on the exploration and testing of conceptual validity during the pretesting phase. The results showed an excellent model fit for the professional identity scale, organizational identification scale, learning strategy scale, school support scale, enterprise support scale, and family moral support scale (Table 1). The BQ is not a rigorous scale and was mainly tested for content validity with experts' help and modified through participant feedback from both tests.

**Table 1.** Model fit of scales.

Scales	Fit Index	$\chi^2$	df	$\chi^2/df$	RMSEA	GFI	AGFI	NFI	CFI	IFI
	Professional identity		23.423	8	2.928	0.078	0.976	0.938	0.959	0.972
Organizational identification		42.346	9	4.705	0.108	0.959	0.903	0.944	0.955	0.955
Learning strategy		114.499	62	1.847	0.051	0.948	0.923	0.921	0.962	0.962
School support		34.520	7	4.931	0.111	0.963	0.889	0.965	0.972	0.972
Enterprise support		53.986	12	4.499	0.105	0.955	0.896	0.944	0.956	0.956
Family moral support		12.509	4	3.127	0.082	0.984	0.941	0.983	0.988	0.988

### 3.2.4. Difficulty, Discrimination, and Empirical Validity of the Tests

The difficulty of a test item should be close to 0.5 to maximize the test's detectability by reflecting the test taker's competence level [53]. The tests used in this study were of moderate difficulty (scores between 0.4 and 0.5), had a high degree of discrimination in test assessment criteria, and effectively distinguished the teaching skill levels of VET teachers [16].

### 3.3. Procedure

First, the project team contacted the school directors to prepare for the testing before the formal diagnosis and to remind the participating teachers to prepare the tools and materials needed. In most cases, the diagnostic assessment took seven and a half hours in total (approximately two and a half days), with approximately four hours on the first half-day, and three and a half hours on the second half-day. Before the first half-day, the project team introduced the COMET professional competence diagnostic method to the teachers and encouraged them to pay attention to the tests, ensuring that all questionnaires were analyzed anonymously and that the results were used for macro-statistical purposes only and not for individual performance assessment. The teachers completed the TSD (3 h) and the IFQ (approximately 25 min). On the second half-day, the teachers completed the LED test (3 h) and the BQ (20 min).

### 3.4. Data Analysis

IBM SPSS23.0 (SPSS Inc., Chicago, IL, USA) and IBM SPSS Amos24 were used to analyze the data. Firstly, IBM SPSS23.0 was used to process the questionnaire data and VET teachers' professional competence score, and then code the remaining data according to the research requirements. The course types were three unordered multi-categorical

variables. To allow multi-categorical data to enter the model, we created a dummy variable for analysis as continuous data. Secondly, IBM SPSS Amos24 was used to verify the research hypothesis.

## 4. Results

### 4.1. Model Fit

The model fit of the initial model test is shown in Table 2:  $\chi^2/df = 10.506$ , RMSEA = 0.133, RMR = 0.855, GFI = 0.925, AGFI = 0.707, NFI = 0.832, CFI = 0.840, and IFI = 0.846. The model is hypothesized to be acceptable within a certain range, given the specificity of the vocational education field, as it is close to the acceptable psychometric standard.

**Table 2.** The model fit of the factors influencing professional competence of VET teachers.

$\chi^2$	df	$\chi^2/df$	RMSEA	GFI	AGFI	NFI	CFI	IFI
283.653	27	10.506	0.133	0.925	0.707	0.832	0.840	0.846

