

Research Article

New Media College Students' Education Evaluation System Based on Improved CW-CPCC Algorithm

Yu Zhang  and Xuying Sun 

Office of Academic Affairs, Cangzhou Normal University, Cangzhou 061000, Hebei Province, China

Correspondence should be addressed to Yu Zhang; zhangyu@caztc.edu.cn

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The strengthening of comprehensive quality education of college students in colleges and universities has been more and more concerned and accepted by people. The educational evaluation of college students should not only conform to the objective reality but also ensure that it is effective. However, the evaluation indicators in the current education evaluation are grayscale, qualitative, and difficult to assess. Aiming at this problem, this study proposes an improved CW-PPCC-based evaluation algorithm for college students' education, which quantifies the qualitative indicators that are difficult to measure in the form of data, using AHP and data envelopment. On the basis of big data, the correlation coefficient of product distance quantitatively evaluates the quality of undergraduate education and realizes an effective evaluation of the education quality of college students. The experimental results show that the algorithm can effectively realize the evaluation of education quality, and has high accuracy and high application value.

1. Introduction

In today's society, strengthening the comprehensive quality education of college students in colleges and universities has been paid more and more attention and accepted by people [1]. The direct object of college students' education management is students, that is, college teachers are the main evaluation subject in the process of education management [2]. They can guide students' study and life. In this increasingly competitive social atmosphere, if students want to survive and seek development, they must strive to cultivate high-quality talents and workers who meet the needs of socialist modernization in colleges and universities [3]. At the same time, colleges and universities should continue to give full play to China's huge advantages in human resources, which are related to the overall quality of the future generation. Therefore, promoting and developing the evaluation of student education management in colleges and universities are not only an effective way to comprehensively promote the development of colleges and universities in China, but also a necessary guarantee to strengthen and improve quality education in colleges and universities [4].

From the current research on educational evaluation, educational evaluation involves many contents, both qualitative and quantitative; there are single index and multi-index; and there are linear and nonlinear. Generally speaking, educational evaluation is a complex and nonlinear comprehensive evaluation problem. To solve this problem, we need to use a variety of methods. Because the existing methods cannot solve all the problems involved in educational evaluation, the purpose of this study is to explore how to apply the CW-PPCC algorithm to educational evaluation, so as to provide a convenient, feasible, and easy-to-implement computer method for educational evaluation.

The evaluation system of college students' education management refers to the process of judging the work status and objective effect of college students' education management through system information according to a certain goal [5]. It has the following characteristics: first, the evaluation system of college students' education management must be based on the established objectives. Second, the evaluation system of college students' education management is a systematic evaluation activity that is purposefully and sequentially carried out by collecting relevant authoritative

information and following strict system procedures [6]. It should not only meet the objective reality but also ensure effectiveness. This is also a driving force to promote the continuous improvement of college students' education management evaluation. Its functions are as follows [7].

First, whether the evaluation system of college students' education management is sound or not can provide feasible opinions and suggestions for people to measure the quality level of students' education management in a university and also provide standards for measurement, so as to clarify the goal of each college student in the future [8].

Second, by carrying out the evaluation of college students' education management, students can better understand the future development direction of the school and individuals, analyze the gap between themselves and others and the main reasons for these gaps, and prevent students from being content with the status quo and slack after reading the university [9].

Third, through the evaluation system, we can also make the evaluation subject realize where the advantages of the school and students are, and how to further promote the better development of the school [10]. At the same time, we can carry forward the existing advantages, correct the deficiencies, and constantly promote the further development of the education and management of college students and the comprehensive quality of students [11].

Fourth, the practical application of college students' education management evaluation can promote the school to further correct the purpose of running the school, fully mobilize the enthusiasm of the evaluation subject and the evaluated, select an example through the evaluation results, promote students to correct their bad habits, encourage students to strive for goals, and make progress in comparison and competition with other students [12].

