International Journal for Housing Science and Its Applications
Publish August 5, 2025. Volume 46, Issue 3 Pages 3640-3649

https://doi.org/10.70517/ijhsa463307

Construction and application of teaching quality assessment model for college courses based on multivariate statistical analysis

Zhaoyan Shang[1,*] and Zhongjian Liu[1]
[1] Law Department, Shandong University of Finance and Economics, Jinan, Shandong, 250014, China
Corresponding authors: (e-mail: 20065565@sdufe.edu.cn).

Abstract Classroom teaching evaluation in universities is of great significance for improving the level of talent cultivation and classroom teaching quality. In this paper, in order to evaluate the university classroom teaching more objectively, the principal component analysis and systematic clustering algorithm are used to establish the course teaching quality assessment model. The data of classroom teaching quality evaluation of 30 teachers in S university are used to verify the example. First, three independent variables, namely, teaching resources and atmosphere creation, faculty situation and classroom teaching situation, were extracted based on the portfolio evaluation method. Then, the teachers' classroom teaching quality was comprehensively evaluated and ranked by systematic cluster analysis. The error term test proves that the teaching quality of college courses can be accurately assessed based on $Y = 1.782 + 0.211p_1 + 0.261p_2 + 0.165p_3$. Finally, the teaching quality improvement countermeasures in three aspects, namely, upgrading the level of "application-oriented" teachers, expanding classroom teaching content, enriching professional learning resources, and creating a professional learning atmosphere, are put forward in the light of the teaching experience of the courses.

Index Terms Principal Component Analysis, Systematic Clustering Algorithm, Portfolio Evaluation, Teaching Quality Assessment

I. Introduction

School teaching quality is the core element of talent cultivation quality, colleges and universities need to build a practical teaching quality evaluation system [1]. Teaching quality evaluation is an important link in the daily management process of colleges and universities, is a complex and abstract nonlinear problem, affected by a variety of factors, the law of change is more complex, the traditional quality assessment model has been unable to meet the current complex quality evaluation work [2]-[4]. In this context, the academic community began to explore and establish the model of teaching quality evaluation system, and the related research provides important theoretical support for the reform of teaching quality evaluation in colleges and universities, and also provides a key grip for clarifying the core connotation of undergraduate teaching quality evaluation in colleges and universities.

The research mainly includes multivariate statistical analysis methods such as fuzzy comprehensive evaluation method, cluster analysis method and hierarchical analysis method [5]-[7]. In terms of fuzzy comprehensive evaluation method, Sun, M et al. utilized the combination of fuzzy comprehensive evaluation and hierarchical analysis to construct a new method for evaluating the quality of English classroom teaching in colleges and universities, which overcame the subjectivity and inaccuracy of the traditional evaluation method [8]. Liu, S and Chen, P proposed a new fuzzy comprehensive evaluation method to evaluate the classroom practice teaching of computer science majors in colleges and universities, which is more scientific and fair compared with the traditional evaluation methods [9]. The classroom teaching quality evaluation based on improved fuzzy neural network model proposed by Jiang, Y et al. was tested in practice at Henan University of Traditional Chinese Medicine, and the results showed that the new assessment method was able to reflect the actual teaching quality situation [10]. In terms of cluster analysis method, Xian, S et al. established a teaching quality assessment model and algorithm based on principal component cluster analysis of student teaching evaluation [11]. Zhang, M et al. utilized a new clustering model for the evaluation and monitoring of teaching quality under interval number conditions by means of a constructed system containing 4 primary and 15 secondary indicators [12]. Lang, W et al. utilized the k-mean clustering algorithm to evaluate the quality of college English classroom teaching in terms of both students' learning outcomes and teachers' teaching efforts [13]. In terms of hierarchical analysis, Qin, Y et al. proposed Interval Hierarchical Analysis (I-AHP) for evaluating the quality of mathematics classroom teaching in response to the uncertainty in the process of evaluating the quality of classroom teaching [14]. Wen, X et al. proposed a teaching quality evaluation model based on hierarchical analysis for college education, which achieved a smaller error and was suitable for distance education evaluation [15]. In summary, in recent years, scholars have made certain achievements in the research of teaching evaluation by using multivariate statistical analysis methods, but the research on teaching evaluation theory is more, the research on evaluation method technology is less, and the technology used is relatively single.

