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Research Article

Research on Classroom Teaching Quality Evaluation and Feedback System Based on Big Data Analysis

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With the development of information technology, the era of big data has gradually entered classroom teaching, and the evaluation of students' learning quality and classroom teaching efficiency has been widely concerned. In order to further improve the quality of classroom teaching in colleges and universities, this paper analyzes the classroom teaching quality evaluation and feedback system based on the big data. Principal component analysis is used to analyze the evaluation index of classroom teaching quality and feedback information to apartment. Through the study of education quality estimate and feedback system under big data, the feedback mechanism of classroom teaching quality evaluation is improved to achieve high-quality and efficient teaching.

1. Introduction

The classroom teaching quality estimate and feedback system refers to the comprehensive analysis of the information in the teaching process and the determination of improvement plans based on the feedback results [1–3]. In recent years, with the deepening of networked information in the era of big data, networked data analysis has been applied to every field of life and become an indispensable part of teaching activities in the new field [4]. Compared with the conventional classroom teaching quality evaluation model, teachers as the main body, through students, peers, leaders, and supervisors to improve the teaching work of teachers, using big data to analyze teaching quality can suggest to improve the reasonable appraise system, leading to the results being not ideal. In the big data, how to use big data for analysis technique to analyze the current of the evaluation of teaching is very significant [5, 6].

At present, big data teaching analysis is mainly a quality evaluation and feedback system. The quality of teaching is based on big data analysis. Literature [7] conducts big data

on teaching quality data, finds out the factors affecting teaching quality, and makes correlation analysis. Literature [8] collects all kinds of data related to teaching quality and stores, analyzes, and displays the data based on the deficiencies existing in current evaluation of teaching quality in colleges. Using big data technology can achieve objective evaluation of teaching quality, with timely monitoring, warning, and improvement. In [9], weights are assigned to each evaluation item through network hierarchy analysis, a teaching quality index system is constructed, and teaching evaluation feedback is given through multiple evaluation subjects. Literature [10] has established a multievaluation system and conducted in-depth analysis on the existence of problems in the multievaluation system. On this basis, the application of big data in the comprised system of colleges is proposed.

For big data analysis methods, Gong [11] uses k-means clustering analysis to conduct feature classification management for different teacher evaluations, in order to improve the accuracy of evaluating teaching quality in colleges. Literature [12] proposed to optimize and improve the teaching evaluation system by using the marginal

computing path, so as to improve and ensure the accuracy of the appraisal and the efficiency of the evaluation. In the literary world [13], the computer system is used to regress the classroom quality of colleges and universities for data collection and statistics, and the most advanced teaching feedback mode is established based on large amounts of data. In the literary world [14], Cite Space measurement visualization analysis software is used to conduct evaluation and analysis of teaching, and the evaluation system is quantitatively processed to improve the deficiencies existing in the system. Literature [15] uses cluster analysis to analyze online teaching quality evaluation, which has achieved the purpose of improving teaching quality. Based on information data analysis, literature [16] establishes a perfect network evaluation system and carries out multi-directional and angle data mining, aiming at improving teaching quality.

The above literature uses big data to analyze the problems existing in the classroom teaching quality evaluation and feedback system and uses data analysis technology to establish and improve the teaching quality evaluation index system, so as to improve the accuracy of teaching quality evaluation. Using different data analysis methods to analyze the feedback results of classroom teaching quality evaluation, the improvement can promote the quality of classroom teaching in colleges and universities. Based on the above, this paper mainly uses principal component analysis to analyze the evaluation indicators of classroom teaching quality and analyzes and optimizes the problems existing in the analysis of the principal components. Finally, the teacher rating of a school is taken as an example to verify and analyze the representativeness of the original method and the improved method, so that the classroom teaching quality evaluation feedback system can be improved and the quality of classroom teaching in colleges and universities can be improved.

2. Data Analysis Classroom Teaching Quality Evaluation and Feedback System

2.1. Big Data Analysis

(1) In big data analysis, data is usually acquired, integrated, analyzed, and displayed. The foundation of big data analysis is data collection and the data source of teaching quality evaluation feedback system model. Data integration mainly includes data extraction, cleaning, and loading. Data analysis is the key step of big data analysis and data processing. Data presentation is the visualization of data, the original data, and analysis results for visual processing. The big data analysis process is shown in Figure 1.

(2) This study analyzes the feedback system of classroom teaching quality evaluation based on big data and divides the evaluation system into three levels, namely, input layer, kernel layer, and output layer. By analyzing the evaluation index system, an analysis
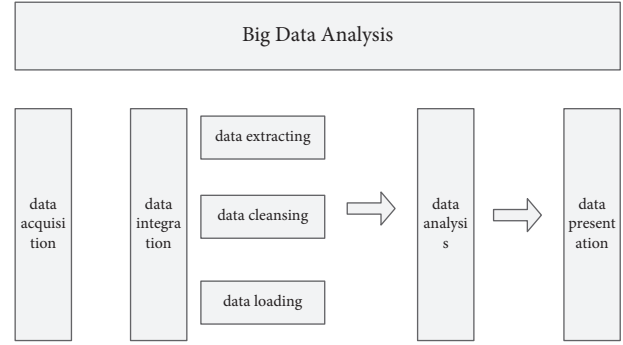

Figure 1: Big data analysis process.

algorithm is determined to optimize the evaluation index system and then improve the quality of classroom teaching, as shown in Figure 2.

2.2. Classroom Teaching Quality Evaluation and Feedback System Model.

Classroom teaching quality and feedback system is the monitoring and evaluation of teachers' classroom teaching quality. The traditional teaching quality evaluation and feedback system model is primarily composed of school leadership, teaching management, teachers, students, administrative departments, and units that select and employ individuals, such as outside experts, as the main body. Teachers need to manage and monitor the teaching process and evaluate the teaching objectives. Then, the evaluation results are evaluated after feedback analysis, as shown in Figures 3 and 4.

2.3. Analysis Principles and Methods.

Data analysis classroom teaching quality evaluation is an effective teaching means, in the classroom, which can effectively increase students' enthusiasm for learning and teachers' level of classroom teaching quality. The investigation of classroom teaching quality assessment and feedback system based on data analysis can make a deep analysis of the evaluation results, find the problems in the evaluation results more deeply, provide a good basis for the assessment of teachers' teaching abilities, and provide long-term guidance for teachers' self-improvement of teaching level.

