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Calculation-based Quality Assessment of “Dual-Teacher” Teacher Cultivation under the Industry-Teaching Integration Model

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Abstract “Dual-teacher” teachers have become the focus of teacher training in the integration of industry and education because of their ability to teach both theory and practice. Based on the research perspective of students' experience, this paper preliminarily constructs an assessment system for the quality of “dual-teacher” teacher training, which contains 5 primary indicators and 33 secondary indicators. In order to further rationalize the structure and content of the assessment system, an exploratory factor analysis method is used to reconstruct the assessment system. Finally, the assessment system of teacher training quality is obtained, which contains 6 first-level indicators and 28 second-level indicators. At the same time, the hierarchical analysis method was chosen as the assignment method for the indicators of the assessment system, and the fuzzy comprehensive evaluation method was used to obtain the objective scoring performance. The comprehensive cloud method is used to calculate the cloud characteristic parameters of each index, and the evaluation cloud diagram is drawn to obtain the evaluation grade, so as to construct the cloud model of teacher training quality evaluation. The judgment matrices of the constructed teacher training quality evaluation system for each level of indicators satisfy CR<0.1, which meets the requirements of objective and fair assessment of teacher training quality.

Index Terms teacher training quality assessment, industry-teaching integration, hierarchical analysis method, comprehensive cloud approach

I. Introduction

With the development of social economy and the progress of science and technology, the traditional teacher training mode has been unable to meet the social demand for talents [1], [2]. Under such an educational background, how to cultivate compound college teachers has become an urgent problem [3]. The traditional teacher training mode in colleges and universities mainly focuses on the teaching of theoretical knowledge of education and teaching and the cultivation of academic research ability, while the cultivation of practical work ability is relatively insufficient [4], [5]. In the education model of industry-teaching integration, college teachers need to have more complex abilities, not only need to have theoretical knowledge of education and teaching and academic research ability, but also need to have practical work experience and practical ability [6]-[8]. The cultivation of “dual-teacher” teachers in colleges and universities has become a hot topic in the field of education, which is of great significance [9].

The "double-teacher" teacher training model in colleges and universities is mainly characterized by the combination of industry, education and research, and the combination of theory and practice, and pays attention to the cultivation of teaching and professional skills in the training process, and also pays attention to the improvement of their humanistic qualities and comprehensive abilities [10]-[13]. Under this model, colleges and universities will establish extremely close links with industries and enterprises, and it will be a general trend for professional teachers and experts and experienced technicians from industries and enterprises to jointly develop courses and complete teaching tasks together [14]-[16]. However, how to cultivate the quality of “dual-teacher” teachers has become a difficult problem for colleges and universities [17]. Therefore, the construction of “dual-teacher” teacher training quality assessment mechanism to realize the organic integration of theoretical teaching and practical teaching is one of the urgent problems [18], [19].

With the deepening of education reform and the continuous innovation of teaching mode, the new teacher team represented by “dual-teacher” teachers is increasingly being paid attention to and emphasized by the education sector, which can not only enhance the comprehensive quality of teachers, but also stimulate the innovative spirit of students. Literature [20] emphasizes the importance of “dual-teacher” teacher team construction in the training of talents in colleges and universities, and proposes that colleges and universities should broaden the cultivation channels, introduce the competition mechanism, insist on the introduction of talents and other suggestions, take innovation as the driving force, improve the assessment mechanism, promote the development of teachers' abilities, and build a high-quality ” Dual-teacher” teacher team. Literature [21] introduces the mode of training “dual-teacher” teachers in foreign countries and makes a comparative analysis of these training models, and puts forward the training modes of school-enterprise cooperation training mode, university training mode and other training modes by combining with China's current situation and makes suggestions for the training of “dual-teacher” teachers. It also proposes training models such as school-enterprise cooperation training model and university training model in light of China's current situation. Literature [22] points out that the quantity and quality of the current higher vocational education faculty do not meet the requirements of the development of higher vocational education and emphasizes that the cultivation and development of teachers with high moral character who can adapt to the way of human resource development in vocational education has become an urgent problem for higher vocational education. Literature [23] introduces burnout and its characteristics and effects, and explores the impact of the “dual-teacher” teacher construction path on teacher burnout psychology in colleges and universities, as well as the improvement of teacher burnout psychology through this path, which is verified through this comparative survey. Literature [24] analyzes the construction of “dual-teacher” faculty to find out the problems in the construction of faculty, examines the strategy of “dual-teacher” faculty cultivation, and determines that the construction of “dual-teacher” faculty in vocational education should be strengthened in depth to promote the construction of the main force in a comprehensive manner. The construction of “dual-teacher-type” teacher team should be strengthened in depth to promote the construction of the main force and comprehensively promote the construction of the team. Literature [25] through the investigation of “dual-teacher” teachers' professional development support in many universities found that “dual-teacher” teachers' professional development support exists in the phenomenon of disconnect between the content of continuing education and teachers' needs. Based on this, we propose the strategies of performance incentives and school-enterprise cooperation training for the professional development of “dual-teacher” teachers. Literature [26] emphasizes the importance of the core qualities of “dual-teacher” teachers for the sustainable development of higher vocational colleges and universities, and the need to recognize its importance and focus on improving the quality and effectiveness of the training, especially the weaknesses of the teachers. Based on the modified Delphi method and structural equation modeling, literature [27] studied the connotation, structure and influence of “dual-teacher” quality and competency, and the results showed that the motivation of teachers' participation had a significant positive influence on both “the effectiveness of training methods” and “the enhancement of dual-teacher competency”. The results show that the motivation of teachers' participation has a significant positive effect on the “effectiveness of training methods” and the “enhancement of dual-teacher competence”.