In this paper, the principal component analysis in multivariate statistical analysis is used to establish a classroom teaching quality evaluation model, and on the basis of principal component analysis, expert assessment and principal component analysis are combined and applied to teaching evaluation. In this combined evaluation method, the number of principal components is determined according to the variance contribution rate, and then cluster analysis is carried out from the data of the scores of each principal component, using the information of each principal component to cluster the samples, and then the teachers' teaching is ranked according to the magnitude of the score value of the first principal component in each category. Finally, the factors affecting the teaching quality of college courses are analyzed by multiple regression analysis to get the main factors affecting the teaching quality, and accordingly, targeted measures to improve the teaching quality of courses are proposed.

II. Assessment of teaching quality of college courses based on multivariate statistical analysis

II. A. ***Construction of the evaluation index system***

The evaluation of classroom teaching in colleges and universities should fully reflect its disciplinary characteristics [16]. Based on the teaching purpose and cultivation objectives at university level, integrating students', teachers' and experts' opinions, the teaching quality evaluation index system proposed in this study for classroom teaching in colleges and universities is shown in Table 1. The evaluation body consists of two parts: students and peers. Under student evaluation, there are five first-level indicators: teaching content, teaching methods, teaching attitude, student motivation and language appearance. These include: rich content, appropriate focus and difficulties (x1), strong practicality, focus on student practice (x2), advanced methods, highlighting the student body (x3), flexible use of multimedia, network and other means of assisting teaching (x4), adequate preparation for class, full of emotion (x5), respect and care for the students (x6), high motivation of students to learn (x7), and voice and intonation standards (x8). Under the peer evaluation, there are 3 level 1 indicators: scientific research ability, love and dedication, and professional quality. Including: research ability (x9), active participation in teaching and research activities (x10), rich and solid professional knowledge (x11), and clear and advanced teaching philosophy (x12).

Table 1: The teaching quality evaluation index system of classroom teaching

Evaluation dimension	Primary indicator	Secondary indicator	Description index
Student evaluation	Teaching content	x1	The content is rich, the focus is appropriate
		x2	Practical and practical
	Teaching method	x3	The method is advanced and emphasizes the student body
		x4	Flexible use of multimedia, network and other means
	Teaching attitude	x5	Be full of lessons and be full of emotions
		x6	Respect and love students
	Student motivation	x7	Students learn to be motivated
	Language status	x8	Phonetic and intonation standards
Peer evaluation	Scientific ability	x9	Scientific ability
	Love is dedicated	x10	Actively participate in the education and research activities
	Professional quality	x11	Professional knowledge and solid knowledge
		x12	There are clear and advanced teaching ideas

II. B. Principles and models of multivariate statistical analysis

The principal component and factor analysis method in multivariate statistical analysis is based on the comprehensive evaluation system of multiple indicators, and applies statistical analysis methods to analyze and process the indicators, transforming the original multivariate variables into several comprehensive variables independent of each other, eliminating the overlap of information between indicators, and at the same time reflecting the weight coefficients of the original information provided by most of the information of the original multivariate variables. It effectively avoids the subjectivity and arbitrariness of the weight estimation in the multi-indicator evaluation method [17]. The specific algorithm of principal component analysis method is as follows:

(1) Standardize the original data. Because the evaluation indexes have different quantitative outlines and large differences in orders of magnitude, the raw data need to be standardized before the principal component analysis. The purpose of standardization is to make the mean value 0 and the standard deviation 1.

