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Article

A study on competency modeling of "double-qualified" teachers in higher vocational colleges in China

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Abstract: This research focuses on the construction of the competency of "Double-qualified" teachers in higher vocational colleges. Through comprehensive literature analysis, in-depth interviews and questionnaire surveys, a competency model covering three dimensions, namely personality charm, teaching literacy and practical skills, has been successfully established. This model provides a scientific basis for higher vocational colleges in teacher selection, performance evaluation and professional training, and particularly emphasizes the importance of teachers' cultivation of students' practical abilities and professional qualities in the context of vocational education. The research reveals that these three competency dimensions are interdependent and jointly influence teachers' educational and teaching achievements as well as students' career development.

Keywords: higher vocational teachers; double-qualified teacher; competency; competency model

1. Introduction

In the context of globalization, with the rapid development of vocational education, the construction of higher vocational colleges and universities, as an important base for cultivating highly skilled personnel, has become particularly important. In particular, "Double-qualified" teachers, who possess both theoretical teaching and practical teaching abilities simultaneously, have become the key factor in improving the quality of higher vocational education. Generally speaking, employee competence and efficiency are critical to the performance and development of an organization (Haque, 2021). Higher performance can promote a strategic approach to HR and expand the strategic strategy of HR management (Fong and Snape, 2013). Especially for the education sector, employee performance is seen as an impact component of higher growth.

As an important part of human resources in higher vocational colleges and universities, teachers' performance is affected by the behavior of their colleagues and the organizational climate (Li, 2011; Jusmin et al., 2016). For decades, research on performance evaluation in higher education institutions has mainly focused on the setting of organizational goals and evaluation techniques (Azma, 2010; Chen et al., 2006). As far as the researchers know, this orientation of performance evaluation is biased, ignoring the incentive function of evaluation, and cannot motivate teachers to promote professional development and achieve organizational goals through management (Jusuf Zekiri, 2015).

With the rapid development of vocational education, the demand for "Double-

qualified" teachers is growing increasingly. However, most of the existing competency models are based on the theoretical frameworks of the traditional education domain and are aimed at teachers in a general sense or those of specific disciplines. Whether they can be comprehensively applicable to "Double-qualified" teachers of different disciplines and types and to what extent the unique characteristics of vocational education and the practicality of "Double-qualified" teaching have been taken into consideration have become issues that urgently need to be addressed.

Vocational education has its own unique characteristics, such as its emphasis on practicality, skills and close links with industry, which are often not adequately reflected in existing competency models. The purpose of this study is to critically analyze the limitations of existing competency models, especially their shortcomings in adapting to the vocational education environment and the role of "Double-qualified" teachers. By exploring the core competency elements of "Double-qualified" teachers, this study aims to construct a competency model that is more in line with the characteristics of vocational education and comprehensively reflects the teaching and practicing abilities of "Double-qualified" teachers. This model will provide a scientific basis for the recruitment, assessment and training of teachers in higher vocational colleges and universities, and will help to improve the overall quality of the teaching force and teaching effectiveness.

In summary, this study aims to solve the deficiencies of the existing competency model in adapting to the vocational education environment and the role of "Double-qualified" teachers, and to provide a scientific basis and practical guidance for the construction of higher vocational colleges and universities' teachers by constructing a competency model that meets the characteristics of vocational education. This study not only has important theoretical value, but also will have a profound impact on the practice of vocational education.

2. Literature review

2.1. Competency theory

In 1973, Professor McClelland pointed out in "Testing for Competency Rather Than Intelligence" (Testing for Competency Rather Than Intelligence) that traditional intelligence tests, personality tests, and academic tests cannot effectively predict work performance in complex jobs and senior positions, and there are often prejudices and discrimination against minorities, women, and disadvantaged groups. Only competency tests can make up for these deficiencies. The publication of this article has set off an upsurge of competence research. Mclagan (1980) proposed that competency is a combination of knowledge, skills, and abilities sufficient to complete a major task. Boyatzis (1982) thought that competence refers to the underlying characteristics of an individual, which can be motivation, qualities, skills, self-image, social role, and the knowledge he applies. According to Spencer and Spencer (1993), competency is the underlying fundamental characteristic of an individual that has a causal relationship with the reference standard (general or outstanding performance). It is not only related to work, but also can anticipate or influence work behavior and performance. Vazirani (2010) pointed out that some scholars, after reviewing 337 citations on the research of manager competence, defined competence as the skills,

abilities and personal characteristics required by "effective" or "excellent" managers. Candace and Ronald (2019) emphasize the use of competency analysis to determine which individual competencies are necessary for success in a particular job competency, which can help organizations identify organization-wide core competencies or specific functions.

A competency model is a behavioral job description specific to each career function and position (Fogg, 1999). Using a competency model and understanding one's strengths and weaknesses can help individuals manage their career success (Vazirani, 2010). Spencer and Spencer (1993), building on McClelland's research, changed the six levels in their iceberg model to five levels from a trait perspective (As shown in **Figure 1**), where knowledge and skills are located in the upper level of the model, which are more hidden and difficult to develop, and self-concept, traits, and motivation are located in the lower level, which are relatively easy to develop.

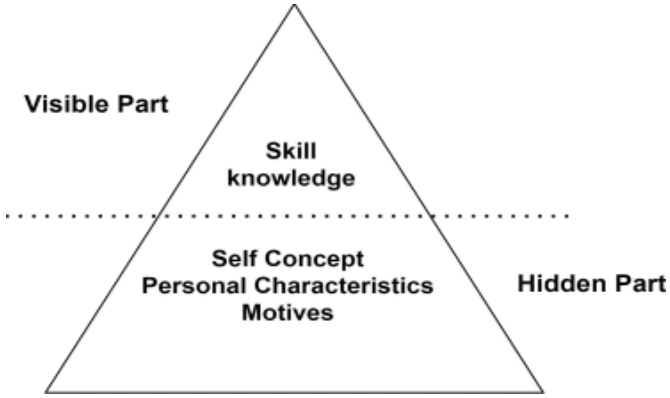

Figure 1. The iceberg model of competency by spencer and spencer (1993).