In this paper, from the perspective of students' experience of teaching, combining with the existing literature on teacher quality assessment, we preliminarily constructed a quality assessment system for the training of “dual-teacher” teachers based on learning experience. Using exploratory factor analysis to further optimize the index structure and content of the system, we obtained a teacher training quality assessment system consisting of 6 first-level indexes and 28 second-level indexes. Meanwhile, the hierarchical analysis method is used as the assignment method of the indicators of the assessment system, and the fuzzy comprehensive evaluation method is used as the method of obtaining objective evaluation results. On the basis of obtaining the scoring values, the comprehensive cloud method is introduced, and the steps of calculating the cloud characteristic parameters of the evaluation results of each index and the evaluation level are elaborated to construct the cloud model for the evaluation of the quality of teacher training. After assigning weights to each quality in the evaluation system, the consistency test of the first-level indicators is carried out to analyze the example of the cloud model of teacher training quality evaluation.

II. Quality assessment system for “dual-teacher” teacher training

II. A. System overview

As a sub-system of the Teacher Training Monitoring and Management Platform, the Teacher Training Quality Evaluation and Analysis System relies on the network to communicate with the server of the Teacher Training Monitoring and Management Platform, obtains teacher training data by API interface or user import, categorizes the statistical data according to counties, districts, or municipalities, and adopts the hierarchical analysis method to compute the evaluation index of each evaluation unit in the evaluation area, and generates the quality early warning map.

II. B. Screening of quality evaluation indicators based on learning experience

Ten relatively authoritative online course quality evaluation standards with different perspectives are selected as reference samples, and all reference indicators have been researched and demonstrated to ensure the scientificity of the selected indicators in this study. The selected indicators are categorized and screened according to the five dimensions of learning experience (sensory experience, emotional experience, content experience, action experience, and service experience), which avoids duplication and redundancy of the indicators and ensures the reasonableness of the preliminary screening indicators. Through theoretical induction, comparative analysis, merging similar indicators, eliminating duplicated indicators and other work, the preliminary screening obtained 33 online open course quality evaluation indicators based on the learning experience under the 5 degrees are shown in Table 1.

Table 1: Preliminary screening results of quality index

Dimensionality	Serial number	Observation indicators (Overview)
(A) Sense judgment	A1	Layout navigation clear
	A2	Excellent video quality
	A3	Fast search function
	A4	Language friendly norms
	A5	Appropriate resource granularity
	A6	Rich form of resources
(B) Emotional experience	B1	Specific and clear goals
	B2	Comprehensive and clear outline
	B3	Reasonable time planning
	B4	Experienced teachers
	B5	Rational teacher structure
	B6	Teacher real-time guidance
	B7	Interaction between teachers and students
(C) Content experience	C1	Assistant tutor
	C2	Design reasonable content
	C3	Learning frontier practical
	C4	Carry out cooperative learning
	C5	Set issue driver
	C6	Feedback learning behavior
	C7	Push learning path
	C8	Learning path control
	C9	Evaluation subject diversification
	C10	Diversification of evaluation forms
	C11	Clear evaluation orientation
(D) Action experience	D1	Convenient human-computer interaction
	D2	Participate in curriculum construction
	D3	Curriculum test appropriate
	D4	Uploading shared resources
	D5	Access to expansion resources
(E) Service experience	E1	Platform operation controllable
	E2	Information reminder in time
	E3	Ensure information security
	E4	Multiterminal universal

II. C. Research surveys and data collection

II. C. 1) Subjects of investigation

A random sample of online open course participants in the teacher training category was selected as the survey respondents, and the question “What can be done to make the online open course better?” was used to guide the survey. The question guided the random sampling survey. As the main participants and direct beneficiaries of the courses, whether teachers can get the learning experience that meets their actual needs is the direct basis for evaluating the quality of the courses, and it becomes the key hand to improve the quality of the courses. In addition, teachers have relatively rich teaching experience and teaching wisdom, are familiar with course design methods, have high learning literacy and strong critical reflection ability, their evaluation of the course is direct and objective, and the survey data is more reliable and valid.

II. C. 2) Data collection

In this survey, the participants of 17 courses in the "Teacher Teaching Ability Enhancement M00C Program" of a course network were selected as the target, and the questionnaires were distributed in the form of online survey. Based on the preliminary screening results of the indicators, 33 survey questions were designed and a 6-point Likert scale was used to collect data. 1000 questionnaires were distributed and 857 valid questionnaires were collected, with a validity rate of 85.70%. The distribution of the survey respondents' tenure is as follows: kindergarten (6.68%), elementary school (15.14%), junior high school (24.69%), senior high school (26.90%), middle/higher vocational (6.68%), university (17.21%), and others (2. 70%).

The total sample was randomly divided into two independent samples using the random case selection function of the SPSS statistical analysis software; 456 data were used as Sample E for exploratory factor analysis. The other 401 data were used as Sample F for validation factor analysis.