(2) Calculate the correlation coefficient matrix R :

$$R=\begin{bmatrix} r_{11} & r_{12} & r_{13} & \cdots & r_{1p} \\ r_{21} & r_{22} & r_{23} & \cdots & r_{2p} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ r_{p1} & r_{p2} & r_{p3} & \cdots & r_{pp} \end{bmatrix} \tag{1}$$

where: $r_{ij}(i,j=1,2,\cdots,p)$ represents the correlation coefficient between the original variables x_i and x_j. The r_{ij} is calculated as shown in equation (2):

$$r_{ij}=\frac{\sum_{q=1}^{p}(x_{qi}-\overline{x}_i)(x_{qj}-\overline{x}_j)}{\sqrt{\sum_{q=1}^{p}(x_{qi}-x_i)^2\sum_{q=1}^{p}(x_{qj}-x_j)^2}} \tag{2}$$

where: $\overline{x}_i$ and $\overline{x}_j$ are the means of the i th and j th evaluation indicators

(3) Calculate the eigenvalues and eigenvectors of the correlation coefficient matrix R.

Calculate the eigenvalues $\lambda_i(i=1,2,\cdots,p)$ according to Eq. (3), and further calculate to obtain the eigenvectors λ_i of the eigenvalues $t_i(i=1,2,\cdots,p)$:

$$\left|\lambda I-R\right|=0 \tag{3}$$

(4) Calculate the contribution rate and cumulative contribution rate of each principal component

The contribution rate of the first m principal components is $\lambda_m/\sum_{i=1}^{p}\lambda_i$, then the contribution rate of the first m principal components is $\sum_{i=1}^{m}\lambda_i/\sum_{i=1}^{p}\lambda_i, m<p$. In general, when the cumulative contribution rate obtained from the calculation reaches 85% or more, m principal components can be used to replace p evaluation indicators, and at this time retains the loss of most of the information of the original data.

(5) Principal component selection

According to step (4) to finalize the principal component coefficient matrix as shown in equation (4):

$$\begin{cases} y_1=t_{11}\cdot x_1^{'}+t_{12}\cdot x_2^{'}+\cdots+t_{1p}\cdot x_p^{'} \\ y_2=t_{21}\cdot x_1^{'}+t_{22}\cdot x_2^{'}+\cdots+t_{2p}\cdot x_p^{'} \\ \vdots \\ y_m=t_{m1}\cdot x_1^{'}+t_{m2}\cdot x_2^{'}+\cdots+t_{mp}\cdot x_p^{'} \end{cases} \tag{4}$$

where: $x_i^{'}(i=1,2,\cdots,p)$ is the i th evaluation index after standardization.

(6) Calculate principal component loadings and scores

Calculate the principal component loadings matrix according to equation (5):

$$H=(z_j,x_i)=\sqrt{\lambda_j}\cdot t_i, i,j=1,2,\cdots,p \tag{5}$$

II. C.Systematic clustering algorithm

The basic idea of the systematic clustering algorithm is to first set each sample into a separate class, and the distance between each two classes is used as an evaluation index to measure the degree of similarity between them. The larger the distance, the less similar the two classes are. The smaller the distance, the more similar the two classes are. After the two classes with the highest degree of similarity are merged into a new class, the distance between the new class and other classes is calculated, and the class with the highest degree of similarity to the new class is merged, and all classes are merged into one class by continuously iterating this process.

The systematic clustering algorithm includes the following processes:

(1) Data preprocessing

Since there are often differences in the unit of measurement and the degree of change between the m indicators of the n samples, such differences usually lead to a wide range of analysis results of the data, in order to eliminate the impact of different scales and the degree of change of the variables, so that the data are comparable, the data need to be standardized. After the standardized transformation, the data are free from the limitations of the unit of measurement, dimensionless, but if there are still some indicators of the data do not reside in the range of [0, 1], the data need to do further normalization, which can greatly improve the accuracy and reasonableness of the results of the system clustering. Data normalization methods usually have the following kinds:

Standard deviation normalization:

$$x_{ij}^{'} = \frac{x_{ij} - \overline{x}_j}{s_j} \quad (i = 1, 2, \cdots, n, j = 1, 2, \cdots, m) \tag{6}$$

Among them:

$\overline{x}_j = \frac{1}{n}\sum_{i=1}^{n} x_{ij}, s_j = \left[\frac{1}{n}\sum_{i=1}^{n}(x_{ij} - \overline{x}_j)^2\right]^{\frac{1}{2}}, (j = 1, 2, \cdots, m)$ denotes the raw data for the j th indicator for the i th sample. $x_{ij}^{'}$ the standardized data for the i th indicator of the i th sample.