2.3.1. Principal Component Analysis.

(1) Principle of principal component analysis. Principal component analysis is a statistical analysis technique that reduces a large number of indicators to a small number of indicators [17]. Principal component analysis can shed light on the large number of elements in the original data by using fewer unrelated variables.

(2) Principal component analysis algorithm flow. For principal component analysis, there are m index variables: x_1, $x_2, \ldots, x_m$ are a total of n comprised objects. The JTH index of the I evaluation object is x_{ij}, and all indexes x_{ij} are transformed into standardized indexes $\tilde{x}_{ij}$.
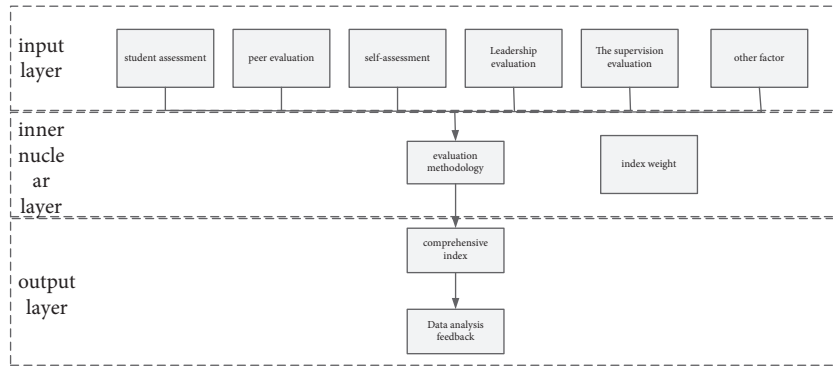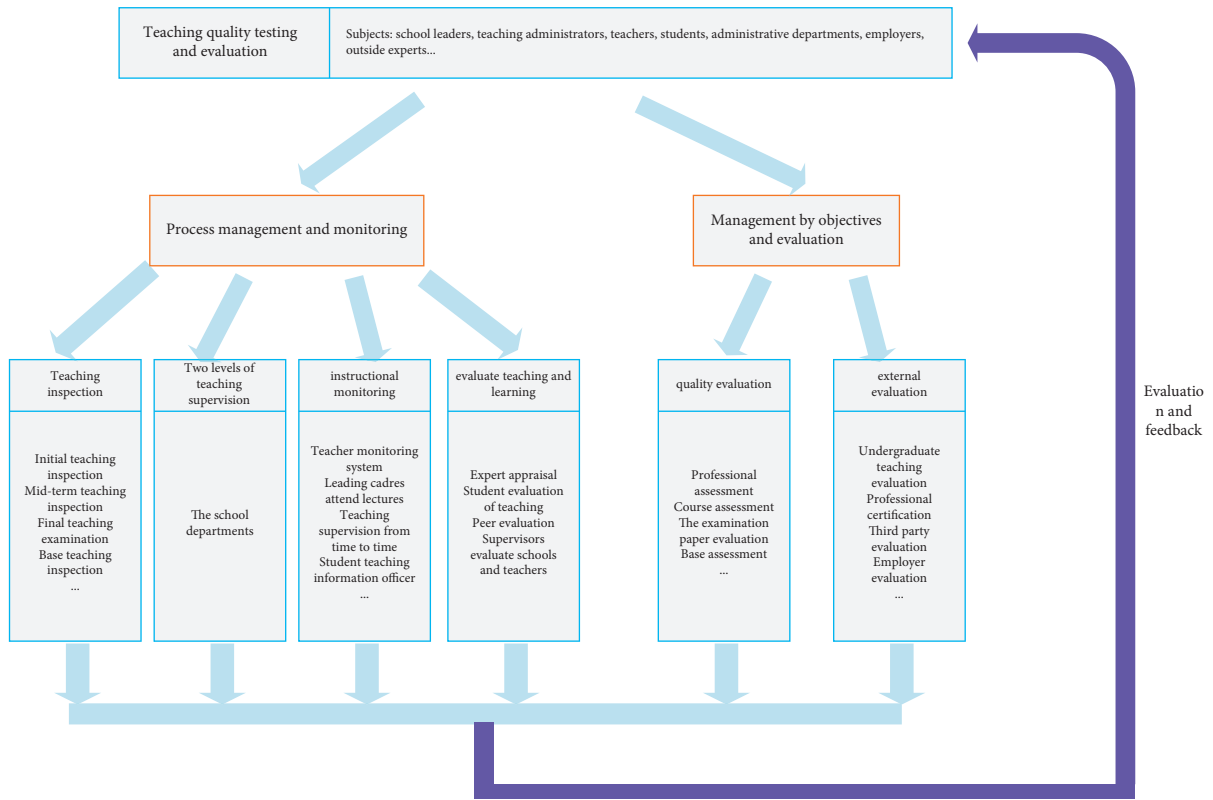
Figure 2: Big data analysis model framework.

Figure 3: Traditional teaching quality evaluation feedback system.

$$\widetilde{x}_{ij} = \frac{x_{ij} - \widetilde{x}_{ij}}{s_j} \quad (i = 1, 2, \ldots, n, j = 1, 2, \ldots, m). \tag{1}$$

$$\widetilde{x}_j = \frac{1}{n} \sum_{i=1}^{n} x_{ij}. \tag{2}$$

$$s_j = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} \left(x_{ij} - \widetilde{x}_j \right)^2} \quad (j = 1, 2, \ldots, m). \tag{3}$$

And $\widetilde{x}_j$, s_j are the sample mean and standard deviation of the ith indicator, which are called according to them

$$\widetilde{x}_i = \frac{x_i - \widetilde{x}_i}{s_i} \quad (i = 1, 2, \ldots, m). \tag{4}$$