To solve the above problems, this study proposes a CW (combined weight)-PPCC (Pearson's product-distance correlation coefficient) undergraduate education quality evaluation algorithm [13]. The index quantization algorithm based on "AHP + DEA" reasonably solves the problem that it is difficult to quantify the evaluation index. The combined weighting method based on direct weight and Euclidean distance ensures the objectivity of the evaluation index. It creatively proposes to introduce virtual variables to consider the influence degree of each evaluation index on the evaluation object and quantify this influence degree by Euclidean distance, so as to make the weight assignment of the evaluation index more accurate. Engineering examples show that the undergraduate education quality evaluation algorithm based on CW-CPCC has high accuracy and high application value [14].

2. State of the Art

According to the object, educational evaluation can be divided into several subcategories, such as student evaluation, teaching evaluation, curriculum evaluation, teacher evaluation, and so on. Among them, student evaluation is the core content of educational evaluation [15]. It is the real grasp of students' ability, behavior and state, and the value judgment on this basis [16]. It involves students' physiology,

psychology, behavior, and so on. Educational evaluation has gone through four generations so far. In this process, the evaluation thought is deepening and enriching day by day, and the evaluation technology is also in constant evolution, coexistence, and enrichment. Table 1 shows the characteristics of learning evaluation in different periods and the corresponding evaluation technology:

Wang Yunfeng, Zhang Lei, and Zhang Liang pointed out in the article "construction of the developmental evaluation system of graduate education quality" that the evaluation concept of college students' education quality lacks humanistic thought, and the evaluation of college education quality is "evaluation for evaluation," which is controlled by the superior competent department, ignoring the role and subjectivity of middle school students and colleges in it [17]. Zhang Hua and Liu Wanhai, in "several problems to be clarified in the current student evaluation" and Ma Zhicheng, in "rethinking the problems of student evaluation," both put forward the problems of a one-sided subject and a single method in the current domestic education quality evaluation [18]. Xue Eryong pointed out that students are becoming more and more important participants in the current higher education quality evaluation. However, in the actual implementation of education quality assessment, the participation of experts and teachers is much higher than that of postgraduates, and the right of students' participation is ignored to a certain extent [19]. Tan Yali pointed out that the importance of the evaluation methods of the quality of education in colleges and universities is not enough, and she also pointed out that the evaluation methods of the quality of education in colleges and universities need to be updated. From the discussion of domestic scholars, it can be seen that student evaluation has begun to occupy a certain proportion of China's graduate education quality evaluation, but there are still some problems such as a single method and a one-sided subject. Further research is needed to establish a scientific student evaluation index [20].

Big data is bound to change the thinking and concept of our times, becoming "the next frontier of innovation, competition, and productivity improvement." The outline of the 13th five-year plan for national economic and social development of the People's Republic of China clearly takes big data as a basic strategic resource, comprehensively implements the action to promote the development of big data, speeds up the sharing, opening, development, and application of data resources, and helps industrial transformation and upgrading and social governance innovation.

Schoenberg believes that big data is to obtain products, services, or insights of great value through the analysis of massive data. The characteristics of big data can be summarized as "4V," that is, large capacity, diversity, fast speed, and value. Big data has brought profound changes to education. For colleges and universities, big data has brought profound changes in the following aspects: first, the transformation of educational thinking and concepts, changing students' cognitive way of understanding the world, and understanding the world. In order to adapt to the overall changes in students' cognitive style of world outlook, educational managers need to have comprehensive overall thinking, compatible diversified thinking, and phenomenal-

TABLE 1: Characteristics and corresponding evaluation techniques of learning evaluation in different periods.

Name	Period	Evaluation essence	Feature	Evaluation technology
1 st evaluation	Late 19th century to 1930s	Test	Evaluation is to measure and test students' memory of knowledge or a certain trait	Standardized test and ability test
2 nd evaluation	1930s to 1950s	Describe	The evaluation process is to describe the degree to which the educational results are consistent with the educational objectives; the key to evaluation is to determine clear and operable behavior objectives.	Target classification technology and summative evaluation
3 rd evaluation	1950s to 1970s	Judge	Value judgment is the essence of evaluation. Evaluation is not only the description of the result according to the predetermined goal but also the predetermined goal itself; the process of evaluation is confirmed.	Goal achievement degree, goal weight, and formative evaluation
4 th evaluation	From 1970s to nowadays	Construct	Rating is essentially a psychological construction formed through negotiation; the significance of evaluation lies in service; students are also the participants and subjects of evaluation.	Qualitative evaluation technology and multivariate evaluation technology