Table 2: Component matrix

Variable		Common factor					
		1	2	3	4	5	6
		S1	S2	S3	S4	S5	S6
A4		0.836					
A5		0.785					
E4		0.752					
A2		0.714					
A3		0.688					
A1		0.622					
B1			0.848				
B3			0.791				
B7			0.669				
B2			0.625				
C1			0.586				
B4			0.561				
D2				0.766			
D1				0.749			
D4				0.715			
D3				0.675			
D5				0.523			
C2					0.749		
C9					0.674		
C4					0.640		
C10					0.558		
C5					0.549		
E3						0.828	
E2						0.812	
E1						0.797	
C7							0.782
C6							0.733
C3							0.518
Initial extraction of eigenvalues	Characteristic value	13.53	2.204	1.733	1.299	1.268	0.987
	Variance contribution value (%)	48.288	7.87	6.185	4.638	4.527	3.521
	Variance cumulative contribution value (%)	48.288	56.158	62.343	66.981	71.508	75.029
Rotate the sum of squares to load	Characteristic value	4.472	4	3.592	3.4	2.817	2.74
	Variance contribution value (%)	15.969	14.284	12.827	12.108	10.058	9.784
	Variance cumulative contribution value (%)	15.969	30.253	43.08	55.188	65.246	75.03

II. C. 3) Exploratory factor analysis

Factor rotation using the maximum variance method and Kaiser normal distribution can improve the explanatory power of the public factors, and the eigenvalues, variance contributions and cumulative variance contributions of the public factors were calculated. The results of the factor loading matrix after principal component analysis and great variance rotation are shown in Table 2.The cumulative variance contribution rate of the six public factors: (A) sensory experience, (B) emotional experience, (C) content experience, (D) action experience, (E) service experience, and (F) utility experience reaches 75.025%, which can better represent the information of the original indicator variables. The factor loading coefficients of the 28 variables in the factor loading matrix through rotation are all greater than 0.5, which is ideal for analysis.

Orthogonal rotation was implemented on the factor loading matrix to make the common features of the public factors more prominent and more nomenclaturally interpretable:

(1) Sensory experience factor (S1), with a contribution rate of 15.969% explained by variance, removes the A6 indicator and adds the E4 indicator based on the pre-designed sensory experience dimensions, containing a total of six variables.

(2) Emotional experience factor (S2), with a contribution rate of 14.284% explained by variance, is based on the original emotional experience dimensions by removing B5 and B6, which have lower factor loadings, and adding C1 variables, containing a total of 6 variables.

(3) The action experience factor (S3), with a contribution rate of 12.827% explained by variance, is the original variable factors are all replaced with D1-D5, containing a total of 5 variables.

(4) The content experience factor (S4), with a contribution rate of 12.108% explained by variance, all belonging to the pre-designed content experience dimensions, containing a total of five variable factors, C2, C4, C5, C9, and C10.

(5) The service experience factor (S5), with a contribution rate of 10.058% explained by variance, belongs to the service experience dimension, and contains a total of three variables excluding the E4 variable.

(6) Practicality experience factor (S6), the contribution rate explained by variance is 9.784%, the three indicators are C7, C6, and C3, which mainly focuses on learners' personalized learning needs and emphasizes the practicality of learning.

III. A cloud model for evaluating the quality of teacher preparation

III. A. Hierarchical Analysis

Hierarchical analysis method (AHP), is a method used for multi-objective decision analysis, through the simulation of comprehensive and comparative analysis capabilities, to build a hierarchical problem solving path. The specific idea is to decompose the problem under study into decision-making goals, guidelines and programs, and correspondingly construct three different levels, namely, goal level, guideline level and program level. For the importance of each guideline level indicator for the target level, to create a two-by-two judgment matrix, so that experts for the matrix of the relative importance of the two indicators to judge the analysis, and finally get the relative importance of each indicator each other, relative to the weight of the previous level of indicators and so on. Taking procurement performance evaluation as an example, the calculation process is as follows:

(1) Establishment of hierarchical structure model

In procurement performance evaluation, the goal is the procurement performance of the enterprise. Then the procurement performance target decomposition, to get the first level of indicators, due to the first level of indicators is relatively general, it is difficult to calculate directly, so it is also necessary to further subdivide the indicators in the first level of indicators, to get a number of more detailed, can be measured and compared with the second level of indicators, and there is also a program layer at the bottom, which will be the hierarchical structure of the model to complete the construction. The hierarchical model is shown in Figure 1.

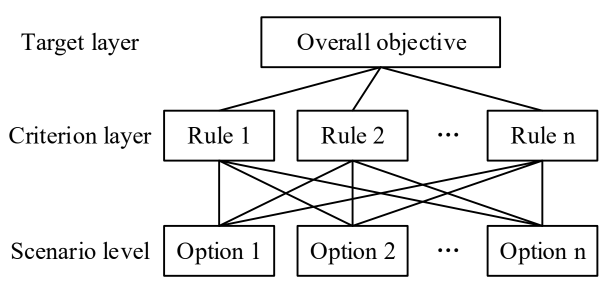


Figure 1: Hierarchical model

(2) Two-way comparison of elements at the same level

The judgment matrix is constructed by combining the first-level criterion level and the internal second-level indicators under the first-level criterion level, and the experts are invited to compare the indicators in the judgment matrix and score the relative importance of each other, with the range of 1~9 points.