It is standardized index variable.
Matrix of correlation coefficients

$$R = \left(r_{ij} \right)_{m \times m}. \tag{5}$$

$$r_{ij} = \frac{\sum_{i=1}^{n} \widetilde{x}_{kj} \widetilde{x}_{ki}}{n-1}, \tag{6}$$

where $r_{ii} = 1$, $r_{ij} = y_{ji}$, r_{ij} is the correlation coefficient between the ith and jth indices.
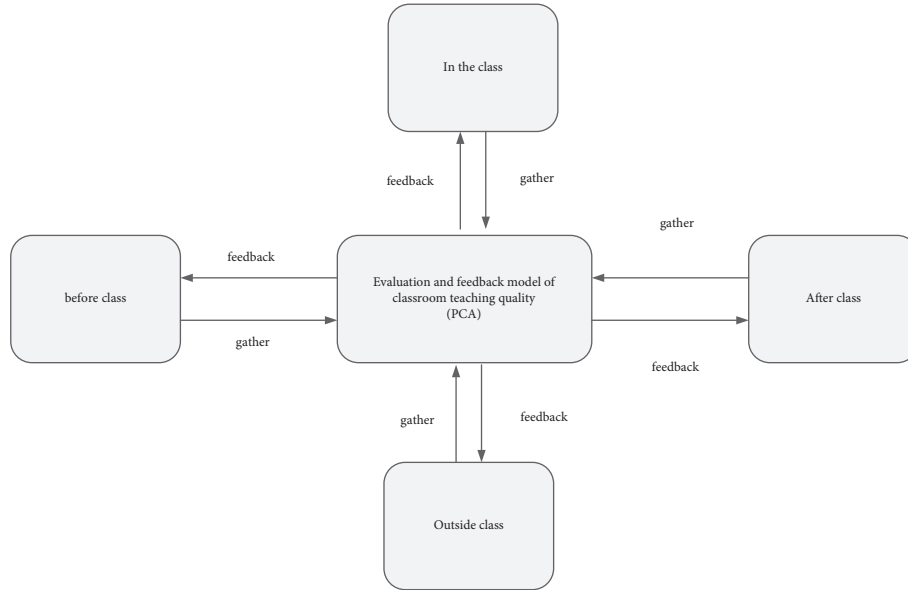
FIGURE 4: Evaluation feedback model.

Determine the eigenvalues [18] and eigenvectors.

The eigenvalues are sorted from largest to smallest.

Determine the correlation coefficient's eigenvalue matrix $\lambda_1 \geq \lambda_2 \geq \lambda_3 \ldots \geq \lambda_m \geq 0$, and corresponding characteristic vectors $\mu_1, \mu_2, \ldots, \mu_m$, where

$\mu_j = (\mu_{1j}, \mu_{2j}, \ldots, \mu_{nj})^T$ feature vectors are used to create new index variables.

$$\begin{cases} y_1 = \mu_{11}\widetilde{x}_1 + \mu_{21}\widetilde{x}_2 + \ldots + \mu_{n1}\widetilde{x}_n \\ y_2 = \mu_{12}\widetilde{x}_1 + \mu_{22}\widetilde{x}_2 + \ldots + \mu_{n2}\widetilde{x}_n, \\ \ldots\ldots \end{cases} \quad (7)$$

where y_1 is the first principal component in the formula, y_2 is the second principal component, and $y\ m$ is the MTH principal component.

$P(P \leq M)$ principal components were selected to calculate the comprehensive evaluation value.

I calculate the eigenvalue λ_j ($j = 1, 2, \ldots, M$) rate of information contribution and accumulation contribution rate, according to

$$b_j = \frac{\lambda_j}{\sum_{k=1}^{m} \lambda_k}, j = 1, 2, \ldots, m. \quad (8)$$

The main component's information contribution rate y_j:

$$\alpha_p = \frac{\sum_{k=1}^{p} \lambda_k}{\sum_{k=1}^{m} \lambda_k}. \quad (9)$$

Main components are $Y\_1, Y\_2, \ldots$ When α_P is close to 1 ($\alpha\_P = 0.85, 0.90, 0.05$), the first P index variables $y_1, y_2, \ldots, y_p$ as P principal components are used instead of the original M index variables, allowing for a more comprehensive analysis of p principal components.

Ii calculate the overall score

$$Z = \sum_{j=1}^{P} b_j y_j, \quad (10)$$

where b_j is the information contribution rate of the JTH principal component as measured by the comprehensive score value.

(3) Process of principal component analysis method: it is shown in Figure 5.

(a) Selection principle of evaluation indexes for analysis of the principal components: in the evaluation of classroom teaching quality, the selection of evaluation indicators is very important. To some extent, evaluation quality has nothing to do with the number of evaluation indicators but is primarily related to the role of evaluation indicators in the evaluation process. The main indicators are the indicators which thus play a decisive role in the evaluation process. The level of evaluation quality has nothing to do with the evaluation quality and the number of evaluation indexes, but only with the proportion of evaluation indexes in the evaluation system. Therefore, the principle of evaluation indicators is particularly important. The common selection methods of evaluation indicators are as follows.

(4) Least variance method: N objects to be evaluated are usually selected in the evaluation process: $Y_1, Y_2, \ldots, Y_n$, where each object has m evaluation indexes represented by X_{ij} ($I = 1, 2, \ldots, n$ and $J = 1, 2, \ldots, M$); assuming that the evaluation index values all fluctuate within a certain range, when the impact of an evaluation index on the evaluation result is small enough, we can exclude these evaluation indexes and optimize and screen the index system through the principle of least variance [19]:

$$Y_j = \left(\frac{1}{n} \sum_{j=1}^{m} \left(X_{ij} - \overline{X}_j \right)^2 \right)^{1/2} \quad j = 1, 2, \ldots, m. \quad (11)$$
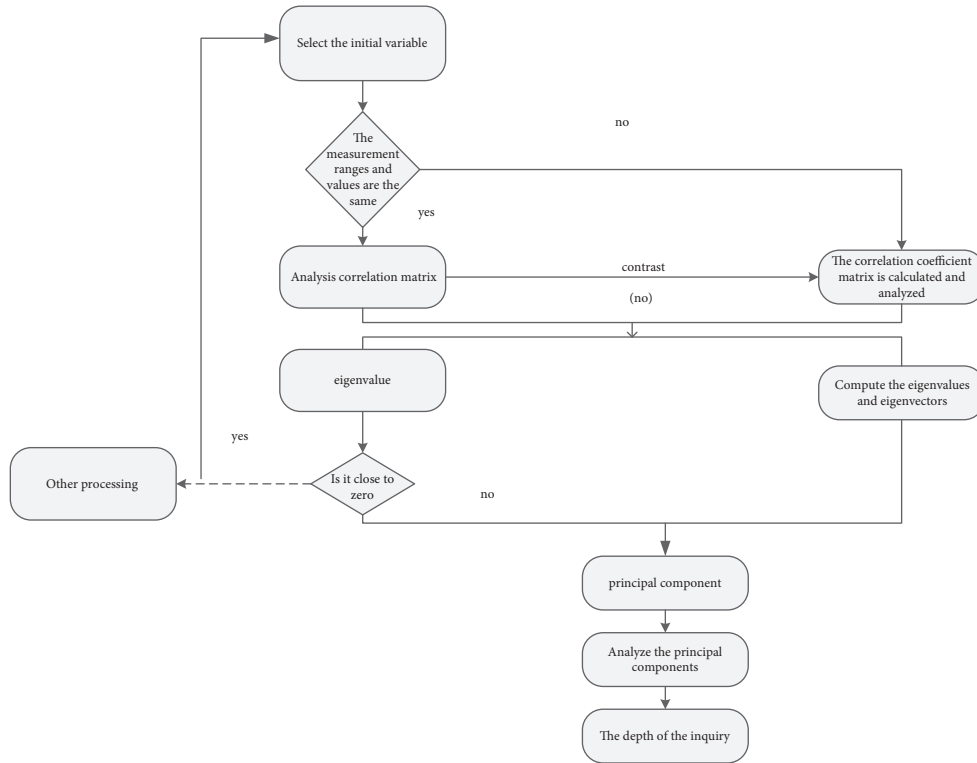
FIGURE 5: Flowchart of principal component analysis.

It is the sample mean square error of n evaluation objects:

$$\overline{X}_j = \frac{1}{n} \sum_{j=1}^{m} X_{ij} \quad j = 1, 2, \ldots, m. \tag{12}$$

It is the sample mean obtained at the end.

Suppose there is l_0 $(1 \le l_0 \le m)$, such that

$$Y_{l_0} = \min_{1 \le j \le m} \{Y_j\}. \tag{13}$$

When $Y_{l_0} \approx 0$, the corresponding $X\_(l\_0)$ of $Y\_(l\_0)$ can be deleted.

(5) Minimax deviation method: for evaluation objects, the maximum distance X_j of evaluation index S_j is solved one by one:

$$S_j = \max_{1 \le j, l \le n} \left\{ \left| X_{ij} - x_{lj} \right| \right\}. \tag{14}$$

Find the minimum value of S_j and S_0:

$$S_0 = \min_{1 \le j \le n} \{S_j\}, \tag{15}$$

and when $S_0 \longrightarrow 0$, the corresponding evaluation index of S_0 can be deleted [20].

(b) Problems of analysis of the principal components: yhe original principal components data cannot truthfully reflect the actual problems. In the comprehensive evaluation of various influencing factors, information overlap often exists and the main characteristics cannot be determined. The contribution rate of the first principal component is often not prominent, leading to the lack of comparability and objective correlation among the selected indicators. Therefore, it is difficult for principal component analysis to obtain correct evaluation results.

3. Improve Lecture Quality Evaluation and Feedback System Based on Data Analysis

3.1. Improvement of Analysis Methods. By using principal component analysis (PCA) to assess classroom teaching quality, the original data is first processed using the original PCA model. When the difference of index information of original data is small and the distinction is not obvious, the effect of dimension reduction in analysis is not obvious. Therefore, we improved the principal component analysis method, transformed the original index into an optimized index, and carried out mean processing at the same time, so as to achieve the effect of will. Index optimization was carried out through cosquare difference matrix [21].

3.1.1. Processing of Original Data. According to the original data model of principal component analysis, there are known m evaluation indexes and N evaluation objects.

Among them,

$$\overline{x} = \frac{1}{m} \sum_{k=1}^{m} x_i. \tag{16}$$

It is the mean value of the original index:

$$V = \frac{1}{m-1} \sum_{k=1}^{m} (x_i - \overline{x}_i)(x_j - \overline{x}_j). \tag{17}$$

It is the covariance of the original index:

$$\omega_{ij} = \lambda_{ij} \frac{v_{ij}}{\sum_{i=1}^{m} v_i} + (1 - t\lambda_{ij}) \frac{g_i}{\sum_{i=1}^{m} g_i}, \ (i = 1, 2, \ldots, n; j = 1, 2, \ldots, m). \tag{18}$$

It is the inertia coefficient corresponding to the original index.

$\omega\_1 \, x\_1, \ \omega\_2 \, x\_2 \ldots \omega\_m \, X\_M$ is the first-level optimization index, where

$$x = 1mk = 1m\omega kxk,$$

$$\tilde{x} = \frac{1}{m} \sum_{k=1}^{m} \omega_k x_k. \tag{19}$$

It ss the first-order optimized mean value.

$$\overline{V} = \frac{1}{m-1} \sum_{k=1}^{m} (\omega_{ki} x_i - \tilde{x}_i)(\omega_{kj} x_j - \tilde{x}_j). \tag{20}$$

It is the first-order optimization covariance.

$y\_1, \ y\_2 \ldots Y\_m$ is the second-level optimization index, where

$$\tilde{V} = \frac{1}{m-1} \sum_{k=1}^{m} (y_{ki} - \overline{y}_i)(y_{kj} - \overline{y}_j) = \frac{1}{\tilde{x}_i \tilde{x}_j} \overline{V}. \tag{21}$$

It is the second-level optimization index covariance [22].