According to this model, the "above-water" part represents the basic abilities for an individual to perform a job. One can only enter this field through the knowledge and skills in relevant areas. Therefore, this part of the abilities determines whether a person can do the job or not. The "below-water" part influences the utilization of knowledge and skills, especially motivation and values, which are directly related to the degree of utilization of knowledge and skills. This part of the abilities determines the quality of a person's abilities. Consequently, the iceberg model not only provides a comprehensive perspective on teachers' abilities but also enables a better exploration of deeper characteristics and teachers' motivations, so as to gain a better understanding of teachers' behaviors and performances and identify the key factors that distinguish high performers from average performers (Wang, 2015).

Research on faculty competence in Chinese higher education began in 2004, and there are different views on the meaning of competence. One view is: Competency is a potential and lasting personal attribute (Personal Attributes)-that is, what is a person? For example, Wang (2015) believes that competency characteristics refer to the knowledge, skills, abilities, values, personality, motivation and other characteristics that lead to high management performance. Peng (2011) also believes that competence is a collection of predictable and measurable personality characteristics that drive employees to produce excellent work performance, and is the knowledge, skills, personality and internal drive that can be expressed in different ways. Similarly, Song

(2011) also defines competence as the sum of characteristics such as knowledge, skills, abilities and characteristics possessed by high-performers when people are engaged in a certain job or complete a certain task. Another point of view emphasizes the action characteristics of competence, and proposes that competence is an individual-related behavior category (Clusters of Related Behaviors), that is, what people do? Typically, Zhang and Xiao (2004) believe that competence is the individual characteristics that are conducive to effective work and predictable behavioral characteristics that point to work performance possessed by high-performers in a specific organizational environment, cultural atmosphere and work. Wang (2009) believes that competence is not so much a performance-related individual characteristic as a more pragmatic human resource management idea.

A number of studies have delved into the modeling and hierarchy of teacher competencies. Chen et al. (2022) used BEI techniques, questionnaires, and focus interviews with groups of teachers to explore teacher competencies in higher education, and constructed a model of teacher competencies consisting of six dimensions: cognitive competencies, interpersonal competencies, achievement traits, acceptance traits, faculty traits, and knowledge and skills. Dervenis et al. (2022) conducted a comprehensive literature review and identified six major dimensions of teacher competencies in higher education, encompassing 32 specific competencies. This multidimensional approach is essential for assessing and developing competencies to ensure quality education and improve student outcomes. The studies by Starkey (2019), Nikou and Aavakare (2021) categorized teacher competencies into generic, pedagogical, and professional domains. The study discusses the impact of personal and environmental factors on the acquisition of these competencies and emphasizes the importance of continuous professional development. The studies by Ng et al. (2023), Zhang et al. (2021) explore the challenges and opportunities posed by the adoption of artificial intelligence and digital technologies in education.

Based on the Iceberg Model, this paper defines teacher competence in higher education institutions as the underlying, deep-rooted characteristics of individuals that differentiate good and average teachers in higher education institutions, including motivation, traits, self-image, attitudes or values, knowledge and skills. The iceberg model provides a comprehensive framework for understanding and developing "Double-qualified" teachers. By focusing on teachers' intrinsic motivations, attributes and values, higher education institutions can better identify and develop the key characteristics that distinguish good teachers from average ones. At the same time, it provides guidance for individual teachers' professional development, helping them to recognize the need for continuous self-improvement and reflection on self-concept, attributes and motivation, in addition to the enhancement of knowledge and skills.

2.2. "Double-qualified" teachers

In China, a "Double-qualified" teacher in vocational education is one who has both theoretical teaching and practical skills. This concept first appeared in a 1995 circular of the State Education Commission and has gradually become a fundamental element of China's vocational education system. With the follow-up continuous development, in the research of many scholars, Wang (1990) first put forward his

views on the concept of "Double-qualified" teachers. He proposed that the requirements for the quality of "Double-qualified" teachers in teaching work should meet that teachers should actively participate in the student's practice process, regularly go to the factory for practical training, and participate more in research on technical projects in scientific research, which means that they have reached the level of "Double-qualified" teachers.

In China, a unified standard for the identification of "Double-qualified" teachers has not yet been formed. The existing "Double Certificate" theory, "Double Structure" theory, "Double Title" theory, and "Double Quality" theory all have certain one-sidedness (Kang et al., 2017). There are currently three main problems in the "Double-qualified" teaching staff: First, the proportion of young teachers is too high, resulting in an unreasonable age structure; second, teachers with intermediate professional titles dominate, while the number of teachers with senior professional titles is relatively small, and the professional title structure needs to be optimized; third, some professional settings do not fully serve the needs of regional economic development, and there is an unreasonable professional structure problem that requires appropriate adjustment (Jin, 2019).

In the study of Cui and Shi (2020), it is pointed out that vocational colleges and universities still focus too much on thesis, academic achievements and the amount of classroom hours in the evaluation of titles, but lack of quantitative evaluation system for technical skills and teaching quality. This evaluation method leads vocational college teachers to focus too much on research and thesis publication, while neglecting the importance of theoretical teaching and practical skills instruction, which in turn affects the overall quality of "Double-qualified" teachers. In addition, "Double-qualified" teachers come from a relatively single source, with insufficient systematic knowledge of vocational education and teaching, and their professional quality needs to be upgraded. The shortage of funding has also become a key factor restricting the construction of "Double-qualified" teachers (Li and Jiang, 2018). Adequate funding is the basic guarantee for the construction of "Double-qualified" teacher team, which requires strong support for job service training, incentive policies and other aspects. Higher vocational colleges and universities to improve the business level of the teacher team, did not do a good job of assessment, cannot rely on more reliable indicators to accurately assess the ability of teachers, it is difficult for teachers to find out their own teaching deficiencies, purposeful and directional adjustment of their own ability structure (Cui and Shi, 2020).