(3) Calculate the weight vector W

This paper mainly adopts the root method to calculate the weight, and its calculation method is divided into three steps: 1) calculate the product of judgment matrix m_i, 2) calculate the root of m_i of m_i of the n th root, and 3) normalize the vector.

(4) Consistency test

Consistency test can avoid the subjective judgment error caused by the distortion of the calculation, for example, think that the indicator A is more important than B, the indicator B is more important than C, but also think that C is more important than A, which is obviously wrong, so we need to carry out a consistency test for the judgment matrix. The test steps are as follows:

a) Calculate the maximum eigenvalue $\lambda_{\max}$ as in equation (1):

$$\lambda_{\max} = \frac{1}{n}\sum_{i}\left[\frac{(Aw)_i}{w_i}\right] \tag{1}$$

In this formula, A is the judgment matrix, w is the weight vector, n is the order of the matrix, and W_i is the i th element of the weight vector.

b) Calculate the consistency (CI) of the judgment matrix as in equation (2):

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{2}$$

c) Calculate the consistency ratio (CR) as in equation (3):

$$CR = \frac{CI}{RI} \tag{3}$$

where *RI* is the correction coefficient, which can be obtained by consulting the table of *RI* values.

In the consistency test, consistency is considered acceptable when $CR < 0.1$.

III. B. Fuzzy integrated evaluation method

Fuzzy Comprehensive Evaluation (FCE) is a commonly used evaluation method in performance evaluation, which takes into full consideration of various factors that will be affected with the evaluated object, and finally makes a comprehensive evaluation of it. The application steps based on the case of procurement performance evaluation of Company M are mainly as follows.

(1) Establish the evaluation index set The so-called evaluation index set is the performance evaluation index system, which is represented by “*U*”, then $U=\{u_i\}$, i=1,2··…,n,n represents the number of evaluation indexes in the index layer, which means that the evaluation indexes need to be selected from the n indexes, which means that the evaluation indexes need to be selected from the n indexes. n represents the number of evaluation indicators in the indicator layer, indicating that procurement performance needs to be evaluated from n aspects (factors).

(2) Clarify the evaluation level set in the performance evaluation process, the performance of each indicator has a good and bad, with quantitative thinking, fall in which score period, it belongs to which interval of evaluation. Evaluation level set “*V*” to indicate, $V=\{v_j\}$, j=1,2.……,m,m indicates the number of evaluation levels. According to the research of M company, the current company procurement performance evaluation is divided into a total of 4 levels. In the current evaluation of procurement performance of Company M using fuzzy comprehensive evaluation method, this evaluation level division standard is also followed. Since the vector value of the fuzzy judgment vector is required to be a specific numerical value, the median of each interval is used as the vector value, which further leads to the fuzzy judgment vector *V*= {95, 85, 75, 35}.

(3) Calculate the weight set of evaluation indexes

This paper mainly determines the weight set of the indicators by hierarchical analysis.

(4) Establish the performance evaluation matrix

Quantitative indicators can be determined with the help of historical values of the enterprise, industry benchmark values, etc. Qualitative indicators can be scored by experts, so that experts can judge the degree of good or bad performance of the indicator, and then calculate the affiliation vector, and get the performance evaluation matrix (R) as in equation (4):

$$R = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} \tag{4}$$

(5) Calculate the affiliation vector. It is denoted by B and calculated as in equation (5):

$$B = A \circ R = (a_1, a_2, ..., a_m) \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix} = (b_1, b_2, ..., b_n) \tag{5}$$

(6) Calculate the performance evaluation score

Denoted by G, the calculation formula is shown in equation (6):

$$G = B \times V^T \tag{6}$$

(7) Analysis of fuzzy comprehensive evaluation results

For Company M, through the above steps to get the company's overall procurement performance evaluation score, you can see the overall procurement level of the enterprise, the higher the score indicates that the procurement level is better. The higher the score, the better the procurement level is. The performance of specific level 1 or level 2 indicators can also be evaluated in the affiliation vector. A better performance of an indicator indicates that the corresponding aspect of the indicator is the highlight of the company's procurement work, while a worse performance of an indicator indicates that the company's procurement has problems in this area, and the reasons should be further explored to help the company improve the next step of the formulation and implementation of the procurement strategy.

III. C. Construction of the evaluation cloud model

III. C. 1) Introduction to cloud modeling

Cloud model is a stochastic mapping model that uses expectation E_e, entropy E_s, and hyperentropy H to describe qualitative concepts, and completes the evaluation by generating three numerical features of the corresponding level through the evaluation value of the indicator. The cloud generator, as part of the cloud model generation algorithm, transforms the numerical features of the cloud into cloud drops, a process that can be realized by hardware curing or modular software. In this paper, MATLAB software is utilized to implement its algorithmic process steps are as follows:

(1) Forward cloud generator

Forward cloud generator is the process of transforming qualitative concepts described by language into quantitative ones, by inputting E_x, E_n, H_e and the number of cloud droplets N into the forward generator, a number of cloud droplets are generated based on the 3 digital features using a specific algorithm $d_{rop}(x_i, \mu_i)$, where: x_i is the i th cloud droplet and μ_i is the affiliation degree.