Polar deviation standardization:

$$x_{ij}^{''} = \frac{x_{ij}^{'} - \min_{1 \le i \le n}\{x_{ij}^{'}\}}{\max_{1 \le i \le n}\{x_{ij}^{'}\} - \min_{1 \le i \le n}\{x_{ij}^{'}\}}, (j = 1, 2, \cdots, m) \tag{7}$$

where $x_{ij}^{''}$ is the normalized data of the j th indicator of the i th sample. After the polar transformation process, all the indicator data $x_{ij}^{''} \in [0,1]$.

(2) Calculation of sample-to-sample distance

In the cluster analysis of practical problems, the proximity between any two sample points is usually measured by measuring the distance between them, if d_{ij} is defined as the distance between the sample x_i and the sample x_j , there are several methods of calculating the distance between samples as follows:

Absolute value distance:

$$d_{ij} = \sum_{k=1}^{m} | x_{ik} - x_{jk} | \tag{8}$$

European distance:

$$d_{ij} = \left[\sum_{k=1}^{m}(x_{ik} - x_{jk})^2\right]^{1/2} \tag{9}$$

Minkowski Distance:

$$d_i = \left[\sum_{k=1}^{m}(x_{ik} - x_{jk})^q\right]^{1/q} \tag{10}$$

Chebyshev distance:

$$d_{ij} = \max_{1 \le k \le m} | x_{ik} - x_{jk} | \tag{11}$$

Mar's Distance:

$$d_{ij} = \left[(x_i - x_j)^{'} S^{-1}(x_i - x_j)\right]^{1/2} \tag{12}$$

where S is the covariance.

Lang's distance:

$$d_{ij} = \sum_{k=1}^{m} \frac{| x_{ik} - x_{jk} |}{x_{ik} + x_{jk}} \tag{13}$$

(3) Calculating class-to-class spacing

Class to class spacing is calculated by the longest distance method, the shortest distance method, the mean intergroup linkage method, the mean intragroup linkage method, the center of mass method, the median method, and the sum of squares of deviations method. The longest distance method is to take the maximum distance between two samples of different classes as the distance between the two classes. The shortest distance method is to combine two or more classes with the smallest distance. The between-group mean connection method is to take the average of the distances between two samples of individuals in two classes as the distance between the classes. The within-group mean linkage method is to take the average of the distances between all individuals in the merged class as the between-class distance after combining the two classes into one class. The center of mass method and the median method are used to take the distance between the mean and median of the variables of the two classes as the interclass distance, respectively. The sum of squared deviations method: n samples are first set up as n classes, and since the sum of squared deviations within a class increases as the number of classes decreases, the two classes with the smallest increase in the sum of squared deviations are merged until all the classes are merged into one class.

III. Empirical analysis of teaching quality assessment of college courses

The data for the empirical analysis conducted in this chapter come from the data of the students' assessment of the teaching effectiveness of 30 teachers at the end of the semester in S college. Combined with the teaching indicators constructed in the previous section, on the basis of principal component analysis, expert assessment and principal component analysis are combined and applied to teaching evaluation. The two combined evaluation methods realize the combination of subjective and objective evaluation of teaching evaluation, avoiding the one-sidedness of evaluation and making the evaluation more convincing. After that, the factors affecting the teaching quality of college courses are analyzed by multiple regression analysis.

III. A. Portfolio evaluation based on principal component analysis

Principal component analysis is also commonly used in teaching evaluation, where we combine subjective and objective assessment based on principal component analysis for teaching evaluation [18]. The combination of traditional expert evaluation and the first principal component evaluation method is to modify the principal component evaluation method with information from traditional expert survey research.

(1) The raw evaluation data are standardized and the information obtained from the expert survey research is given the appropriate weights to the importance of the variables, on the basis of which the sample covariance array is obtained as shown in Figure 1.