3.1.2. Data Analysis.

The covariance matrix of the evaluation index matrix is obtained

$$\tilde{V} = \frac{1}{m-1} \sum_{k=1}^{m} (y_{li} - \overline{y}_i)(y_{lj} - \overline{y}_j). \tag{22}$$

The principal component expression $Z = UY$ is obtained, and the corresponding eigenvector matrix is

$$U = \begin{bmatrix} u_1' \\ \ldots \\ u_m' \end{bmatrix} = \begin{bmatrix} u_{11} & \ldots & u_{1m} \\ \ldots & \ldots & \ldots \\ u_{m1} & \ldots & u_{mm} \end{bmatrix}. \tag{23}$$

The variance contribution α and cumulative variance contribution β were calculated

$$\alpha = \frac{\lambda_i}{\sum_{i=1}^{m} \lambda_i}. \tag{24}$$

$$\beta = \frac{\sum_{i=1}^{p} \lambda_i}{\sum_{i=1}^{m} \lambda_i} \quad p < m. \tag{25}$$

The number of principal components P was selected according to the principle of $\beta \geq 85\%$ [23].

Calculate the principal component factor load matrix.

$$\begin{cases} z_1 = \mu_{11} \tilde{x}_1 + \mu_{21} \tilde{x}_2 + \ldots + \mu_{m1} \tilde{x}_m \\ z_2 = \mu_{12} \tilde{x}_1 + \mu_{22} \tilde{x}_2 + \ldots + \mu_{m2} \tilde{x}_m . \\ \qquad \ldots \ldots \end{cases} \tag{26}$$

Construct comprehensive evaluation function

$$F = \alpha Z = \alpha_1 z_1 + \alpha_2 z_2 + \ldots + \alpha_p z_p. \tag{27}$$

Principal component analysis method was improved, which can solve the problem of the first principal component contribution rate that is not up to standard, increasing the contribution of the very first primary component. The feature extraction (pca) was improved, and the cumulative contribution of the index of the first component is more outstanding, reduces the dimension of evaluation index, and improves the efficiency of the principal component analysis method.

3.2. Improved Teaching Quality Evaluation Feedback System.
It is shown in Figure 6.

4. Practical Application of Principal Component Analysis

4.1. Evaluation Index System of Classroom Teaching Quality.
It is shown in Table 1.

4.2. Data Collection.
The teaching quality evaluation adopts the method of online teaching evaluation. After the teacher completes the teaching plan, the educational affairs department issues the teaching performance assessment form to each student's educational administration system, and the student logs in the teaching system to evaluate teaching. The evaluation index is divided into four grades: excellent, good, pass, and fail (9.5 for excellent, 7.5 for good, 6.0 for pass, and 4.0 for fail). The average score is calculated according to the score assigned by the students. In order to improve the rationality of the score, all votes filled in with the same score are invalid. For teachers t01-T02, the party's indicators are summarized in Table 2.

4.3. Evaluation and Analysis of Classroom Teaching Quality Indicators.
The original principal component analysis method was used to extract the characteristics of the indicators to find out the main factors affecting the evaluation indicators. The cluster analysis method was being used. This experiment processed the indicator data obtained in Table 2 and calculated the eigenvalues, the evaluation indicators' variability contribution rate, and combined contribution rate. The data obtained are shown in Table 3.

The characteristics of indicators were harvested using mean - mean principal component analysis (PCA). In this experiment, the principal component analysis (PCA) method was used to process the index data obtained in Table 1 and calculate the feature vector, variance
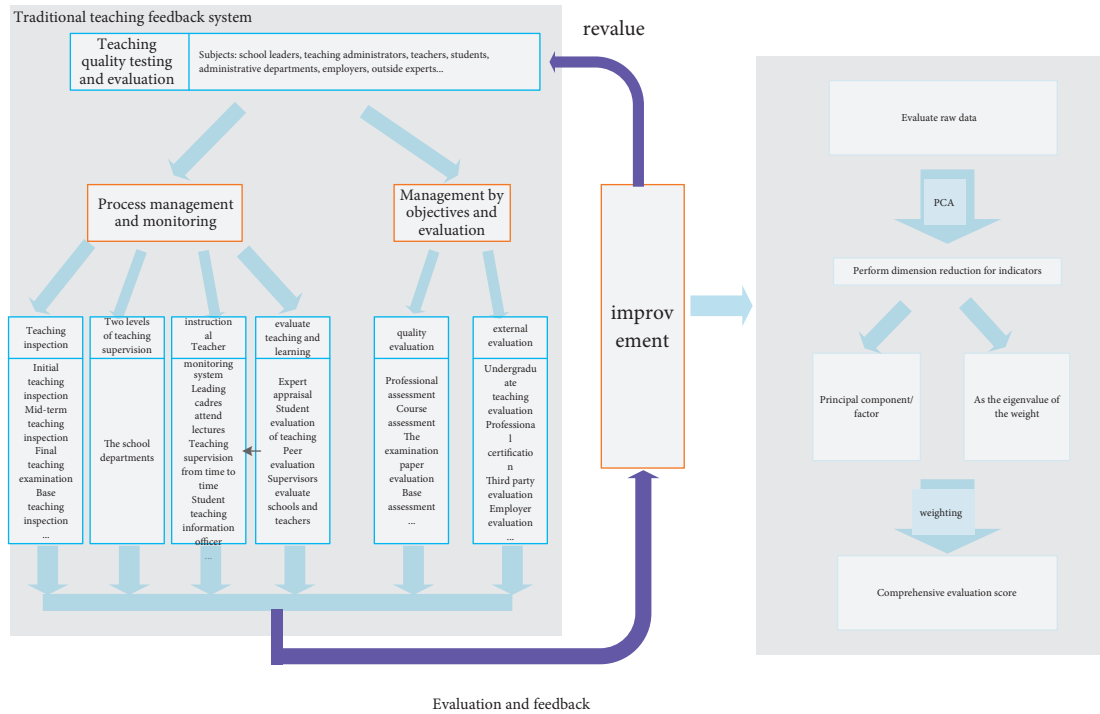
Figure 6: The improved classroom teaching quality evaluation system.

Table 1: Evaluation index system of classroom teaching quality.