### 4.2. Research Findings

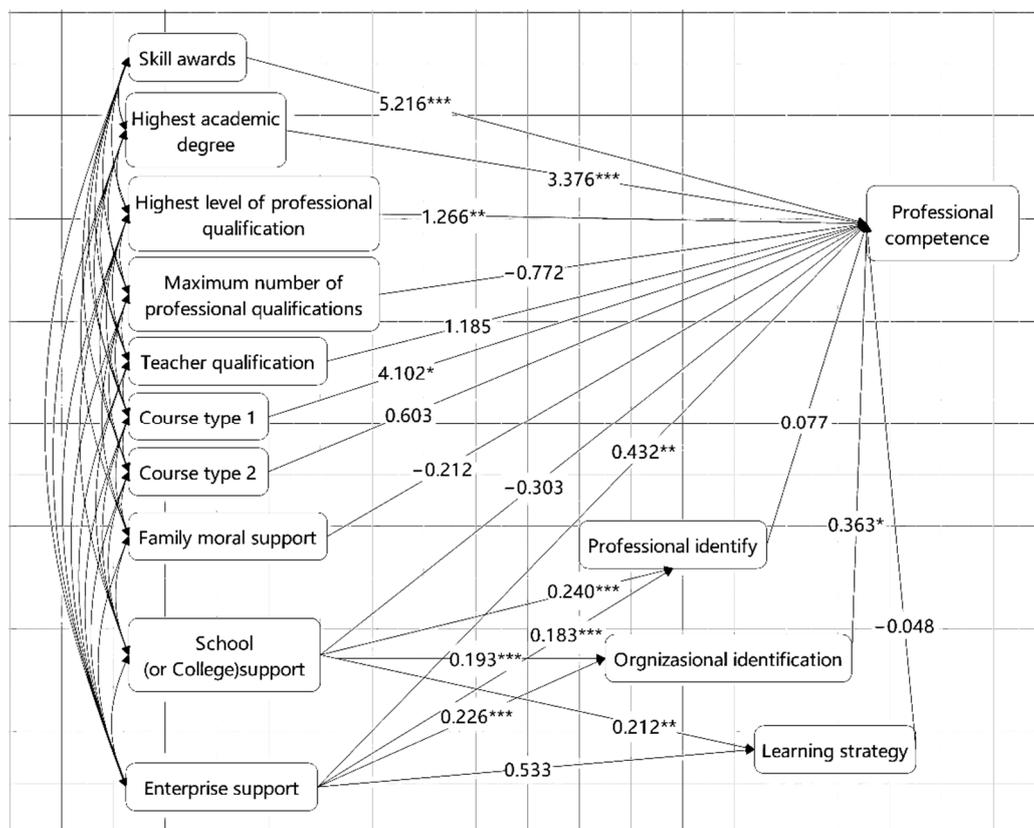
As shown in Table 3, skill awards ( $\beta = 5.216$ , CI [3.319, 7.161]), highest academic degree ( $\beta = 3.376$ , CI [2.012, 4.810]), course type (practical over theoretical) ( $\beta = 4.103$ , CI [0.813, 7.270]), highest level of professional qualification ( $\beta = 1.266$ , CI [0.619, 1.883]), and enterprise support ( $\beta = 0.432$ , CI [0.160, 0.715]) positively influenced VET teachers' professional competence. School support negatively affected VET teachers' professional competence ( $\beta = -0.303$ , CI [-0.576, -0.034]). Teacher qualification ( $\beta = 1.185$ , CI [-2.669, 5.276]), the maximum number of professional qualifications ( $\beta = -0.772$ , CI [-2.089, 0.543]), family moral support ( $\beta = -0.212$ , CI [-0.573, 0.141]), and the course type (integrated theoretical and practical over theoretical) ( $\beta = 0.603$ , CI [-1.811, 2.955]) had a non-significant effect on professional competence. Organizational identification positively mediated the relationship between enterprise and VET teachers' professional competence ( $\beta = 0.082$ , CI [0.011, 0.165]) and between school support and professional competence ( $\beta = 0.070$ , CI [0.009, 0.145]). Professional identity had an insignificant effect as a mediating variable between school support, enterprise support, and professional competence ( $\beta = 0.018$ , CI [-0.071, 0.111];  $\beta = 0.014$ , CI [-0.055, 0.091]). Learning strategy was also an insignificant mediating variable between school support, enterprise support, and teachers' professional competence ( $\beta = -0.010$ , CI [-0.061, 0.035];  $\beta = -0.025$ , CI [-0.137, 0.083]). The results of the hypothesis testing are shown in Table 3, and the results of the research hypothesis path diagram are presented in Figure 3.