In summary, although the concept of "Double-qualified" teachers is not unified, they all pay attention to the common characteristics of "Double-qualified" teachers in teaching and educating people and practical operation skills. Due to the background of the formation of higher vocational colleges in China and the imperfect development of "Double-qualified" teachers, this research paper defines the concept of "Double-qualified" teachers as follows: "Double-qualified" teachers refer to professional or part-time educational staff who engage in theoretical or practical teaching in higher vocational colleges, undertake certain scientific research tasks, and have certain practical experience in enterprises. In the perspective of the iceberg model, these teachers not only excel in knowledge and skills, but also have strengths in deeper traits such as self-concept, traits, and motivation. For example, they may have stronger self-

drive, more positive work attitudes, and higher levels of professional commitment, intrinsic traits that motivate them to achieve better results in teaching and student mentoring.

3. Materials and methods

In this study, relevant competency elements were obtained by analyzing relevant literature, the behavioral events of renowned teachers and interviews with "Double-qualified" teachers, and combining domestic and international competency model research results. These competency elements were further verified and screened by questionnaire survey.

First of all, in the data retrieval database of CNKI, the keywords are "higher vocational colleges", "Double-qualified" teachers, and "competence". In order to improve the credibility and timeliness of the literature, the core journals and CSSCI in the past five years are the main selection ranges. Secondly, on the official website of the Ministry of Education, about 25 relevant educational documents issued by the state from 2019 to 2023 on vocational education, teacher quality, and teacher team building are inquired. Finally, based on the previous research on "Double-qualified" teachers in higher vocational colleges, by combing the relevant literature of CNKI and the Ministry of Education, sorting out and analyzing the literature, the same or similar items are merged, and finally the competency elements of "Double-qualified" teachers in higher vocational colleges are obtained, including 80 items, and these items are arranged in descending order according to the frequency of occurrence greater than 50 times. The results are as follows (see **Table 1**).

Table 1. Results of literature acquisition on competency factors of "Double-qualified" teachers in higher vocational colleges.

Serial number	Competency factor	Frequency	Serial number	Competency factor	Frequency
1	Innovation ability	210	10	Love and dedication, integrity and honesty, professional skills.	98
2	Self-confidence	182	11	Corporate practical experience, reflective ability, fairness and justice.	86
3	Professional knowledge, sense of responsibility	166	12	Analytical ability, aggressive, ability to apply and transform scientific research results, self-control, organizational management ability.	80
4	Team work spirit, information processing ability	156	13	Industry influence, professionalism, psychological endurance, cheerful personality, social service ability.	78
5	Language expression ability	142	14	Correct educational values, professional ethics, flexibility, affinity, advanced educational concepts, organization and coordination ability, relationship establishment and maintenance, enthusiasm, information technology application teaching ability.	75
6	Communication skills	138	15	Professional loyalty, understanding ability, logical reasoning ability, curriculum development ability, efficiency sense, academic communication ability, self-management.	72

Table 1. (*Continued*).

Serial number	Competency factor	Frequency	Serial number	Competency factor	Frequency
7	Teachers' moral accomplishment	128	16	Advanced vocational education concepts and teaching methods, lifelong learning ability, professional title structure, professional quality, creating trust, decisiveness, skill expertise, understanding others, ability to accept new knowledge and new methods, education background.	66
8	Tolerance, scientific research ability, dedication	116	17	Ability of "integration of theory and practice", extensive hobbies, ability to participate in the construction of training facilities, insight, service awareness.	63
9	Achievement motivation, learning ability, respect for others	108	18	Double-qualified background, meticulous thinking, ideological and moral cultivation, motivation for improvement, challenge and support, adaptability.	52

Based on the selection criteria of renowned teaching teachers, we hope to provide the direction of learning and efforts for all "Double-qualified" teachers in higher vocational colleges by using the selection criteria of excellent teachers, and extract the key elements of teachers who participate in the selection of renowned teaching teachers.

In 2021 and 2023, a total of 44 teachers from higher vocational colleges won renowned teachers of the "Ten Thousand Talents Program". By applying the method of text analysis and key events, four renowned teachers are selected as the participants of the interviews. From their behavior events, it can be analyzed that it is very necessary for teachers in higher vocational colleges to have the following competency factors: combination of production, education and research, rigorous research, ability to track professional development trends and industry trends, love and dedication, teaching students in accordance with their aptitude, caring for students, and practical experience in enterprises.

When using the interview method, the interview outline was designed in advance, mainly focusing on "what qualities do you think the" Double-qualified "teachers in higher vocational colleges can better meet the needs of the post" and "talk about what you have done in your career? The most impressive event left" and other issues are exchanged and recorded, and the relevant elements required are extracted through the analysis of the recording text to provide a basis for model construction. To ensure the objectivity and representativeness of the interview, on the basis of location, accessibility and willingness to collaborate, "Double-qualified" teachers from two higher vocational college in China are selected as the interview object. Interviews are conducted with six teachers and one manager of the school (as shown in **Table 2**).

The selection of interviewees took into account the purpose of the study, sample characteristics, feasibility and representativeness, to ensure that the interviewees were teachers and administrators with "Double-qualified" qualifications in higher vocational colleges and universities, and covered various dimensions such as different teaching ages, disciplinary backgrounds, and job roles, etc., so as to reflect the key qualities required for higher vocational colleges and universities to fulfill the job requirements of "Double-qualified" teachers. This is to fully reflect the key qualities of "Double-qualified" teachers in higher vocational colleges and universities to fulfill

the job requirements. At the same time, considering the resource constraints and geographic location, we chose teachers from the same representative higher vocational institution as the interview subjects, and made sure that the interview subjects had certain levels in terms of titles and academic qualifications, as well as the willingness to be interviewed and the conditions of the interview were met, so as to ensure that the results of the interviews were comprehensive and accurate.