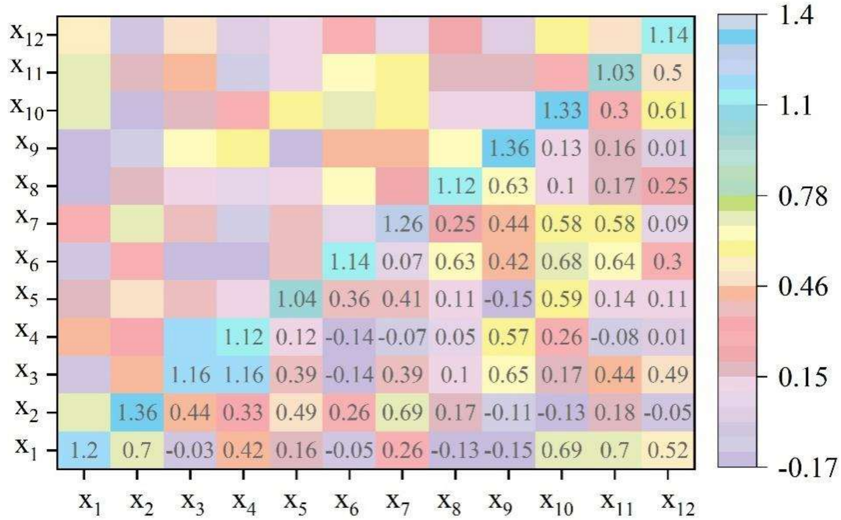


Figure 1: Covariance matrix

(2) Principal component analysis was conducted from the obtained covariance array to obtain the corresponding eigenvalues, the first three eigenvalues were 1.263, 3.365 and 6.352 respectively, with a cumulative contribution rate of 88.63%, so these three principal components would summarize the data set well. These three principal components are named teaching resources and atmosphere creation (Prin1), teacher situation (Prin2) and classroom teaching situation (Prin3).

(3) The eigenvectors corresponding to the three eigenvalues are shown in Table 2.

Table 2: The eigenvectors corresponding to the four eigenvalues

	Prin1	Prin2	Prin3		Prin1	Prin2	Prin3
x1	-0.067	0.347	-0.437	x7	0.14	0.022	0.329
x2	-0.206	-0.262	-0.396	x8	0.511	-0.448	0.445
x3	-0.05	0.295	-0.17	x9	-0.064	0.396	-0.336
x4	0.109	0.566	-0.465	x10	-0.399	0.419	0.37
x5	0.347	0.303	0.66	x11	0.617	-0.139	-0.225
x6	0.288	-0.217	0.288	x12	-0.095	0.493	-0.323

(4) The three principal component scores of each teacher are shown in Table 3. Taking teacher 24 as an example, his score under the three principal components is the highest, which is 3.156, 2.676, and 3.065 respectively,

indicating that the teacher performs better in the three aspects of teaching resources and atmosphere creation, faculty situation and classroom teaching situation.

Table 3: The four main components of each teacher score

N	Prin1	Prin2	Prin3	N	Prin1	Prin2	Prin3
1	0.77	0.62	4.428	16	-2.565	2.93	0.611
2	-1.866	-3.68	-1.642	17	2.325	-2.331	-3.649
3	1.699	-2.833	-2.98	18	2.492	-2.182	0.597
4	-3.589	3.815	-1.209	19	2.337	4.725	0.057
5	-2.182	-3.485	-3.474	20	-3.64	-1.339	0.577
6	0.742	3.155	3.209	21	1.852	4.774	-2.057
7	0.677	3.103	2.67	22	3.528	4.776	2.438
8	3.469	-0.554	0.393	23	2.498	0.089	3.517
9	3.238	0.75	4.98	24	3.156	2.676	3.065
10	-1.495	1.243	-1.838	25	-1.539	2.174	4.996
11	-2.405	-0.203	-0.763	26	-0.557	-1.749	3.755
12	2.531	3.38	-2.158	27	1.454	0.174	3.936
13	1.449	-3.2	4.146	28	-0.547	3.044	1.068
14	1.823	1.613	0.763	29	1.921	-1.358	-0.377
15	0.638	0.251	3.967	30	-2.201	-0.841	-3.195

(5) The data matrix of the three principal component scores was subjected to systematic clustering analysis in the software, and the method of systematic clustering was class-averaging, which resulted in a clustering spectrum as shown in Figure 2.