related thinking. The second is to change the cognition of educational subjects. Educators should pay attention to all the data of all students rather than random sampling, pay attention to the hybridity of student data, weaken the accuracy, and pay attention to the correlation of student data. The third is the change of the educational object. Relying on big data collection, individuals can carry out reflective learning and game learning by quantifying self-technology so that the educated people have stronger autonomy. Fourth, significant changes have taken place in the education carrier, reflecting the characteristics of data, massive, complex, and dynamic. At the same time, the communication form of ideological and political education is increasingly showing the trend of miniaturization of the carrier, simplification of information, fine differentiation of objects, and flat structure. Fifth, major changes have taken place in educational means and methods. Using big data technology, the subjective human spiritual world can also use data for objective quantitative analysis and evaluation like the objective material world.

Aiming at this problem, this study proposes an improved CW-PPCC-based college student education evaluation algorithm, which quantitatively evaluates the quality of undergraduate education on the basis of big data by using combined weights combined with the correlation coefficient of Pixi's product distance. The main structure of the algorithm is shown in Figure 1.

3. Methodology

3.1. Quantitative Treatment of "AHP + DEA" Evaluation Index. When establishing evaluation algorithms, some indicators are often qualitative indicators, such as faculty and structure, teaching conditions and utilization, professional construction and teaching reform, and scientific research input and output. Quantitative analysis of qualitative indicators can make evaluation more objective. In this study, the subjective method AHP (analytical hierarchy process) and the objective method DEA (data envelopment analysis) are used to quantify the qualitative indicators.

3.1.1. AHP Quantitative and Qualitative Indicators. On the whole, the problems in the evaluation of the AHP model are essentially caused by the establishment of the hierarchical linear structure of the value system. If the structure of the value system itself does not have a hierarchical linear structure, but the value structure is quantified as the mathematical structure determined by the AHP model, a knot unrelated to the evaluated value will be obtained. In the evaluation practice, the construction of the evaluation index system is consistent with the element structure of the AHP model, which makes it difficult for us to find the possible problems in the premise of the evaluation with the AHP model. Starting from a fictional hypothesis, the AHP model is used to produce an "accurate" evaluation conclusion, but it results in negative effects, which is the price we pay for quantitative evaluation by using the AHP model.

The AHP method takes the decision-making level as the highest level and divides the influencing factors into multiple levels according to the inclusion relationship, and each level is divided into several levels. The influencing factors are processed step by step, the weight is determined according to the decision degree of the bottom level to the top level for the evaluation of the relative influence of the next level indicators, and the judgment matrix should be constructed and assigned with reference to the indicators of the previous level. The main steps of the analytic hierarchy process are as follows:

Step 1: We build a hierarchical model. It is generally divided into three layers: the top is the target layer, the bottom is the scheme layer, and the middle is the criterion layer or index layer.

Step 2: We construct a pairwise comparison matrix. The judgment matrix indicates the importance of the factors related to a factor at the previous level, assuming that factor A in layer a and factor B1, B2..., Bn in the next layer. A pairwise comparison matrix is established after a pairwise comparison of elements in the same layer by some scaling method.

In the pairwise comparison matrix, a_{ij} is used to represent the comparison result of the i-th factor relative to the j-th factor, then