(2) Inverse cloud generator

The inverse cloud generator, in contrast, is the process of converting quantitative values into qualitative ones. The number of cloud droplets N is fed into the inverse generator to output the numerical features E_x, E_n, H_e.

III. C. 2) Determination of the evaluation criteria cloud

With reference to previous studies, the evaluation level of teacher training quality is divided into five grades: low, low, average, good, and excellent toughness level, and the range of rating values is [0, 100], in which the ratings of toughness level are taken as [0. 301, (30, 60), (60, 80], (80, 90], and (90, 100]), respectively. And define the set of rubrics for the evaluation of resilience indicators of teacher preparation quality as Y, so that $Y = \{Y_1, Y_2, Y_3, Y_4, Y_5\}$ |Low level of resilience, Low level of resilience, Average level of resilience, High level of resilience, High level of resilience|. The values taken in each comment set have bilateral constraints $[Y_{\min}, Y_{\max}]$, and the parameters of each parameter of the benchmark cloud $C_Y(E_e, E_s, H_e)$ are computed as in Eq. (7), which yields the parameters of the benchmark cloud as (15, 12, 74, 0.5), respectively, (45, 12, 74, 0.5), (70, 8, 49, 0.5), (85, 4, 25, 0.5), and (95, 4, 25, 0.5).

$$\begin{cases} E_{xY}=\dfrac{Y_{\min}+Y_{\max}}{2} \\ E_{nY}=\dfrac{Y_{\max}-Y_{\max}}{2\sqrt{2\ln 2}} \\ H_{eY}=k \end{cases} \tag{7}$$

where: k is a constant used to represent the thickness of the cloud layer, generally obtained empirically, in this paper we take $k=0.5$.

III. C. 3) Determination of evaluation indicator cloud characteristic parameters

Invite M experts to score and evaluate the quality toughness of teacher training, and get the evaluation index cloud as equation (8):

$$C_U=\begin{bmatrix} \mu_{11} & \cdots & \mu_{1n} \\ \vdots & \ddots & \vdots \\ \mu_{k1} & \cdots & \mu_{kn} \end{bmatrix} \tag{8}$$

where: μ_{ij} is the evaluation result of the i th expert on the j th indicator.

The numerical characteristic parameter of the j th evaluation indicator cloud is equation (9):

$$\begin{cases} E_{sUj}=\dfrac{1}{k}\sum_{i=1}^{k}\mu_{ij} \\ E_{sUj}=\sqrt{\dfrac{\pi}{2}}\times\dfrac{1}{k}\sum_{i=1}^{k}|\mu_{ij}-E_{sUj}| \\ H_{sUj}=\sqrt{|S_{Uj}^2-E_{sUj}^2|} \end{cases} \tag{9}$$

where: $S_{Uj}^2=\frac{1}{k-1}\sum_{i=1}^{k}(\mu_{ij}-\bar{U}_j)^2$ is the sample variance of the evaluated value of the j evaluation indicator, and $\bar{U}_j$ is the the average value of the evaluation results of the experts on the evaluation indicators.

The results of the comprehensive evaluation often do not intuitively reflect the degree of resilience of the quality of teacher training at all levels, so combined with the comprehensive weights of the evaluation indicators of the resilience of the quality of teacher training sought above $\omega_j=(\omega_1,\omega_2,\cdots,\omega_n)$, the computation of the indicators of each indicator cloud characteristic parameter of the criterion layer, so as to realize the precise evaluation of the toughness of each level of teacher training quality for targeted improvement. The calculation formulas are shown in Eqs. (10)-(12):

$$E_{xU}=\frac{\omega_1}{\omega_1+\omega_2+\cdots+\omega_j}E_{xUi1}+\frac{\omega_2}{\omega_1+\omega_2+\cdots+\omega_j}E_{xUi2}+\cdots+\frac{\omega_j}{\omega_1+\omega_2+\cdots+\omega_j}E_{xUij} \tag{10}$$

$$E_{nU}=\frac{\omega_1^2}{\omega_1^2+\omega_2^2+\cdots+\omega_j^2}E_{nUi1}+\frac{\omega_1^2}{\omega_1^2+\omega_2^2+\cdots+\omega_j^2}E_{nUi2}+\cdots+\frac{\omega_1^2}{\omega_1^2+\omega_2^2+\cdots+\omega_j^2}E_{nUij} \tag{11}$$

$$H_{eU}=\frac{\omega_1^2}{\omega_1^2+\omega_2^2+\cdots+\omega_j^2}E_{eUi1}+\frac{\omega_1^2}{\omega_1^2+\omega_2^2+\cdots+\omega_j^2}E_{eUi2}+\cdots+\frac{\omega_1^2}{\omega_1^2+\omega_2^2+\cdots+\omega_j^2}H_{eUij} \tag{12}$$