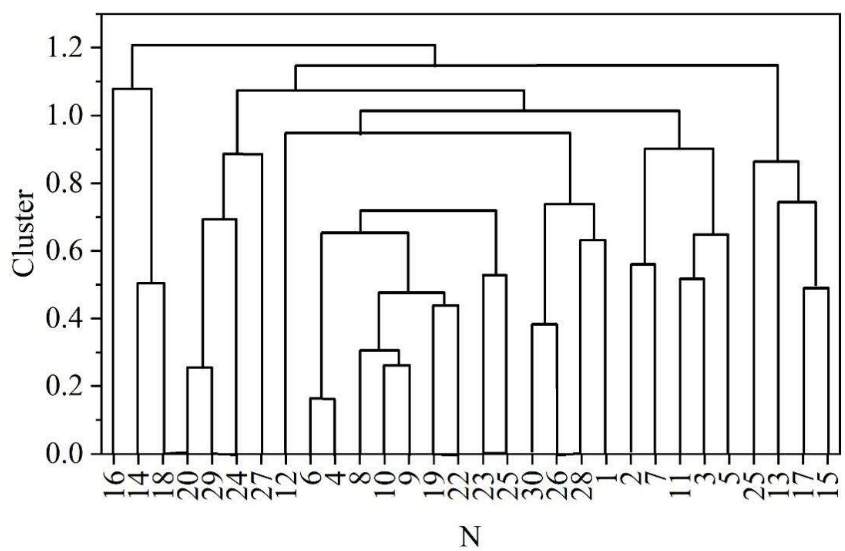


Figure 2: Hierarchical cluster diagram based on class averaging method

(6) The 30 samples are divided into five categories, {16}, {14, 18}, {20, 24, 27, 29}, {25, 13, 17, 15}, {12, 6, 4, 8, 10, 9, 19, 22, 23, 25, 30, 26, 28, 1, 2, 7, 11, 3, 5}, and the mean of the first principal component of each category is computed, and according to the this mean of the descending order, the order of these five categories of samples are {14, 18}, {16}, {12, 6, 4, 8, 10, 9, 19, 22, 23, 25, 30, 26, 28, 1, 2, 7, 11, 3, 5}, {20, 24, 27, 29}, and {25, 13, 17, 15}. Then, in each category, the ranking of each teacher's teaching quality is obtained according to the size of the first principal component as shown in Table 4.

Table 4: The ranking of teachers' teaching quality

N	1	2	3	4	5	6	7	8	9	10
Ranking	17	18	21	6	22	5	19	7	9	8
N	11	12	13	14	15	16	17	18	19	20
Ranking	20	4	30	1	29	3	28	2	10	23
N	21	22	23	24	25	26	27	28	29	30
Ranking	27	11	12	24	13	15	25	16	26	14

III. B. Multiple linear regression analysis

Multiple linear regression modeling:

$$Y = C + \sum a_i p_i \tag{14}$$

Where Y denotes the quality of course instruction and is the dependent variable. C denotes the constant term. p_i denotes the i th influencing factor, the independent variable. a_i denotes the elasticity coefficient of the i th influencing factor to the dependent variable, the independent variable.

In order to prevent the sample demographic characteristics from confounding the model, the demographic characteristics variables were included in the model together as control variables, and the results of the regression analysis are shown in Table 5.

From Table 5:

(1) Model fit: the value of the coefficient of determination R2 is 0.423, indicating that the eight influencing factors can jointly explain the 42.3% change in the quality of course teaching.

(2) Multicollinearity: the variance inflation factors (VIF) are all less than 5, and by the test, the model does not have obvious multicollinearity problems.

(3) Significance: the significance of the three independent variables of teaching resources and atmosphere creation, faculty situation, and classroom teaching situation is sig.<0.05 and passes the test. The significance sig.>0.05 of 5 demographic characteristics control variables of gender, ethnicity, arts and science division situation, whether only child or not, and place of origin failed the test.