**Table 3.** Non-standardized results of path analysis of factors influencing professional competence of VET teachers.

Hypothesis	Estimate	95% CI		p	Support or Not Support	
		Lower	Upper			
Direct effects						
H1	Skill awards->PC(professional competence)	5.216	3.319	7.161	0.000	✓
H2	Highest degree->PC	3.376	2.012	4.810	0.000	✓
H3	Teacher qualification->PC	1.185	-2.669	5.276	0.548	×
H4	Maximum number of professional qualifications->PC	-0.772	-2.089	0.543	0.258	×
H5	Highest level of professional qualification->PC	1.266	0.619	1.883	0.001	✓
H6	School support->PC	-0.303	-0.576	-0.034	0.026	✓
H7	Enterprise support->PC	0.432	0.160	0.715	0.001	✓
H8	Family moral support->PC	-0.212	-0.573	0.141	0.231	×

Table 3. Cont.

Hypothesis	Estimate	95% CI		p	Support or Not Support	
		Lower	Upper			
H9	Course type 1->PC	4.102	0.813	7.270	0.016	✓
H10	Course type 2->PC	0.603	-1.811	2.955	0.643	×
Indirect effects						
H11	School support->organizational identification->PC	0.070	0.009	0.145	0.210	✓
H12	Enterprise support->professional identity->PC	0.014	-0.055	0.091	0.675	×
H13	School support->professional identity->PC	0.018	-0.071	0.111	0.675	×
H14	Enterprise support->organizational identification->PC	0.082	0.011	0.165	0.021	✓
H15	School support->learning strategy->PC	-0.010	-0.061	0.035	0.624	×
H16	Enterprise support->learning strategy->PC	-0.025	-0.137	0.083	0.624	×

Figure 3. Path diagram (\*\* $p \leq 0.01$ ; \* $p \leq 0.05$ ).

## 5. Discussion

The study found that skill awards, highest academic degree, course type (practical over theoretical), highest level of professional qualification, and enterprise support positively influenced professional competence. Reasons for these findings are discussed first, followed by consideration of the factors that exerted no significant effect or a negative impact on professional competence.

For H11, there are three sources of skill awards for teachers. The first is from professional skill-based competitions, such as the automotive maintenance professional skills competition. The second is from professional teaching skill competitions, such as the teaching skills competition. The third is from awards received by teachers for guiding students in competitions, such as outstanding instructor in a skills competition. Developmental task theory suggests that these skills, competitions, and awards contribute to

the development of VET teachers' professional competence, exerting a positive impact on professional competence—as was observed in our study.

For H2, the highest academic degree also had a positive effect on teachers' professional competence in our study. A study found that teachers with bachelor's or master's degrees (and above) have significantly higher levels of professional competence than those with an associate degree (or below) [54]. This may be because teachers with higher education levels have greater professionalization and more opportunities for professional development. In addition, some studies have shown that teachers with higher education levels are more satisfied with their jobs, experience less job stress, and are more satisfied with their leadership and management, professional identity, salary, promotion and further education, and policy system [55].

For H5, the highest level of professional qualification also positively affects teachers' professional competence. As proof that workers have the necessary knowledge and skills for a particular occupation, the requirements for the different levels of professional qualifications vary. There are five levels of professional qualifications in China, namely elementary (Level 5), intermediate (Level 4), advanced (Level 3), technician (Level 2), and senior technician (Level 1). When higher levels are declared, more competence is required in the teacher's area of expertise, and more stringent requirements must be met. For example, participants with a technician accreditation must have extensive practical experience in production and operational skill specialties, be able to train intermediate skilled personnel, and use key operational techniques and production technology to solve complex problems. Applicants must also have obtained advanced certificates before applying for technician appraisal. Furthermore, applicants need to acquire more knowledge and skills to obtain a high-level professional qualification. The applicant must acquire more theoretical knowledge and practical skills to progress to a higher level. Higher qualification levels indicate more profound knowledge and skills, and more competent teachers.