General objective	Level indicators	The secondary indicators
Improve teaching quality	Teaching attitude	Rigorous teaching attitude, as a model, compliance with discipline and punctuality, care for and strict requirements of students, listening to students' suggestions and opinions modestly. A1
		Teaching enthusiasm, teaching earnest, devotion, demonstration guidance standard, tour guidance patient, and meticulous. A2
	Teaching content and organization	Sufficient preparation before practice can ensure that the experimental equipment and instruments are in good condition, the equipment and components are fully prepared, the practice teaching site is clean, and there are no factors affecting the teaching in the room. A3
		Rich knowledge, concrete and substantial practice content, reasonable personnel allocation. A4
		Be able to combine theory with practice and integrate with advanced technology and technology. A5
	Teaching method	Attach importance to classroom discipline, students experiment, and practice operation in order, without experimental accidents. A6
		Standard blackboard writing, clear; the language is fluent, concise, clear, and vivid. A7
		Emphasize operation essentials, operation rules, and precautions before operation and demonstrate correct and skilled operation. A8
		Teaching and practice time allocation is reasonable and can timely troubleshoot and answer questions accurately. A9
		Teaching method is reasonable, enlightening, and inducing, step by step, teaching according to their aptitude can fully mobilize the initiative of students, pay attention to the training of students' operational ability, and encourage creative practice. A10
	Teaching efficiency	Students can master the contents of lectures and the operation methods and actions of practical projects
		Technical specifications and requirements can be completed independently. A11
		The students showed great interest in the course and learned a lot from the teacher
		The professional knowledge, operation skills, and many truths of life, teachers, and students harmonious relationship. A12

Table 2: Teacher classroom teaching quality subindex data table.

Index items	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	T13	T14	T15
Index1	8.85	8.45	7.1	8.15	8.95	7.75	8.18	9.2	8.4	8.2	6.98	9.25	9.05	8.1	8.65
Index2	8.82	8.4	7.05	8.2	9.05	7.85	8.15	9.2	8.3	8.25	7.1	9.2	9.1	8.08	8.65
Index3	8.6	8.3	6.96	8.03	8.6	6.9	8.85	9.5	8.25	7.2	7.06	8.5	8.07	8.3	8.6
Index4	9.1	8.5	7.45	7.71	8.6	6.75	8.5	8.7	8.8	7.5	7.77	8.5	7.95	7.7	8.05
Index5	8.6	9	7.25	7.55	8.3	6.88	7.83	7.95	8.1	7.35	7.41	9.1	7.93	8.1	8.3
Index6	9	8.7	6.85	7.95	8.1	7.25	8.83	9.5	8.25	7.1	6.71	8.1	8.5	7.7	8.7
Index7	9.05	7.65	7.16	7.61	8.8	6.65	8.5	8.3	8.2	7.5	7.29	8.3	8.66	8.1	8.43
index8	9.1	8.6	6.95	8.03	8.5	7.5	7.83	8.54	8.08	7.33	7.17	8.26	8.6	7.7	8.57
Index9	9.2	8.3	6.89	7.61	8.5	6.68	9.17	9.5	8.79	7	6.82	8.5	8.68	8.3	8.43
Index10	9.25	8.4	7	8.34	9.1	6.88	8.17	9.5	8.5	7.6	7.65	8.45	8.95	8.5	8.45
Index11	8.9	8.7	6.75	7.82	8.4	7.15	9.17	8.7	8.35	7.05	6.71	8.3	7.98	8.3	8.58
Index12	8.8	8.65	6.9	7.9	8.25	7.06	9.08	8.78	8.2	6.98	6.89	8.35	7.9	7.65	8.6

Table 3: Original principal component analysis.

Principal component number	Characteristic value	Contribution rate (%)	Cumulative contribution rate (%)
1	9.7663	81.3854	81.3854
2	0.8029	6.691	88.0765
3	0.4977	4.1474	92.2239
4	0.3906	3.2548	95.4787
5	0.2254	1.878	97.4787
6	0.189	1.5747	98.9314
7	0.053	0.4419	99.3733
8	0.0425	0.3538	99.7271
9	0.0228	0.1901	99.9172
10	0.0077	0.0641	99.9813
11	0.0014	0.0114	99.9926
12	0.0009	0.0074	100

Table 4: Averaging principal component analysis method.

Principal component number	Characteristic value	Contribution rate (%)	Cumulative contribution rate (%)
1	8.4675	79.3932	82.7765
2	0.7638	7.4178	90.1943
3	0.3795	4.2844	94.4787
4	0.3602	2.0042	96.4829
5	0.1883	1.4203	97.9032
6	0.0945	1.2859	99.1891
7	0.024	0.3698	99.5589
8	0.0278	0.2986	99.8575
9	0.0119	0.0875	99.945
10	0.0039	0.0398	99.9848
11	0.0013	0.0113	99.9961
12	0.0005	0.0039	100

Table 5: Principal component analysis has now been improved.

Principal component number	Characteristic value	Contribution rate (%)	Cumulative contribution rate (%)
1	7.1398	78.9847	83.1915
2	0.6894	8.1453	91.3366
3	0.5894	3.5098	94.8486
4	0.2947	2.1298	96.9762
5	0.1148	1.3639	98.3401
6	0.0381	1.0371	99.3772
7	0.0251	0.2987	99.6759
8	0.0198	0.1984	99.8743
9	0.0101	0.0839	99.9582
10	0.0029	0.0289	99.9871
1	7.1398	78.9847	83.1915
2	0.6894	8.1453	91.3366

Table 6: Comparison of three principal component analysis results.

	Original principal component analysis			Mean value principal component analysis			Improved principal component analysis		
	Characteristic value	Contribution rate (%)	Cumulative contribution (%)	Characteristic value	Contribution rate (%)	Cumulative contribution (%)	Characteristic value	Contribution rate (%)	Cumulative contribution (%)
1	9.7663	81.3854	81.3854	8.4675	79.3932	82.7765	7.1398	78.9847	83.1915
2	0.8029	6.691	88.0765	0.7638	7.4178	90.1943	0.6894	8.1453	91.3366
3	0.4977	4.1474	92.2239	0.3795	4.2844	94.4787	0.5894	3.5098	94.8486
4	0.3906	3.2548	95.4787	0.3602	2.0042	96.4829	0.2947	2.1298	96.9762
5	0.2254	1.878	97.4787	0.1883	1.4203	97.9032	0.1148	1.3639	98.3401
6	0.189	1.5747	98.9314	0.0945	1.2859	99.1891	0.0381	1.0371	99.3772
7	0.053	0.4419	99.3733	0.024	0.3698	99.5589	0.0251	0.2987	99.6759
8	0.0425	0.3538	99.7271	0.0278	0.2986	99.8575	0.0198	0.1984	99.8743
9	0.0228	0.1901	99.9172	0.0119	0.0875	99.945	0.0101	0.0839	99.9582
10	0.0077	0.0641	99.9813	0.0039	0.0398	99.9848	0.0029	0.0289	99.9871
11	0.0014	0.0114	99.9926	0.0013	0.0113	99.9961	0.0009	0.0108	99.9979
12	0.0009	0.0074	100	0.0005	0.0039	100	0.0002	0.0021	100

contribution rate, and cumulative value of the evaluation index. The calculated data are shown in Table 4.