Table 2. Interviewee information.

No.	Gender	Age	Teaching experience	Specialty taught
1	Male	28	3	Mechanical Design and Manufacturing
2	Male	35	8	Electronic Information
3	Female	38	10	Art and Design
4	Female	40	13	Nursing
5	Female	45	16	Marketing
6	Male	49	21	Administration

Through the interview, the corresponding "Double-qualified" teachers' competency elements are extracted from them. These elements include 21 dimensions of "Double-qualified" teachers in higher vocational colleges: love and dedication, teaching ability combined with theory and practice, communication ability, on-the-job training, ability to guide students to participate in vocational skills competitions, language expression ability, teaching students in accordance with their aptitude, hands-on operation ability, subjective initiative, lifelong learning concept, classroom control ability, practical teaching ability, ability to understand the needs of enterprises and front-line skills, advanced education concept, self-control ability, solid teaching basic skills, students' career planning and guidance ability, proficient in professional skills, information technology application teaching ability, instructional design with reality and logic, learning ability.

The relevant competency elements are obtained by analyzing relevant literature, renowned teachers' behavior events and "Double-qualified" teacher interview, combining with the research results of domestic and foreign competency models, sorting the acquired competency elements, merging relevant items, deleting unimportant items, etc., and finally identifying 23 competency elements. Including fairness and justice, tolerance, confidence and optimism, knowledge, humor, communication skills, lifelong learning concept, teamwork spirit, advanced vocational education concept, language expression ability, teaching students in accordance with their aptitude, teaching ability of information technology application, instructional design with reality and logic, classroom control ability, curriculum reform and development ability, consciousness of school-enterprise cooperation, practical enterprise experience, teaching ability of combining theory with practice, ability of analyzing enterprise and job demands, hands-on operation ability, insight into industry dynamics, social service capacity, ability of guiding students in vocational skill competitions.

According to the obtained competency elements, the questionnaire of competency elements of "Double-qualified" teachers in higher vocational colleges is

compiled. The structure of the questionnaire includes two parts: basic information and competency. The basic information part of the questionnaire mainly includes age, education, professional title, etc., which reflects the basic status quo of the investigated objects; In the competency part, Likert's five-point scale method is used to describe the importance of the acquired competency element behavior to the competent "Double-qualified" teacher in the questionnaire, and the respondents are asked to evaluate the work behavior that outstanding teachers should have.

After the questionnaire was developed it was first validated by three experts in the field to ensure that the content of the questionnaire was scientifically sound and reasonable. Subsequently, the questionnaire was pretested on a small scale to assess the comprehension of the questions and the overall fluency of the questionnaire. Based on the feedback from the pre-test, the questionnaire was adjusted and optimized as necessary to form the final questionnaire. The questionnaire was distributed through Questionnaire Star researcher to teachers of higher vocational colleges and universities in all provinces of China, and a total of 380 valid questionnaires were collected by removing invalid questionnaires and incomplete questionnaires. After the internal consistency test, the internal reliability of the 23 elements of the competency element survey part of the questionnaire is relatively ideal, reaching 0.923. It can be considered that the scale has good reliability and the measurement results are reliable. (As shown in **Table 3**)

Table 3. Reliability statistics.

Number of Cronbach's alpha	Terms
0.923	23

4. Finding

4.1. Process of the factor analysis

4.1.1. Basic principles of factor analysis

The purpose of factor analysis is to use a few independent factors to describe the relationship between multiple original factor variables, and classify the relevant original factor variables into one category; In fact, it is a dimensionality reduction analysis technology, that is, it tries to classify multiple indicators with the least number of unmeasurable factors under the condition that the original factor variable information is lost the least. By using fewer factors to reflect most of the information of the original factor variables, the factor variables can be made clearer, easier to understand, and more practical. In this study, 23 competency elements of "Double-qualified" teachers in higher vocational colleges are extracted. If these variables participate in data modeling, it will greatly increase the calculation workload in the analysis process. Therefore, we need to use the method of factor analysis to classify the 23 elements of the competency model into a category, and use the common factors to reflect most of the extracted information of the competency elements.

4.1.2. Adaptability test of factor

The factor analysis method is to extract a few factors that can represent these factors from many competency factor variables. Therefore, factor analysis can only be

carried out if there is a correlation between competency factor factors to judge whether a group of indicators is suitable for factor analysis. The main method is to carry out KMO sampling adequacy test and Bartlett sphere test on the data. The findings of this study are as follows (as shown in **Table 4**).

Table 4. KMO and Bartlett's tests.

Kaiser-Meyer-Olkin metric of sampling adequacy		0.939
Bartlett's sphericity test	Approximate chi-square	8405.493
	df	253
	Sig.	0.000

Table 4 shows the results of factor analysis adaptability test of the "Double-qualified" teacher competency factor questionnaire in higher vocational colleges. Among them, the KMO value is 0.939, which is greater than 0.9, indicating that it is very suitable for factor analysis. The results of Bartlett's sphere test show that the chi-square value is 8405.493, the degree of freedom is 253, and the significance level is 0.000. The significance is obvious， it indicates this study is suitable for factor analysis.

4.1.3. Factor extraction

In this study, the most commonly used analysis method in factor analysis-principal component analysis method is used. The basic principle of principal component analysis is to reduce the dimension of multiple competency factor indicators, and reduce the dimension of variables on the basis of retaining the original index information as much as possible, so that it is more conducive to statistical analysis. Adopt the principal component analysis method as the way to extract factors, a principal component is a common factor, and extract those factors whose eigenvalue is greater than 1 according to the eigenvalue as the basis for judging the obtained principal component factors (Xue, 2004). The results are as follows. (As shown in **Tables 5** and **6**)

Table 5. Common factor variance.