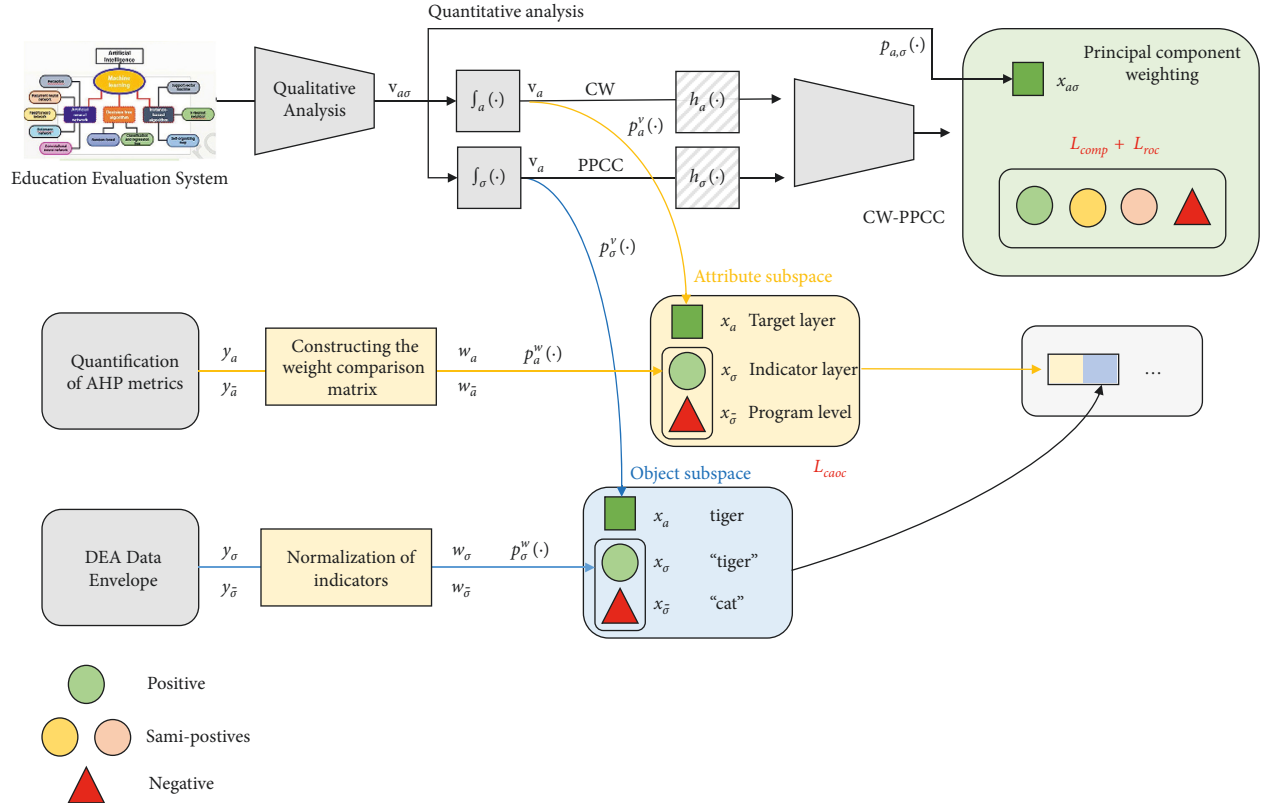


FIGURE 1: Structure diagram of the evaluation algorithm based on improved CW-PPCC.

$$a_{ij} = \frac{1}{a_{ji}}. \quad (1)$$

The pairwise comparison matrix is as follows:

$$A = (a_{ij})_{n \times n} = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{bmatrix}. \quad (2)$$

Step 3: A single-level sorting (the weight vector calculated) hierarchical single ranking refers to calculating the weight of the important order of the factors related to the previous level according to the judgment matrix. It can be reduced to solving the maximum eigenvalue of the matrix and the corresponding eigenvector. According to the properties of the matrix, the calculation satisfies the following formula, from which the eigenvector corresponding to the maximum eigenvalue of a can be solved.

$$AW = \lambda_{\max} W. \quad (3)$$

Among them, λ_{\max} is the largest characteristic root of matrix A; W is corresponding to the normalized eigenvector of λ_{\max} ; the component W_i of W is the weight of a single ranking of corresponding factors.

$$W_i = \frac{1}{n} \sum_{j=1}^n \frac{a_{ij}}{\sum_{k=1}^n a_{kj}}. \quad (4)$$

Step 4: We calculate the consistency index CI.

$$CI = \frac{\lambda_{\max} - n}{n - 1}. \quad (5)$$

The corresponding average random consistency index RI (random index) is determined by looking up the table: RI = 0.89.