III. C. 4) Determination of parameters for the evaluation of integrated cloud features

Based on the characteristic parameters $C_{ij}\left\{E_{xUj},E_{nUj},H_{eUj}\right\}$ of the cloud of evaluation metrics, combined with the combined weights of the evaluation metrics sought above, $\omega_j=(\omega_1,\omega_2,\ldots,\omega_n)$. The comprehensive evaluation cloud $C=(E_x,E_x,H_e)$ is derived, and its characteristic parameter is calculated as equation (13):

$$\begin{cases} E_x = \sum_{j=1}^{n} (E_{xUj} \times \omega_i) \\ E_n = \sum_{j=1}^{n} (E_{nUj} \times \frac{\omega_j^2}{\omega_1^2 + \omega_2^2 + \cdots + \omega_n^2}) \\ H_e = \sum_{j=1}^{n} (H_{eUj} \times \frac{\omega_j^2}{\omega_1^2 + \omega_2^2 + \cdots + \omega_n^2}) \end{cases} \tag{13}$$

III. C. 5) Analysis of evaluation results

MATLAB was used to generate cloud diagrams and to compare the comprehensive evaluation cloud $C(E_x, E_x, H_x)$, the evaluation comprehensive cloud $C_U(E_{xt}, E_{xt}, H_{et})$ with the benchmark cloud $C_Y(E_{xY}, E_{nY}, H_{eY})$. The final results of the teacher training quality assessment can be determined by the location of the pooling of the cloud droplets and the degree of dispersion.

Table 3: Teaching quality evaluation index weight and ranking

Primary index	Weight	Secondary index	Weight	Comprehensive weight
S1	0.1909	A4	0.12694	0.0242
		A5	0.15404	0.0294
		E4	0.15074	0.0288
		A2	0.15385	0.0294
		A3	0.16528	0.0316
		A1	0.24915	0.0476
S2	0.1733	B1	0.1135	0.0197
		B3	0.1839	0.0319
		B7	0.233	0.0404
		B2	0.1124	0.0195
		C1	0.1999	0.0346
		B4	0.1573	0.0273
S3	0.1113	D2	0.242	0.0269
		D1	0.2092	0.0233
		D4	0.183	0.0204
		D3	0.1901	0.0212
		D5	0.1757	0.0196
S4	0.187	C2	0.268	0.0501
		C9	0.1283	0.024
		C4	0.1847	0.0345
		C10	0.2305	0.0431
		C5	0.1885	0.0352
S5	0.1506	E3	0.6761	0.1018
		E2	0.1193	0.018
		E1	0.2046	0.0307
S6	0.1869	C7	0.3317	0.062
		C6	0.1274	0.0237
		C3	0.5409	0.1011

IV. Testing and Application of Assessment Systems and Cloud Models

In this chapter, on the basis of utilizing the hierarchical analysis method to empower the indicators of the proposed teacher training quality assessment system, the validity of the proposed assessment system is verified through the consistency test method. The application analysis of the cloud model of teacher training quality assessment is developed.

IV. A. Indicator weights

The assignment of the indicators of the evaluation system proposed in this paper using hierarchical analysis is shown in Table 3.

It can be obtained by observing Table 3:

Among the first-level indicators, (S1) sensory experience indicator has the highest proportion of 0.1909 in the teacher training quality assessment system, which indicates that students pay more attention to the teaching methods of teachers on the industry-teaching integration model. Among the second-level indicators, there are two second-level indicators, (A4) language friendly specification and (A5) appropriate resource granularity, whose weights are more than 0.1000, 0.1018 and 0.1011, respectively, and both of them are subordinate to the first-level indicator (S1) sensory experience. It indicates that on the teaching of industry-teaching integration, the teaching style of teachers and the arrangement of teaching resources are important factors that reflect their good training quality.

IV. B. Consistency test

The six level 1 indicators were constructed into judgment matrices as M_{S1}, M_{S2}, M_{S3}, M_{S4}, M_{S5}, and M_{S6}, and the results of consistency test were shown in Table 4.From this, it can be concluded that all the judgment matrices satisfy CR<0.1, i.e., all of them passed the consistency test.

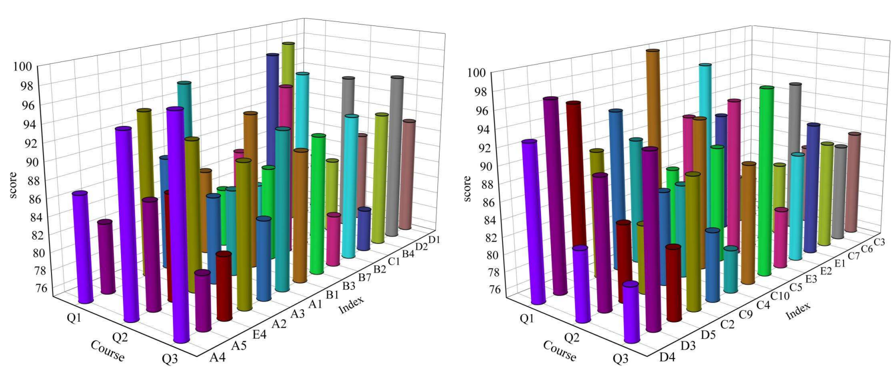
Table 4: Consistency test

Judgment matrix	λ	*CI*	*RI*	*CR*
M_{S1}	4.0501	0.0120	0.8901	0.0133
M_{S2}	5.2598	0.0650	1.1201	0.0581
M_{S3}	5.0720	0.0181	0	0.0161
M_{S4}	2.0001	0	0.5201	0
M_{S5}	3.0211	0.0103	0.6402	0.0171
M_{S6}	3.0002	0.0112	0.8800	0.0189