	Initial	**Extraction**
Fairness and justice	1.000	0.879
Tolerance	1.000	0.879
Confidence and optimism	1.000	0.886
Knowledge	1.000	0.839
Humor	1.000	0.724
Communication skills	1.000	0.702
Lifelong learning concept	1.000	0.806
Teamwork spirit	1.000	0.820
Advanced vocational education concept	1.000	0.904
Language expression ability	1.000	0.875
Teaching students in accordance with their aptitude	1.000	0.862

Table 5. (*Continued*).

	Initial	Extraction
Teaching ability of information technology application	1.000	0.886
Instructional design with reality and logic	1.000	0.885
Classroom control ability	1.000	0.895
Curriculum reform and development ability	1.000	0.871
Consciousness of school-enterprise cooperation	1.000	0.871
Practical enterprise experience	1.000	0.905
Teaching ability of combining theory with practice	1.000	0.874
Ability of analyzing enterprise and job demands	1.000	0.906
Hands-on operation ability	1.000	0.915
Insight into industry dynamics	1.000	0.896
Social service capacity	1.000	0.885
Ability of guiding students in vocational skill competitions	1.000	0.685

As can be seen from **Table 5**, the first column of data is the variable commonality degree under the initial solution of the competency factor analysis, and the commonality degree of the original variables is 1, indicating that all variances of the original competency factor variables can be explained; The second column of data refers to the common degree when extracting the characteristic value according to the specified extraction conditions (the characteristic value is greater than 1). It can be seen that most of the information (greater than 90%) of the factor variables of advanced vocational education concepts, enterprise practical experience, enterprise and job demand analysis ability, and hands-on ability competency elements can be interpreted. The explained information of the competency elements of guiding students' vocational skills competitions is 68.5%, and the extraction degree of all original competency element factor variables under specific conditions is greater than 60%. It can be considered that the extraction effect of the competency factor variables of the "Double-qualified" teachers in higher vocational education is better, the retention of the original information is higher, and the information loss is less.

Table 6. Total variance explained.

Composition	Initial eigenvalue extraction Sum of squares loading sum of squares of rotation								
	Total	% of variance	Cumulative%	Total	% of variance	Cumulative%	Total	% of variance	Cumulative%
1	9.652	41.967	41.967	9.652	41.967	41.967	7.792	33.876	33.876
2	6.943	30.188	72.155	6.943	30.188	72.155	6.926	30.113	63.990
3	3.055	13.285	85.439	3.055	13.285	85.439	4.933	21.450	85.439
4	0.768	3.337	88.777						
5	0.358	1.556	90.333						
6	0.307	1.337	91.669						
7	0.254	1.102	92.772						
8	0.209	0.909	93.681						
9	0.195	0.848	94.529						
10	0.164	0.715	95.244						

Table 6. (*Continued*).

Composition	Initial eigenvalue extraction Sum of squares loading sum of squares of rotation								
	Total	**% of variance**	**Cumulative%**	**Total**	**% of variance**	**Cumulative%**	**Total**	**% of variance**	**Cumulative%**
11	0.146	0.636	95.880						
12	0.125	0.542	96.423						
13	0.111	0.481	96.904						
14	0.102	0.443	97.347						
15	0.088	0.384	97.731						
16	0.087	0.379	98.110						
17	0.083	0.361	98.471						
18	0.073	0.319	98.791						
19	0.063	0.275	99.066						
20	0.062	0.270	99.336						
21	0.058	0.251	99.587						
22	0.050	0.215	99.802						
23	0.045	0.198	100.000						

Table 6 provides the initial relevant information of each competency factor, and the right half is the relevant information of the competency factor whose eigenvalue is greater than 1 extracted through principal component analysis. It can be seen from the table that there are 3 principal components with eigenvalues greater than 1, and the cumulative contribution rate of the total variance of these 3 principal components reaches 85.439%, which indicates that the public factors extracted in this study explain well the basic information of the original variables. Under normal circumstances, if the cumulative variance explanation contribution rate reaches more than 85%, it can ensure that the extracted common factors can retain and explain most of the information of the original factors, and the internal questionnaire will have good construct validity, that is, it is consistent with the results of the "Double-qualified" teacher dimension of higher vocational education expected to be constructed in this study.

4.1.4. Factor rotation

Factor rotation is to use the maximum variance method for factor rotation of the competency factor factors extracted in the previous step, so that the original high correlation of competency factor factors can be clearly distinguished. Therefore, the purpose of factor rotation is to facilitate researchers to obtain the reality of the corresponding factors and facilitate data analysis and processing. After rotation, the factor load will be redistributed, making it easier to name and explain the common factors of competence elements (Liu et al., 2014).

Through data analysis, the factor load matrix of "Double-qualified" teachers in higher vocational colleges is as follows after the competency elements are rotated, the output critical value is determined, and the factor load matrix is adjusted in descending order (see **Table 7**).

Table 7. Rotation composition matrix.

	Compositions		
	1	**2**	**3**
Teamwork spirit	0.903		
Lifelong learning concept	0.890		
Classroom control ability	0.873		
Teaching ability of information technology application	0.872		
Advanced vocational education concept	0.871		
Instructional design with reality and logic	0.867		
Curriculum reform and development ability	0.864		
Language expression ability	0.860		
Teaching students in accordance with their aptitude	0.853		
Communication skills	0.836		
Hands-on operation ability		0.957	
Ability of analyzing enterprise and job		0.951	
Enterprise practical experience		0.951	
Insight into industry dynamics		0.945	
Social service capability		0.938	
Teaching ability of combining theory with practice		0.934	
Consciousness of school-enterprise cooperation		0.930	
Ability of guiding students in vocational skill competitions		0.825	
Tolerance			0.916
Confidence and optimism			0.910
Fairness and justice			0.908
knowledge			0.888
Humor			0.830

Extraction method: Principal component analysis.
Rotation method: orthogonal rotation method with Kaiser normalization.
The rotation converges after 5 iterations.