For H9, possible reasons or evidence for the positive influence of teachers' course type (practical over theoretical) on their professional competence are as follows. First, VET teachers in Chinese VCSs are divided into theoretical, practical, and integrated theoretical-practical teachers. Each type of teacher has a different origin. Theoretical teachers mainly come from ordinary normal colleges or comprehensive universities and have rich theoretical knowledge but little relevant professional practical experience. Practical teachers are mainly from enterprises and have more work experience in such settings. The integrated theoretical-practical teachers are mainly from vocational and technical normal training universities and have some enterprise experience. Second, the three types of courses require different levels of competence and teacher characteristics. VCS students acquire professional knowledge through theoretical courses. Accordingly, theoretical teachers mainly teach objective theoretical knowledge from books [56], such as the mechanical drawing of mechatronics. Practical courses facilitate student acquisition of professional skills and help them adapt to their jobs [57]. Thus, practical teachers mainly teach through factual training, internship guidance, professional skills courses, laboratory courses, and graduation design guidance [58], such as the stage lighting practice course of multimedia technology. Integrated theoretical-practical courses need teachers to combine theory and practice to integrate students' theoretical and practical learning, such as in the engine maintenance practical training course. The central concept of vocational education is for students to learn while working, and work while learning ('Learning by doing') [59]. Thus, VET teachers need to have knowledge and skills in the field of industry, such as VET work qualities, proficiency in the principles of specific professional processes and professional practice, and the competence to perform the educational and training tasks of VET learners [60]. Thus, different courses imply different professional knowledge systems and professional competence dimensions.

For H7, enterprise support had a positive impact on teachers' professional competence. The national implementation program for vocational education and training reform issued by the State Council of China requires teachers to spend at least one month a year training

in enterprises or workshops [61]. This is because post-employment involvement in the production and operation of enterprises is crucial for VET teachers to increase their practical knowledge. Therefore, enterprise support is necessary for them to become teaching experts and ensure continuous professional development. The attitude of enterprises toward teacher participation in enterprise practice, and the form, duration, and depth of teachers' participation in enterprise production and operation [62] impact teachers' experience and practical knowledge acquisition.

For H6, School support had a negative influence on VET teachers' professional competence. The contents of the school support scale used in this study included the attitudes of school leaders towards staff to enhance their professional competence; training and further education opportunities; platforms and resources for teachers' professional competence development; the appraisal and promotion mechanism, incentives, salary, and compensation; and welfare benefits. The information from the BQ showed that in practice, schools provided further training opportunities for teachers. Still, most of the training was based on theoretical learning, training in teaching skills, and student management. This type of learning may have had a limited effect on promoting teachers' professional competence and may have consumed most of their energy, taking away opportunities and time for teachers to train in enterprises.

For H3, our study found that teacher qualifications had an insignificant effect on the professional competence of VET teachers. The regulations on teacher qualifications stipulate that Chinese citizens who abide by the Constitution and the law, love the cause of education, have good ideology and morals, have the statutory qualifications, and have passed the national teacher qualification examination may obtain a teacher qualification [63]. These regulations on the basic quality and competence standards necessary for teachers to undertake education and teaching work are too general to scientifically evaluate teachers' education and teaching competence [64]. Moreover, VET has higher requirements for the professional and technical level of VET teachers, making it difficult for the teacher qualification to accurately reflect teachers' professional competence.

For H4, the insignificant effect of the maximum number of professional qualifications on VET teachers' professional competence suggests that the number of professional qualifications does not determine professional competence. On the contrary, the obsessive pursuit of qualifications distracts teachers and depletes their time and energy, ultimately hindering their professional competence development [16].

For H8, there is a lack of research in the VET field examining the impact of family moral support on the professional competence of VET teachers. Generally, if family members can be more understanding and supportive, the teachers may progress further in their career development. However, the present study's findings were the different: family moral support had an insignificant effect on VET teachers' professional competence. This inconsistency suggests that the professional growth of VET teachers is very complicated. Accordingly, it is necessary to further explore the relationship between family moral support and vocational competence of VET teachers.

For H10, the effect of the course type (integrated theoretical–practical over theoretical) on VET teachers' professional competence was also not significant. A previous study found that the professional competence scores of teachers of integrated theoretical–practical courses were significantly higher than those of theoretical ones [16]. However, no significant difference between them was noted in this study, likely related to the increased sample size and the time the sample was collected. Further exploration of these aspects is needed in future studies.