IV. C. Example Analysis of Evaluation Cloud Models

IV. C. 1) Evaluation results

In this paper, University of G is used as a research object to conduct a case study on the evaluation of the quality of teacher training in University of G. Three open courses were randomly selected from different grades and majors in the College of Animal and Science of the University of G for evaluation, namely, Animal Genetics (Q1), Animal Reproduction (Q2), and Animal Nutrition (Q3). In order to improve the accuracy of the evaluation of the quality of teacher training, in addition to the student evaluation of the three courses evaluated, other faculty members of the College of Animal and Science were asked to score the 15 secondary indicators of the three courses on a percentage basis, respectively. The results of the student evaluations were then averaged to obtain the average scores of the 3 courses on the 28 indicators. The faculty members' scores on the fourteen indicators A4, A5, E4, A2, A3, A1, B1, B3, B7, B2, C1, B4, D2, and D1 are shown in Fig. 2(a), and the scores on the fourteen indicators D4, D3, D5, C2, C9, C4, C10, E3, E2, E1, C7, C6, and C3 are shown in Fig. 2(b).



(a) The score of the teacher being evaluated on the first 14 indicators

(b) The scores of the evaluated teachers on the last 14 indicators

Figure 2: Results of teacher training quality evaluation

IV. C. 2) Evaluation of cloud data characteristics

The virtual cloud algorithm was used to compute the evaluated cloud digital features for the six level 1 indicators, and the cloud feature data for the indicators are shown in Table 5.

Table 5: Cloud feature data for indicators

Primary index	(Ex,En,He)
S1	(9.561,0.949,0.528)
S2	(9.444,1.098,0.448)
S3	(9.453,1.098,0.481)
S4	(9.419,1.172,0.462)
S5	(9.502,0.938,0.498)
S6	(9.534,0.901,0.457)

The numerical eigenvalues and forward cloud algorithm are utilized to make the evaluation cloud data is shown in Figure 3.

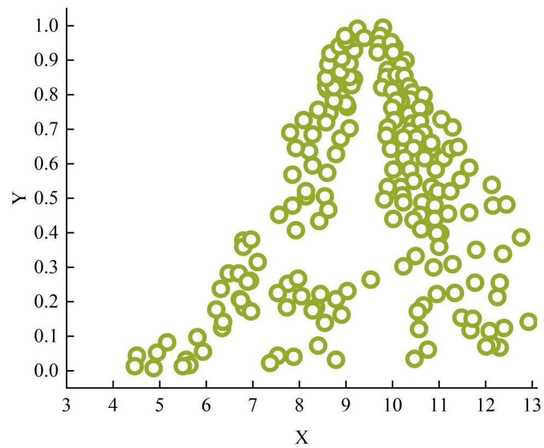


Figure 3: A comprehensive evaluation of the teacher being evaluated

As can be seen from Figure 3, the expected value of the cloud model of the evaluated teacher's comprehensive evaluation results Ex is 9.463, falling in the interval (9,10), and the cloud droplets distributed in this interval are the most numerous and dense, so it can be concluded that the teacher's evaluation results of the evaluation of the learning and teaching of the teacher is “good”. At the same time, it can be seen that most of the cloud drops fall in the "good" range, and the rest mainly fall in the "good" range, so it is more accurate to say that the teacher's evaluation result should be "satisfactory to low".

V. Conclusion

Based on the needs of students' perspectives, this paper designs a set of teacher training quality evaluation system consisting of six dimensions: sensory experience, emotional experience, content experience, action experience, service experience, and practicality experience. At the same time, based on the fuzzy comprehensive evaluation method to obtain objective evaluation scores, a cloud model of teacher training quality evaluation is constructed. With the support of multiple computational methods, it realizes the intuitive and effective assessment of the quality of “dual-teacher” teacher training. The designed quality assessment system passed the consistency test with CR values <0.1 for all six level 1 indicators.

References

[1] Rodríguez Moreno, J., Agreda Montoro, M., & Ortiz Colon, A. M. (2019). Changes in teacher training within the TPACK model framework: A systematic review. Sustainability, 11(7), 1870.
[2] Öztürk, M. (2019). An Evaluation of an Innovative In-Service Teacher Training Model in Turkey. International Journal of Higher Education, 8(1), 23-36.
[3] Mägi, E., & Beerkens, M. (2016). Linking research and teaching: Are research-active staff members different teachers?. Higher Education, 72, 241-258.
[4] Sharma, M. (2015). Simulation Models for Teacher Training: Perspectives and Prospects. Journal of education and practice, 6(4), 11-14.