Table 7 shows that the correlation coefficients between the variables and the total questionnaire are high, all above 0.600. And from the table, we can clearly see that the first factor is mainly loaded with teamwork spirit, lifelong learning concept, advanced vocational education concept, classroom control ability, teaching ability of information technology application, instructional design with reality and logic, curriculum reform and development ability, language expression ability, teaching students in accordance with their aptitude, and communication skills. The second factor is mainly loaded with hands-on operation ability, ability of analyzing enterprise and job demands, enterprise practical experience, insight into industry dynamics, social service ability, consciousness of school-enterprise cooperation, teaching ability combining theory and practice, and ability to guide students in vocational skills competitions. The third factor is mainly loaded with tolerance, self-confidence and optimism, fairness and justice, knowledge, and humor.

According to the results of factor extraction, the three factors are named as; Personality charm, teaching literacy, practical skills, different abilities represent

different meanings and contents, and the connotation explanations of different dimensions of competency elements are summarized as follows.

4.2. Interpretation of extraction factors

4.2.1. Personality charm

Personality is the sum total of a person's character, temperament, morality, ability and other characteristics. Personality charm refers to the special charm that a person has in terms of temperament, temperament, character, ability, etc. that can be loved by others. For a teacher, he needs to be knowledgeable; have good psychological quality, maintain self-confidence and optimism; be able to be fair and just in dealing with people; humorous character stimulate students' potential learning motivation. **Table 8** shows the specific connotations and characteristics of the elements of charisma competence.

Table 8. Connotation and behavioral characteristics of competency elements of personality charm.

Competency dimension		Connotation and behavioral characteristics
Personality charm	Knowledge	Proficient in pedagogy, psychology, management and other multi-disciplinary theoretical knowledge related to teaching, and astronomy, geography, scientific and cultural knowledge.
	Tolerance	We should treat students with a tolerant and forgiving attitude, move them with emotion and understand them with reason; Be tolerant with colleagues, accept and understand different views, concepts and opinions.
	Confidence and optimism	Be able to deal with problems with full confidence, and show an attitude of determination to win their own strength and the difficulties they face.
	Fairness and justice	Dealing with people can be treated with an objective and fair scientific attitude; The standard of rewards and punishments for students is the same, and every student is treated fairly and justly.
	Humor	A person with a sense of humor and interest. In daily life or teaching can use humorous language, behavior, etc. to stimulate the interest of communicators, easy to get along.

4.2.2. Teaching literacy

The primary mission of teachers is to teach and educate people, and high teaching literacy is the key to successfully cultivating excellent students. Teaching literacy refers to the knowledge and skills required by teachers to be competent for teaching tasks. **Table 9** shows the connotations and behavioral characteristics of the competency element of teaching literacy.

Table 9. Connotation and behavioral characteristics of competency elements of teaching literacy.

Competency dimension		Connotation and behavioral characteristics
Teaching literacy	Teamwork spirit	Get along with colleagues can be willing to share and cooperate, encourage each other, and make progress together. Including cooperative scientific research, collective lesson preparation, cooperative curriculum development, etc.
	Lifelong learning concept	In teaching work, self-subjective initiative is strong, always maintain the mentality of continuous learning and continuous improvement, and actively participate in relevant training and practical activities organized at all levels.
	Advanced vocational education concept	Be proficient in the basic theory of vocational education, master its basic concepts and theoretical framework; Skillful use of vocational education research problems to analyze and deal with problems; Understand the development trend of vocational education and preface information. Actively participate in teaching research, learn from and introduce foreign excellent vocational education theories.

Table 9. (*Continued*).

Competency dimension		Connotation and behavioral characteristics
	Classroom control ability	In theoretical education and practical operation teaching, teachers can make the teaching go smoothly and adopt the ability to regulate various elements in classroom teaching, including good relationship between teachers and students, regular communication with students, timely and objective evaluation of students, and good guidance to students.
	Language expression ability	Be good at using clear and easy-to-understand language to express accurately and guide students to understand relevant concepts and theories.
	Teaching students in accordance with their aptitude	According to the different nature characteristics of different students, different talent training methods are adopted.
	Communication skills	Be able to actively communicate with students, colleagues, leaders, and departments to reconcile their relationships.
	Teaching ability of information technology application	In teaching, in addition to using traditional teaching media, we should also have the ability to use modern teaching media to vividly present or simulate actual operations.
	Instructional design with reality and logic	Instructional design in the content should be interlocking, with logic, step by step; It is closely related to real life and achieves the effect of applying what you have learned.
	Curriculum reform and development ability	Scientifically evaluate whether the majors and courses set up by the school fully reflect the analysis of social needs, whether they meet the analysis of the cultivation goals of higher vocational talents, and whether they are able to adapt to the needs of education and teaching and students.

4.2.3. Practical skills

Table 10. Connotation and behavioral characteristics of competency elements of practical skills.