For improvements based on principal component analysis method, to calculate the main factors affecting the evaluation index and the dimension of principal component analysis (PCA) in Table 2 and for standardizing, first calculate the correlation coefficient matrix, and then calculate the characteristic value of evaluation indexes, the variance contribution rate, and cumulative contribution rate, and calculate the obtained data shown in Table 5.

Three kinds of analysis of the principal components were carried out to compare the evaluation index system, and the analysis results were obtained, as shown in Table 6.

As shown in Table 5, there are three kinds in the data analysis of classroom teaching quality evaluation index. From the improved cluster analysis, we can clearly see that the average value of the improved cluster analysis method is compared with that of the principal component analysis method. Using the improved principal component analysis method, the contribution rate of the first component has been improved to a certain extent, which shows that the greater the role of the first component evaluation index, the more accurate the evaluation results. Using the improved principal component analysis method can make the cumulative contribution rate of the first component index more prominent, reduce the dimension of evaluation index, and improve the efficiency of principal component analysis method. As shown in Figure 7 and 8, the statistical charts obtained by the three principal component analysis methods show that the improved component analysis has obvious construction effect.

Variance contribution rate is an indicator to measure the relative importance of each factor. In statistics, it is generally believed that as long as the cumulative contribution rate of principal component analysis reaches over 85%, a small number of principal components can be used to replace the vast majority of information of multiple indicators. As can be seen from Table 6 above, no matter using the original principal component analysis method, averaging principal component analysis method, or the improved principal component analysis method, the accumulative contribution rate of the first two principal components of the improved principal component analysis method reaches more than 85%, and the cumulative total payment of the improved cluster analysis method's first two important components was 91.3366 percent. It clearly shows that the improved correlation-based method is representative and remarkable.

Figure 9 represents the cumulative contribution rate of the original cluster analysis method's first two principal components. The cumulative contribution rate of the first two principal components of the meaning-based cluster analysis method is represented by B, and the cumulative contribution rate of the first two principal components of the improved cluster analysis method is represented by C. It is not difficult to see that the accumulative contribution rate of the first two terms has increased significantly after the original principal component analysis is improved by means.
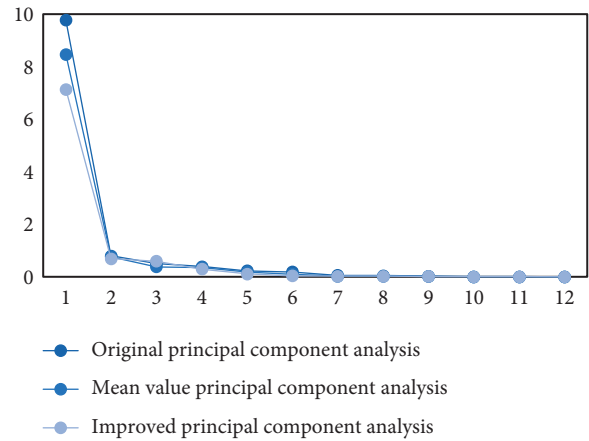

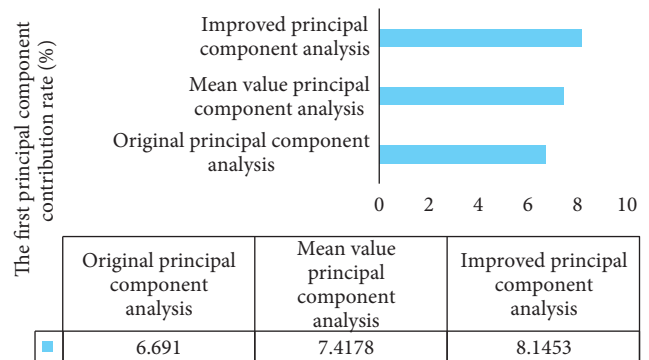FIGURE 7: Statistical chart of three principal component analysis methods.

FIGURE 8: The first principal component contribution ratio comparison.
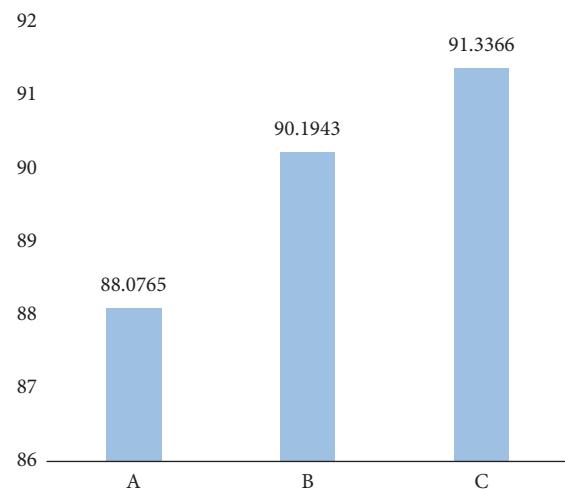

FIGURE 9: The cumulative contribution rates of the two principal components.

The load matrix calculation of each principal component is shown in Table 7 below. The first principal component is all positive load, indicating that the changes of each index of the first principal component have similar influence on the score. In the second principal component, only indicators

TABLE 7: Table of principal component load matrix.