(4) Direction and degree of influence: according to the Beta value of the standardized coefficient of the three independent variables that passed the test of significance, it can be judged that the influence of the three independent variables on the quality of course teaching is positive, and the degree of influence is classroom teaching situation>learning resources and atmosphere creation>faculty situation.

Table 5: Regression analysis results with control variables

Model	Nonnormalized coefficient		Normalization factor	T	Sig.	VIF	R2
	B	Standard error	Beta				
Constant	1.583	0.391	-	4.009	0	-	0.423
Teaching resources and atmosphere creation	0.157	0.06	0.234	2.692	0.02	1.644	
Teacher status	0.226	0.091	0.22	2.729	0.018	1.437	
Classroom teaching	0.19	0.068	0.267	3.095	0.008	1.798	
Gender	0.088	0.055	0.079	1.149	0.26	1.113	
Peoples	0.192	0.122	0.103	1.525	0.138	1.141	
The literary situation	0.012	0.079	0.031	0.481	0.64	1.194	
The only child	-0.002	0.098	-0.002	-0.069	0.936	1.208	
Biotically	-0.036	0.082	-0.015	-0.423	0.676	1.136	

Since the significance of control variables such as gender, ethnicity, arts and science division situation, whether it is an only child or not, and the place of origin of the students did not pass the test, indicating that there is no significant correlation between them and the dependent variable, thus, the insignificant control variables were excluded, and the three independent variables of the teaching resources and atmosphere creation, the teacher's situation, and the classroom teaching situation were retained and analyzed again by the multivariate linear regression analysis, and the results are shown in Table 6.

As can be seen from Table 6:

(1) Model fit: the value of the coefficient of determination R2 is 0.355, indicating that the three factors of teaching resources and atmosphere creation, faculty situation, and classroom teaching situation can jointly explain 35.5% of the changes in the quality of course teaching.

(2) Multicollinearity: VIF are all less than 5, through the test, the model does not have obvious multicollinearity problems.

(3) Significance: the significance of the above three independent variables is sig.<0.05, which indicates that all three independent variables can significantly affect the quality of course teaching after excluding the confounding interference of control variables such as gender, ethnicity, the situation of arts and sciences, whether it is an only child or not, and the place of origin of students.

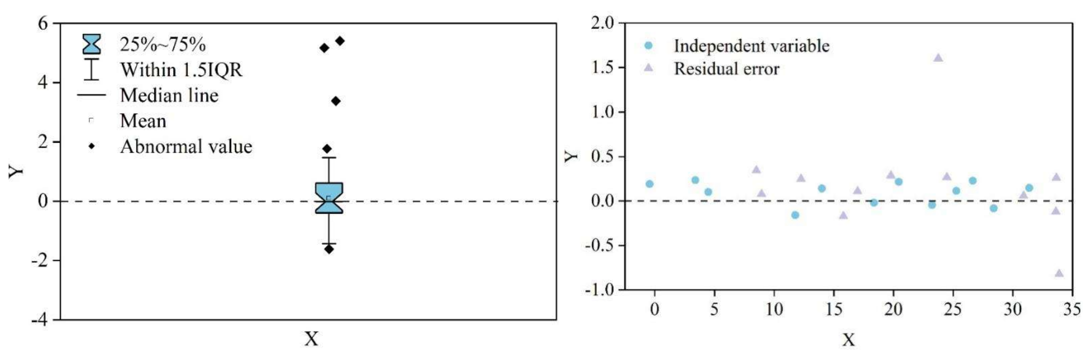
(4) Direction and degree of influence: according to the standardized coefficient Beta value, it can be judged that all the 3 independent variables have a positive influence on the quality of course teaching, and the degree of influence is classroom teaching situation > learning resources and atmosphere creation > faculty situation.