Competency dimension	Connotation and behavioral characteristics	
Practical skills	Hands-on operation ability	Teachers are proficient in the technical requirements and operating procedures of the professional industry, and guide students to practice and practice; Be able to work on the job in the enterprise and solve the problems of hands-on operation on the spot; Be able to use relevant models or instruments for practical teaching.
	Ability of analyzing enterprise and job demands	Be able to analyze and understand the needs of related enterprises and positions in this major, feedback to teaching, and cultivate talents who meet the needs of the society.
	Practical enterprise experience	Actual experience in relevant positions in enterprises or experience in on-the-job practice in this professional industry.
	Insight into industry dynamics	Effectively collect the latest scientific and technological information of this specialty through various channels and methods, grasp the development of the same industry and predict its development trend; Learn from the achievements of others, avoid doing the same work, promote the progress of scientific research projects, and improve the quality of scientific research.
	Consciousness of school-enterprise cooperation	Have the awareness of mutual learning with related industries, actively participate in relevant training and practical activities of cooperative enterprises, and build a harmonious school-enterprise cooperation platform.
	Social service capacity	It refers to the ability of school teachers to promote social and economic development by carrying out corresponding scientific research and applying it to social practice.
	Ability of guiding students in vocational skill competitions	Familiar with the qualifications and procedures of relevant vocational skills competitions, organize study groups, and guide students to participate in the knowledge and skills required for the competitions.
	Teaching ability of combining theory with practice	In the theoretical teaching, it can be supplemented by models or actual cases to understand relevant theories; In actual operation, the theoretical connection between each step can be clarified, and finally the integration of theory and practice can be achieved.

Practical skills refer to the special competencies of teachers engaged in higher vocational education, mainly refers to the ability required for practical teaching, and is the key ability to cultivate qualified higher vocational talents. **Table 10** shows the important connotations and behavioral characteristics of the elements of competence in practice skills.

According to the survey results of the questionnaire, the competency factor model is determined. The specific competency elements included in each dimension of the model are as follows (see **Table 11**).

Table 11. Competency model of "double-qualified" teachers in higher vocational colleges.

Competency dimension	Competency factors
Personality charm	Tolerance, confidence and optimism, fairness and justice, knowledge, humor.
Teaching literacy	Teamwork spirit, lifelong learning concept, advanced vocational education concept, classroom control ability, teaching ability of information technology application, instructional design with reality and logic, curriculum reform and development ability, language expression ability, teaching students in accordance with their aptitude, communication skills.
Practical skills	Hands-on operation ability, ability of analyzing enterprise and job demands, enterprise practical experience, insight into industry dynamics, social service capability, consciousness of school-enterprise cooperation, teaching ability of combining theory with practice, and ability of guiding students in vocational skill competitions.

5. Discussion

Through literature analysis, behavioral event analysis and interviews, this study systematically identifies and validates 23 key elements of senior "Double-qualified" teacher competence, and extracts three core dimensions through factor analysis: personality charisma, pedagogical literacy and practical skills. These three dimensions are intertwined and together constitute a comprehensive framework for the competency of higher vocational "Double-qualified" teachers.

In terms of personal charisma, it was found that qualities such as tolerance, self-confidence, fairness, erudition and humor are crucial for teachers to establish prestige among students and create a positive learning atmosphere. These qualities not only help to enhance teachers' personal charisma, but also effectively stimulate students' motivation and interest in learning. In the context of vocational education, students face multiple pressures from the job market, and teachers' tolerance and self-confidence can provide students with the necessary psychological support to help them better cope with the challenges; while teachers' fairness and erudition can set an example for students and guide them to form the correct values and vocational views (Liu, 2019).

Pedagogical literacy is another important dimension of teacher competence, covering a wide range of aspects such as instructional design, curriculum development, application of information technology, tailoring instruction to students' needs, and communication. In vocational education, the enhancement of pedagogical literacy is directly related to the ability of students to effectively master professional knowledge and practical skills (Kang et al., 2017). Especially in curriculum development and instructional design, teachers need to closely integrate the needs of the industry and the characteristics of students to provide students with targeted and practical teaching content. In addition, with the continuous development of

information technology, teachers also need to continuously improve their own information technology application skills to better adapt to the development trend of modern education technology.

Practical skills are another key dimension of the "Double-qualified" teacher competence in higher vocational education, which emphasizes teachers' abilities in hands-on practice, analysis of enterprise and job requirements, practical experience in enterprises, and insight into industry dynamics. In the context of vocational education, the cultivation of students' practical ability and professionalism is particularly important. Teachers' practical skills are not only related to whether students can have the ability to adapt to the needs of society and the industry, but also directly affect the depth and breadth of school-enterprise cooperation and social services (Jin, 2019). Therefore, teachers need to continuously improve their own practical skills level to better guide students in practical operations, develop their vocational skills and adapt to social needs.

In summary, personality charisma, pedagogical literacy and practical skills are interrelated and mutually reinforcing in the "Double-qualified" teacher competency model. Together, they constitute the core elements of teacher competency, which provides a scientific reference basis for higher vocational colleges and universities to recruit, assess and train teachers. In the future, higher vocational colleges and universities should further strengthen the attention and cultivation of these three dimensions in order to enhance the overall competency level of teachers and provide a strong talent guarantee for the development of vocational education. Meanwhile, this study also provides useful references and lessons for subsequent related studies.

6. Conclusion and limitation

Through systematic literature analysis, interviews and questionnaires, this study successfully constructed a "Double-qualified" teacher competency model for higher vocational education, which covers three core dimensions: personality charisma, pedagogical literacy and practical skills. Each dimension contains several specific competency elements. This model not only provides a scientific basis for the recruitment, assessment and training of teachers in higher vocational colleges and universities, but also takes the characteristics of vocational education into full consideration, which is of great significance for the cultivation of students' practical ability and vocational literacy. However, the study also has certain limitations, including the relatively limited scope of the sample, the subjectivity of the data collection method, the dynamics of the competency elements, and the in-depth validation of the model. Future research can further expand the sample scope, incorporate more objective data collection methods, continuously update the competency elements, and deeply validate the model in order to promote the continuous development of higher vocational teachers' team building.

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References

Azma, F. (2010). Qualitative Indicators for the evaluation of universities performance. Procedia - Social and Behavioral Sciences, 2(2), 5408–5411. https://doi.org/10.1016/j.sbspro.2010.03.882.