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
IndexA1	0.2828	0.4577	−0.2464	−0.005	0.1547	0.2424	−0.0522	−0.0522	0.0765	0.1134	−0.4096	−0.5644
IndexA2	0.2752	0.5062	−0.2788	−0.0587	0.144	0.1976	0.1452	0.1136	−0.1482	0.0297	0.2937	0.6197
IndexA3	0.2988	−0.2164	−0.1901	−0.215	−0.133	0.431	−0.3422	0.3384	0.3314	−0.4591	0.1209	−0.1063
IndexA4	0.2765	−0.2664	0.516	−0.2089	−0.1734	0.3189	0.6187	0.0906	−0.0549	0.0684	−0.0569	0.0948
IndexA5	0.2567	0.27	0.5547	0.5715	−0.0334	0.2213	−0.3502	−0.1307	0.1147	0.0521	0.1425	−0.0302
IndexA6	0.2949	−0.2688	−0.3456	0.1228	−0.2613	−0.0638	0.0945	−0.3126	0.4394	0.507	0.2775	−0.0302
IndexA7	0.2846	0.0627	0.2997	−0.3653	0.5387	−0.4533	−0.0732	0.1421	0.3907	0.0926	0.0942	−0.0226
IndexA8	0.2921	0.215	−0.0117	0.1648	−0.4899	−0.5646	0.2188	0.0542	0.0922	−0.461	−0.099	0.0288
IndexA9	0.3074	−0.1912	−0.0327	−0.1321	0.2399	0.0327	−0.0747	−0.7653	−0.2928	−0.3755	−0.0938	0.0979
IndexA10	0.2963	0.1086	0.0855	−0.4421	−0.3971	−0.1112	−0.4274	0.0204	−0.4621	0.3426	−0.0286	−0.1129
IndexA11	0.2974	−0.2717	−0.1369	0.3152	0.2647	−0.1416	0.1366	0.255	−0.4829	0.3426	0.4302	−0.3542
IndexA12	0.2977	−0.3148	−0.1224	0.3035	0.1507	−0.0636	−0.167	0.2694	−0.0638	0.1717	−0.646	0.3564

TABLE 8: Teacher scores and rankings.

Teacher's number	First principal component (F1)	Ranking	Second principal component (F2)	Ranking
T1	4.0297	1	−0.2026	8
T2	1.703	6	−0.2868	10
T3	−5.3995	15	−0.6224	13
T4	−1.0543	11	−0.025	7
T5	2.3628	3	0.7413	4
T6	−4.985	14	0.4939	5
T7	1.8302	5	−2.1412	15
T8	3.963	2	−0.4327	11
T9	1.0903	9	−0.6553	14
T10	−3.4549	12	1.0028	3
T11	−4.8487	13	−0.5002	12
T12	2.2021	4	1.2428	2
T13	1.6667	7	1.6505	1
T14	−0.7647	10	−0.2497	9
T15	1.6593	8	0.0393	6

FIGURE 10: Comparison of F1 and F2 rankings.

FIGURE 11: Comprehensive analysis of teacher rankings.
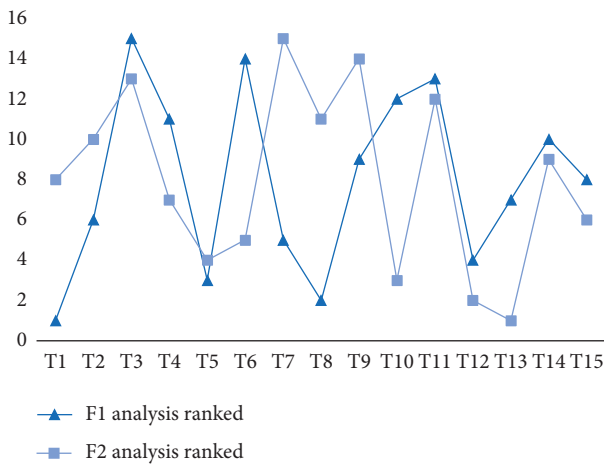
A1 and A2 have a large contribution rate, while other indicators have a small contribution rate, indicating that other components have a small impact on the score and can be ignored. According to the formula, the principal components and score rankings are calculated as shown in Table 8.

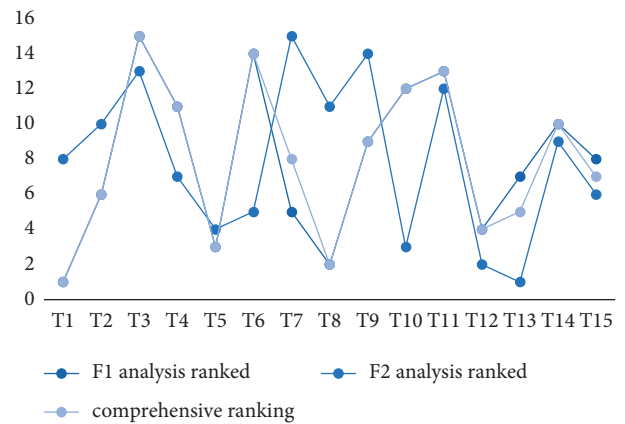For the above analysis, the score ranking of F1 and F2 has a great influence, so the improved principal component analysis method is used for analysis, as shown in Figure 10.

The improved principal component analysis method was used for comprehensive analysis to calculate the score ranking, as shown in Figure 11 and Table 9 below.

Using the improved principal component analysis to evaluate the teaching quality of teachers, the evaluation results are more correct.

TABLE 9: A comprehensive analysis calculates rankings.

Comprehensive ranking	Ranking
3.266	1
1.3668	6
−4.436	15
−0.8597	11
1.9726	3
−4.0277	14
1.3462	8
3.1964	2
0.8435	9
−2.7447	12
−3.9796	13
1.8753	4
1.4669	5
−0.6391	10
1.3531	7

5. Conclusion

In the world of big data, improving school teaching quality is a long-term and difficult task that necessitates the collaboration of teachers and students. Based on big data technology, this paper analyzes the classroom teaching quality evaluation and feedback system and analyzes the teaching quality index using the principal component analysis method, discovering that there are corresponding problems in the correlation-based method. From the above experiments, it can be seen that the use of improved principal component analysis (PCA) can effectively improve the cumulative total of the first principal component contribution rate, thereby improving the accuracy of the evaluation results. The improved principal component analysis (PCA) is used to carry out factor analysis of comprehensive evaluation index on the data, so as to obtain an effective feedback system of classroom teaching quality evaluation.

Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding this work.

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