The consistency ratio Cr (consistency ratio) is calculated as follows:

$$CR = \frac{CI}{RI}. \quad (6)$$

Through calculation, $Cr < 0.1$, it is considered that the consistency of the judgment matrix is acceptable. At this time, it is a consistent matrix, λ_{\max} . The corresponding eigenvector is the weight vector.

Therefore, the indicators that are not easy to quantify in undergraduate education, such as "teaching staff and structure," "teaching conditions and utilization," and "specialty construction and teaching reform," can get the specific data that are easy to operate through this method.

In the AHP method, there are two solutions to ensure the consistency of the contrast matrix.

First is the mathematical check method. According to various schemes put forward by experts, the established inconsistent contrast matrix is adjusted to the consistent contrast matrix in the mathematical sense, which is used as the basis for evaluation.

Second is the expert check method. First, we adjust the inconsistent comparison matrix to the consistency comparison matrix by mathematical method, then invite experts to judge the obtained consistency comparison matrix, and finally determine the consistency comparison matrix for actual evaluation according to the opinions of evaluation experts.

3.1.2. Analysis of BCC Algorithm in DEA Method. The DEA method can be used to quantify the indicators with more relative considerations, such as “science and technology input and output.” There are two basic models of the DEA method: the CCR model and the BCC model. The calculation efficiency of the CCR model is the value of overall technical efficiency. The computational efficiency of the BBC algorithm is the value of pure technical efficiency. Scale efficiency is obtained by dividing the two.

$$\begin{aligned} \text{Scale efficiency} &= \frac{\text{overall technical efficiency}}{\text{pure technical efficiency}} \\ &= \frac{\text{CCR efficiency}}{\text{BBC efficiency}} \end{aligned} \quad (7)$$

When the scale efficiency is 1, the scale return of the university remains unchanged. When the scale efficiency is less than 1, there is a difference between increasing or decreasing returns to scale. We use maxdea6 software for analysis, import the data into the model, and get the efficiency value result.

3.2. “Direct Weight Assignment Method + Euclidean Distance Method” Comprehensive Evaluation Algorithm. The direct weight method can judge the influence degree of the index on the object through the fluctuation of information. By selecting this model, this study can objectively evaluate the influence degree of each index on the quality of education. In the later stage, the weight obtained by the direct weight method is reasonably modified through Euclidean distance to make the result more accurate.

3.2.1. Establishment of Model by Direct Weight Assignment Method. The direct weight method is based on the variation degree of influence factors, obtains the direct weight of each influence factor through information direct, and then obtains the weight of each influence factor. The direct weight method is the most objective method in the evaluation index weighting method. The process is as follows:

Step 1: We build matrix $X = (x_{ij})_{m \times n}$ which is the original data of the quantized sample, c is the evaluation object set, and y is the evaluation index set.

Step 2: Dimensionless Processing. Due to the differences in measurement units and orders of magnitude between the collected data of various indicators, there is incommensurability. In order to eliminate the influence of different dimensions, the data need to be dimensionless. In this study, the maximum-minimum

method is used for processing, and the formula is as follows:

$$y_i = \frac{x_j - \min_{1 \leq j \leq n} \{x_j\}}{\min_{1 \leq j \leq n} \{x_j\} - \max_{1 \leq j \leq n} \{x_j\}} \quad (8)$$

Among them, $y_i = (x_{ij})_{1 \times n}, j = 1, 2, \dots, n$, after standardization, and each element in these row vectors belongs to $[0,1]$.

Thus, we could get

$$\begin{aligned} X' &= (x'_{ij})_{m \times n} \\ &= (y_1, y_2, y_3, \dots, y_m)_{m \times n} \end{aligned} \quad (9)$$

Elements in X' after standardization x'_{ij} . The specific gravity of is as follows:

$$P_{ij} = \frac{x'_{ij}}{\sum_{j=1}^n x'_{ij}} \quad (10)$$

Step 3: It is the calculation of information entropy of each evaluation index calculation formula of known information entropy 2.

$$E_i = -\ln (n)^{-1} \sum_{i=1}^n p_{ij} \ln p_{ij} \quad (11)$$

Information entropy is a measure of disorder degree. The greater the value of information entropy E_i , the higher the disorder degree of information X_i , and the greater the utility value of information, that is, the greater the influence of the evaluation index on the evaluation object. In particular, when $P_{ij} = 0$, $\lim P_{ij} \ln P_{ij} = 0$ is defined.