For H11 and H12, organizational identification mediated the relationship between enterprise support and professional competence of VET teachers, and similarly mediated the relationship between school support and professional competence. This suggests a unique effect of organizational identification on enterprise or school support and the professional competence of VET teachers. Real work experience in enterprises is crucial for the professional competence development of VET teachers. The national implementation

program for vocational education and training reform requires that VET teachers spend at least one month per year in enterprises or workshop settings. However, only good-quality schools with high social prestige, substantial financial support, and rich resources for school–enterprise cooperation can secure opportunities for teachers to do this practical training. Therefore, the more support and assistance teachers encounter in the enterprise, the stronger their organizational identification. Furthermore, organizations are essential for developing professional competence [49]. People with high organizational identification are typically more willing to actively integrate into organizations to improve their job performance [65]. Schools as organizations provide opportunities for teachers to develop professional competence, and teachers with higher school support are more likely to have a more robust organizational identification and be willing to improve their professional competence through their own efforts.

For H13, H14, H15, and H16 were not supported, indicating that the mediating effect of learning strategy or professional competence on school support or enterprise support and professional competence is not significant, suggesting that the complexity and uncertainty of influencing factors on VET teachers' professional competence need more scholars' attention in the future.

## 6. Conclusions

This study explored the factors influencing VET teachers' professional competence in VCS and found that skill awards, highest education and professional qualification level, course type (practical over theoretical), and enterprise support positively influenced VET teachers' professional competence. In contrast, school support negatively influenced teachers' professional competence, and the effects of teacher qualification, maximum number of professional qualifications, family moral support, and course type (integrated theoretical–practical over theoretical) did not significantly affect teachers. Significant mediating effects of organizational identification were noted on enterprise or school support and the professional competence of VET teachers. However, the mediating effects of learning strategy and professional identity on school or enterprise support and professional competence of VET teachers were not significant. The findings suggest specific measures be taken to improve VET teachers' professional competence. First, VET teachers should be encouraged to participate in more high-level skill competitions, and teachers with associate degrees (or below) need to consider upgrading their education. Second, schools should encourage teachers to obtain high-level professional qualifications related to their specialties, bearing in mind their limited resources and time. Third, professional basic course teachers should improve their professional practical competence. When teachers study in enterprises, they should be able to participate fully in enterprises' production and operation processes. Fourth, schools should consider increasing support for teachers' professional and technical competences, such as recommending teachers to participate in internships and training in enterprises and paying attention to the teachers' organizational identification levels.

Future studies could involve international comparisons of teacher quality in VET using large-scale diagnostic methods. Related research could be carried out simultaneously in several countries to identify educational issues and patterns not yet documented, ultimately contributing to the development of VET worldwide.

## 7. Research and Implications Limitations

### 7.1. Implications for Theory

First, this study validated the COMET teacher professional competence assessment program based on a large-scale diagnostic method, demonstrating its feasibility for VET research with an in-depth focus on the professional competence of VET teachers. Second, we explored and validated the main factors influencing VET teachers' professional competence through empirical research and provided an empirical research basis for VET teachers to enhance their professional competence.

### 7.2. Implications for Practice

Over the past decade, researchers have used the COMET vocational competence assessment program to diagnose the professional competence of VET teachers in the Chinese region and have demonstrated the empirical validity of the program. The program can distinguish between teachers with different levels of professional competence, providing a practical approach to effectively measure VET teachers' professional competence on a large scale. Targeted interventions and countermeasures can be proposed to enhance the professional competence of VET teachers based on the factors influencing professional competence and the results of the professional competence diagnosis.

### 7.3. Limitations

This study has several limitations. First, the fit of the model proposed in this study was not satisfactory according to the psychometric criteria. This may be because of the complexity of the hypothesized model map of factors influencing the professional competence of VET teachers, which contains ten independent variables, three mediating variables, and one dependent variable, and the fact that the model has many variables, hypothesis paths, diagnostic scales, and raw data types. Second, the survey and diagnosis faced the problem of a rare sample of professional core course teachers (there are usually only a few specialized teachers in a school) and the problem of teacher willingness to participate. Thus, it was challenging to obtain a large sample size. In the future, in China, if more data are needed, participation in the study could be promoted by government departments such as the Ministry of Education and the Ministry of Human Resources and Social Security. Such efforts could be combined with the course reform of learning areas being promoted in China, the reform of action-oriented teaching and learning, and teacher evaluation projects to gain the understanding, support, and participation of more VET teachers.

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