Table 6: Regression analysis results without control variables

Model	Nonnormalized coefficient		Normalization factor	T	Sig.	VIF	R2
	B	Standard error	Beta				
Constant	1.782	0.334	-	5.73	0	-	0.355
Teaching resources and atmosphere creation	0.165	0.051	0.264	3.28	0.001	1.381	
Teacher status	0.261	0.064	0.222	2.834	0.003	1.385	
Classroom teaching	0.211	0.051	0.3	3.525	0.002	1.52	

III. C. Tests for error terms

Statistics suggests that the error term in regression analysis must obey several basic assumptions: serial independence, zero-mean, normality, and equal variance. The test for the error term is shown in Figure 3. (a) and (b) represent box-and-whisker plots of the residuals and scatter plots of the residuals versus the dependent variable, respectively. Figure (a) shows that the mean of the residuals is very close to 0. The box-and-whisker plot is not only very symmetrical but also has few outliers, indicating that the distribution of the residuals is normal. Figure (b) shows that the scatter points are scattered around 0, indicating that the residuals are isotropic. Thus the error terms are all tested.



(a) Boxplot (b) Residual and independent variables

Figure 3: Error test

III. D. Analysis of results

Through principal component analysis and multiple linear regression analysis, it is concluded that the main influencing factors of the teaching quality of S college courses are classroom teaching situation, learning resources and atmosphere creation, and faculty situation. From the constant term in the multiple linear regression model and the unstandardized regression coefficient B value of each influencing factor, the regression equation was obtained:

$$Y = 1.782 + 0.211 p_1 + 0.261 p_2 + 0.165 p_3 \tag{15}$$

IV. Countermeasures to improve the quality of course teaching

IV. A. Upgrading of "application-oriented" teachers

The results of descriptive statistical results and multiple linear regression analysis of the samples after the extraction of principal components reflect that the teacher situation has received more attention from students. Therefore, improving the level of "application-oriented" teachers has a promoting effect on improving the teaching quality of college courses. In order to further promote the training of "double teachers and double abilities", an exchange mechanism between teachers and industry personnel has been established, and teachers have been organized to participate in temporary training in connected industries and industries, so as to realize platform sharing and teacher training, and create an "application-oriented" high-level teaching team with strong theoretical teaching and practical teaching ability.

IV. B. Expanding classroom instruction

The promotion effect of classroom teaching on the teaching quality of the course is the most prominent among the three main influencing factors, indicating that under the premise of maintaining the existing classroom size, course materials, and classroom teaching atmosphere, expanding the content of classroom teaching of the course will bring about a greater enhancement of the teaching quality of the course. From the purpose of cultivating students' practical application of theoretical knowledge, the course should expand the content of practical training classroom teaching, so that the theoretical classroom teaching content can form a "hierarchical progression effect" and be practically applied and consolidated.

IV. C. Enriching professional learning resources and creating a professional learning atmosphere

The above multiple linear regression analysis results show that enriching professional learning resources and creating a professional learning atmosphere can significantly improve the teaching effect of this course. By carrying out academic lectures and knowledge competitions involving the knowledge of the course, a positive professional learning atmosphere is created, so that information on cutting-edge professional knowledge and skills and mature experiences can be disseminated and shared among the student body, thus expanding and improving the students' professional cognitive perspectives and the comprehensive application of professional knowledge and skills.

V. Conclusion

In this paper, based on the evaluation method of principal component analysis to assess the teaching quality of college courses, teaching resources and atmosphere creation, faculty and classroom teaching situation are selected as the independent variables of the model to carry out regression analysis, and regression equation $Y = 1.782 + 0.211p_1 + 0.261p_2 + 0.165p_3$ is constructed, which is proved to be the optimal regression equation through the test of the error term. Based on the results of the regression analysis, it can be seen that the factors that have a significant impact on the effectiveness of college classroom teaching are teaching resources and atmosphere creation, faculty and classroom teaching. Therefore, this paper proposes three countermeasures to improve the quality of course teaching: improving the level of "application-oriented" teachers, expanding the content of classroom teaching, enriching professional learning resources, and creating a professional learning atmosphere.

Funding

This work was supported by the Humanities and Social Sciences Research Program of the Ministry of Education of China (22YJA790047).

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