Step 4: It is the calculation of the weight of each evaluation index. The calculation formula of the weight of each evaluation index is known as follows:

$$W_i = \frac{1 - E_i}{\sum_{i=1}^k (1 - E_i)} \quad (12)$$

where $I = 1, 2, \dots, K$.

Thus, the weight of each evaluation index on the quality of the evaluation object is obtained, and then, the evaluation index QJ of the j-th evaluation object can be calculated as follows:

$$Q_j = \sum_{i=1}^k W_i x'_{ij} \quad (13)$$

So far, the evaluation index is weighted by the direct value weighting method, and the evaluation index model of the evaluation object is established.

3.3. Dummy Variable + Euclidean Distance Model

- (1) In order to ensure the convergence of the algorithm, the learning rate n must be less than an upper limit,

which determines that the convergence speed of the algorithm cannot be fast, and the closer it is to the minimum, the slower the convergence speed of the algorithm will be due to the gradient change value gradually tending to zero.

- (2) The algorithm cannot guarantee that the learning result will converge to the global minimum of the global sum of squares error E . Because the algorithm adopts the gradient descent method, the training is to gradually reach the minimum value of the error along the slope of the error function from a certain starting point. The solution space of practical problems is often an extremely complex multidimensional surface, and there are many local minima, which greatly increases the possibility of falling into local minima. This makes the selection of the initial value of the weight have a great impact on the network learning results. It is difficult to achieve the global best through the training of the randomly set initial weight.
- (3) There is no unified theoretical guidance for the selection of network hidden layers and hidden layer nodes, but it is often determined according to experience. Therefore, the network often has great redundancy, which virtually increases the time of network learning.

3.3.1. Insert Dummy Variable. In order to reflect the influence of these factors in the model, the accuracy of the model is improved and the function of the regression model is expanded, and they need to be “quantified.” This “quantification” is usually accomplished by introducing “dummy variables.” According to the attribute types of these factors, artificial variables with only “0” or “1” are constructed, which are usually called virtual variables.

Euclidean distance, also known as Euclidean distance, is a commonly used definition of distance. It is the real distance between two points in m -dimensional space.

This study creatively introduces dummy variables to consider the influence degree of each evaluation index on the evaluation object and quantifies this influence degree by Euclidean distance, so as to make the weight assignment of the evaluation index more accurate. In order to adjust and more conveniently control each evaluation index and make the evaluation index more sensitive and accurate, a virtual control quantity, that is, a virtual evaluation object, is inserted here, which is regarded as the $N + 1$ evaluation object. Then, the evaluation index data of the virtual evaluation object are

$$x'_{i0} = \frac{1}{n} \sum_{j=1}^n x'_{ij}. \quad (14)$$

Among them, x'_{ij} is the j -th evaluation index data of the virtual evaluation object.

3.3.2. Adjust the Control Variables to Calculate the Prediction Degree. First, all the original index data of $N + 1$ evaluation

objects are dimensionless. Second, in order to observe the impact of the same fluctuation of each evaluation index on the target layer, the virtual variables are used to evaluate the evaluation indexes of the object $x'_{10}, x'_{20}, x'_{30}, \dots, x'_{k0}$. The data increased by 20% are substituted into the formula, the evaluation indexes are weighted by the direct value weighting method, and the evaluation indexes of N evaluation objects are obtained. Finally, the comprehensive scores of n evaluation objects generated after adjusting and controlling the i -th evaluation index of the evaluation object are obtained as follows:

$$Q_i = \{Q_{i1}, Q_{i2}, \dots, Q_{im}\}, \quad (15)$$

where $i = 0, 1, \dots, m$, M is the number of indicators.