Candace Flatt & Ronald L. Jacobs. (2019). Principle Assumptions of Regression Analysis: Testing, Techniques, and Statistical Reporting of Imperfect Data Sets. Advances in Developing Human Resources, 4, 484-502.

Chen, J., Qiu, Z., Su, R., & Huang, L. (2022). An empirical study on the competence of teachers in higher vocational professional courses that integrates the spirit of craftsmanship. Chinese Journal of Multimedia and Network Teaching, 145-148.

Chen, S., Yang, C., & Shiau, J. (2006). The application of balanced scorecard in the performance evaluation of higher education. The TQM Magazine, 18(2), 190–205. https://doi.org/10.1108/09544780610647892.

Cui, Y., & Shi, W. (2020). The construction of "Double-qualified" teachers in double-high schools: Logic, dilemma, and path. Vocational Education Forum, (10), 90-95.

David, C.McClelland. (1973). Testing for Competency Rather Than Intelligence. American Psychologist,(28):1-14

Dervenis, C., Fitsilis, P., & Iatrellis, O. (2022). A review of research on teacher competencies in higher education. Quality Assurance in Education, 30(2), 199-220. https://doi.org/10.1108/QAE-08-2021-0126

Fogg, C. D. (1999). Implementing your strategic plan: How to turn "intent" into effective action for sustainable change. Amacom Books.

Fong, K. H., & Snape, E. (2013). Empowering leadership, psychological empowerment and employee outcomes: Testing a multi-level mediating model. British Journal of Management, 26(1), 126–138. https://doi.org/10.1111/1467-8551.12048.

Haque, A.(2021) .Strategic HRM and organisational performance: does turnover intention matter? Int J Organ Anal. 29(3) :656–681.

Jin, L. S. (2019). Construction of "Double-qualified" teachers in higher vocational colleges based on competency theory. Education and Careers, (24), 53-56. https://doi.org/10.13615/j.cnki.1004-3985

Jusmin, A., Said, S., Bima, M. J., & Alam, R. (2016). Specific Determinants of Work Motivation, Competence, Organizational Climate, Job Satisfaction and Individual Performance: A Study among Lecturers. Journal of Business Management, 4(3), 53–59. https://doi.org/10.12691/jbms-4-3-1.

Jusuf Zekiri, N. I. (2015). The Importance of Motivation Factors on Employee Performance in Kosovo Municipalities. Journal of Political Sciences & Public Affairs, 03(02). https://doi.org/10.4172/2332-0761.1000152.

Kang, X. M., Wu, Z., & Fu, W. (2017). Problems and path selection of "Double-qualified" teacher training in higher vocational colleges. Education and Careers, (09), 75-79. https://doi.org/10.13615/j.cnki.1004-3985

Li, M. (2011). The Study on Guanxi Structure of Colleagues in the Background of Chinese Culture and its Influence on Individual Job Performance. Advanced Materials Research.

Li, M. Q., & Jiang, W. (2018). Macroscopic requirements and professional expression of "Double-qualified" teacher certification standards. Education and Careers, (08), 38-44. https://doi.org/10.13615/j.cnki.1004-3985

Liu, J., Ren, R., Xing, G. (2014). Presidents of Research Universities: Competency and Professional Development, Beijing: Science Press. 118-119.

Liu, L. (2019). Difficulties and ways to construct "Double-qualified" teachers in higher vocational colleges in the new era. Education and Careers, (23), 74-77. https://doi.org/10.13615/j.cnki.1004-3985

Ng, D. T. K., Leung, J. K. L., Su, J., et al. (2023). Teachers' AI digital competencies and twenty-first century skills in the post-pandemic world. Education Tech Research Dev, 71, 137-161. https://doi.org/10.1007/s11423-023-10203-6

Nikou, S., & Aavakare, M. (2021). An assessment of the interplay between literacy and digital technology in higher education. Education and Information Technologies, 26, 3893-3915. https://doi.org/10.1007/s10639-021-10451-0

PA. Mclagan.(1980). Competency Models.Training&Development Joumal,34(12):22-26.

Peng, J. (2011). Introduction to Human Resource Management. Shanghai: Fudan University Press, 215

RE. Boyatzis.(1982). The Competent Mananger: A Model for Efeective Performance.New York:John Wliey,80-82.

Song, P. (2011). Strategic Training and Development of Enterprise Employees: From the Perspective of Competency

Improvement. Xiamen: Xiamen University Press, 40.

Spencer, L. M., & Spencer, S. M. (1993). Competence at work: Models for superior performance. John Wiley & Sons.

Starkey, L. (2019). A review of research exploring teacher preparation for the digital age. Cambridge Journal of Education, 50(1), 37-56. https://doi.org/10.1080/0305764x.2019.1625867

Vazirani, N. (2010). Review paper: Competencies and competency model – A brief overview of its development and application. SIES Journal of Management, 7(1), 121-131.

Wang, C & Chen, M. (2002). Analysis of Management Competency Characteristics: A Structural Equation Model Test. Psychological Science, (5): 513-516 + 637 _ *

Wang, H. (2015). Research on overall compensation perception, dedication, and job performance of employees in non-state-owned enterprises. Unpublished master's thesis, Shanxi University of Finance and Economics, School of Business Administration, Taiyuan, China.

Wang, S. (2009). Enterprise Employee Counseling Program: From the Perspective of Competency. Beijing: Published by Aviation Industry Press, 36.

Wang, Y. (1990). Constructing "Double-qualified" Specialist Teacher Team. China Education News, 1990-12-5 (3).

Xue, W. (2004) .SPSS statistical analysis method and its application. Beijing: Electronics Industry Press, 341-342.

Zhang, D., He, J., & Fu, D. (2021). How can we improve teacher's work engagement? Based on Chinese experiences. Frontiers in Psychology, 12, 721450.

Zhang, K & Xiao, Y. (2004). Competency Analysis and Human Resource Management. JAC Forum, (2) 65-69