[5] Duong, M. T., Pullmann, M. D., Buntain-Ricklefs, J., Lee, K., Benjamin, K. S., Nguyen, L., & Cook, C. R. (2019). Brief teacher training improves student behavior and student–teacher relationships in middle school. School Psychology, 34(2), 212.
[6] Dar, J. A., & Rather, M. A. (2024). Creative Teaching Attitude And Teaching Competence: A Comparative Study Of Prospective Teachers With High And Low Creative Teaching Attitude On Teaching Competence (Composite Score). Journal Of Economics, 17, 14.
[7] Zhao, F. H., Guo, X. F., & He, Y. (2014). The study and practice of constructing featured specialty based on the double qualified teacher and double mentors. Advanced Materials Research, 971, 2685-2687.
[8] Chunming, L., & Hock, K. E. (2024). Practice Research on Multi-Level and Classification Training of Teachers in Higher Vocational Colleges. Asian Journal of Research in Education and Social Sciences, 6(4), 261-268.
[9] Chen, X. P. (2012). Double Qualified Teachers' Training Strategies and Approaches. Advanced Materials Research, 430, 1335-1338.
[10] Chen, H., & Yin, M. (2020, September). The Construction of “Double-qualified” Teacher Team Based on Multi-party Cooperation:—Take H polytechnic as an example. In 2020 International Conference on Modern Education and Information Management (ICMEIM) (pp. 304-307). IEEE.
[11] Zuo, C. (2019). The current situation, problems and countermeasures of the application of double qualified teachers’ education technology. In Application of Intelligent Systems in Multi-modal Information Analytics (pp. 1114-1121). Springer International Publishing.
[12] Liu, J., & Zhou, F. (2019). Reflections on" Double-Professionally-Titled" Teachers in Higher Vocational Education. In 2019 9th International Conference on Education and Management (ICEM 2019). doi (Vol. 10).
[13] Yao, Y. (2022). ANALYSIS ON THE OBSTACLES AND REALIZATION PATH OF THE CONSTRUCTION OF DOUBLE QUALIFIED TEACHERS BASED ON JOB BURNOUT PSYCHOLOGY. Psychiatria Danubina, 34(suppl 2), 236-236.
[14] Zhang, M., Chen, J., & Liu, K. (2022). Research on the Development Strategy of Double Qualified Teachers in Secondary Vocational Schools under the Background of. Advances in Vocational and Technical Education, 4(5), 15-22.
[15] Shi, X. (2021). Influence of Thinking Logic Barrier on the Construction of Double Qualified Teachers under the 1+ X Certificate System. Psychiatria Danubina, 33(suppl 7), 404-405.
[16] Haiyan, S. H. (2023). RESEARCH ON THE IMPROVEMENT OF CORE QUALITY OF" DOUBLE-QUALIFIED" TEACHERS IN VOCATIONAL COLLEGES UNDER THE BACKGROUND OF NEW ERA. Global Journal of Education and Learning, 11(1), 16-24.
[17] Li, Z., & Li, Y. (2022). The Structural Dimensions of “Double-Qualified” Teachers’ Work Role Transition Competence and Its Generation Mechanism. Sustainability, 14(14), 8237.
[18] Li, Y., & Mao, J. (2021, January). Development of “Double-Qualified” Teachers in Higher Vocational Colleges: Dilemma, Framework and Path. In 6th Annual International Conference on Social Science and Contemporary Humanity Development (SSCHD 2020) (pp. 346-352). Atlantis Press.
[19] Ge, H. (2022). Construction and Application of The Evaluation Index System of Doublequalified Teachers’ Professional Quality in Higher Vocational Colleges. Int. J. Educ. Humanit, 5(2), 79-83.
[20] Qiu, L., Zhang, X., & Hao, D. (2019, September). Research on the construction strategy of double-qualified team in vocational education colleges. In 2019 3rd International Seminar on Education, Management and Social Sciences (ISEMSS 2019) (pp. 401-404). Atlantis Press.
[21] Xiao, Z., & Qin, B. (2013, December). Research on the Training Model of Double-Qualified Teachers. In 2013 International Conference on the Modern Development of Humanities and Social Science (pp. 197-200). Atlantis Press.
[22] Zhai, L., & Yang, Q. (2023). Training Mechanism of the “Double Teacher” Teaching Team in Higher Vocational Undergraduate Colleges under the Background of Integration of Industry and Education. Advances in Vocational and Technical Education (7).
[23] Chen, L., & Qi, Y. (2022). ANALYSIS OF THE CONSTRUCTION PATH OF APPLIED UNDERGRADUATE “DOUBLE-QUALIFIED” TEACHERS BASED ON JOB BURNOUT PSYCHOLOGY. Psychiatria Danubina, 34(suppl 4), 326-326.
[24] Chen, J., Xue, R., Xu, Y., & Wang, W. (2019, October). Research on the Construction of" Double Type" Faculty in Vocational Colleges. In 2019 3rd International Conference on Economic Development and Education Management (ICEDEM 2019) (pp. 64-67). Atlantis Press.
[25] Ou, J. (2023). Research on the Professional Development Support System of Double-Qualified Teachers in Higher Vocational Colleges in the New Era—Taking Higher Vocational Colleges in Hunan Province as Samples. Research and Advances in Education, 2(3), 28-33.
[26] Tao, L. J., & Min, W. H. (2022). FUTURE-READY TEACHING: DEVELOPING CORE SKILLS OF DOUBLE-QUALIFIED TEACHERS IN VOCATIONAL EDUCATION. Research Journal of Education and Allied Studies, 10(4), 1-8.
[27] Cheng, Q., Zhao, L., & Li, W. (2025). The Internal Structure and Influence Mechanism of Double Qualified-Teachers’ Quality and Competence. Education and Urban Society, 57(1), 13-39.