Due to the uncertain number of evaluation objects, if the sensitivity of the index is directly evaluated through the change of ranking, not only the evaluation accuracy is low, but also the evaluation result is easy to be affected by accidental factors. Therefore, this study takes the relative distance between the comprehensive scores of each evaluation object before and after the adjustment of the index as the standard for the sensitivity evaluation of the index. Next, the comprehensive scores of N evaluation objects are processed, the relative change distance of the comprehensive scores of each evaluation object is calculated, and then, sensitivity analysis is conducted on n index objects according to the change distance to judge the influence degree of each index on the evaluation object.

Step 1: Dimensionless Treatment of Comprehensive Score. Since the weight of each evaluation index will change with the adjustment of the data of a certain evaluation index, the order of magnitude of the comprehensive score of each evaluation index calculated after the adjustment of different evaluation indexes is different. In order to make the calculated Euclidean distance comparable, the comprehensive score Q_i after changing the i -th evaluation index needs to be dimensionless. The formula is as follows:

$$Q'_{ij} = \frac{Q_{ij}}{\sum_{j=1}^n Q_{ij}}. \quad (16)$$

Step 2: We calculate the change distance. After adjusting the i -th evaluation index data, the evaluation index of the j -th evaluation object will produce a one-dimensional change distance compared with that before adjustment: $|Q'_{ij} - Q_{0j}|$; then, the relative change distance of N evaluation objects can be calculated by n -dimensional Euclidean distance, and the formula is as follows:

$$D_i = \sum_{j=1}^n |Q'_{ij} - Q_{0j}|^2. \quad (17)$$

Among them, D_i is the relative change distance of the evaluation index of N evaluation objects before and after data adjustment.

Step 3: Judge Sensitivity. The value of each evaluation index of the inserted virtual evaluation object changes by the same 20%, resulting in different Euclidean distances D_1, D_2, \dots, D_K of the evaluation indexes before and after n evaluation objects. The smaller the D_i , the smaller the fluctuation of the evaluation index of the evaluation object for the change of the evaluation index, the weaker the sensitivity of the evaluation index, and the smaller the impact on the evaluation object.

3.4. *CW-CPCC Algorithm Analysis.* Only by rationalizing the obtained weight can the evaluation be more objective and accurate. The method of combining weights can effectively solve the one-sidedness and limitations brought by different models, and the selection of the Pico product distance correlation coefficient model can well eliminate the repeated influence of related indicators on the system.

3.4.1. *Combined Weight (CW).* The evaluation index weight W_i can be obtained by the direct weighting method, and the evaluation index D_i can be obtained by the Euclidean distance. Now, the multiplication model is used to synthesize the two evaluation indexes, and the combined weight CW is introduced, namely,

$$CW = D_i W_i. \quad (18)$$

3.4.2. *Analysis of Pearson's Product-Distance Correlation Coefficient (PPCC).* In practical problems, each evaluation index is often related to each other. The correlation degree between any two random variables can be measured by the Pico product distance correlation coefficient matrix. That is, n evaluation indexes are used, respectively, $x_{i1}, x_{i2}, \dots, x_{in}$, expressed by the following formula:

$$\begin{aligned} I_{ij} &= \text{Corr}(x_{in}, x_{im}) \\ &= \frac{\text{Cov}(x_{in}, x_{im})}{\sqrt{\text{Var}(x_{in})} \sqrt{\text{Var}(x_{im})}} \end{aligned} \quad (19)$$

The correlation coefficients between any two evaluation indexes are calculated, respectively. The repeated influence caused by the two indexes with high influence can be effectively eliminated by weighting the coefficient matrix.

3.5. *Principal Component Weighting.* The closer $|\text{Corr}(X_{in}, X_{im})|$ is to 1, the higher the linear correlation between X_{in} and X_{im} . The closer $|\text{Corr}(X_{in}, X_{im})|$ is to 0, the lower the linear correlation between X_{in} and X_{im} . In order to facilitate analysis and evaluation, the absolute value of the elements in the correlation coefficient matrix is taken and calculated by the linear weighted summation method. Therefore, on the basis of eliminating the interaction between indicators, the weight of the impact of each evaluation index on the evaluation object can be obtained, and then, the

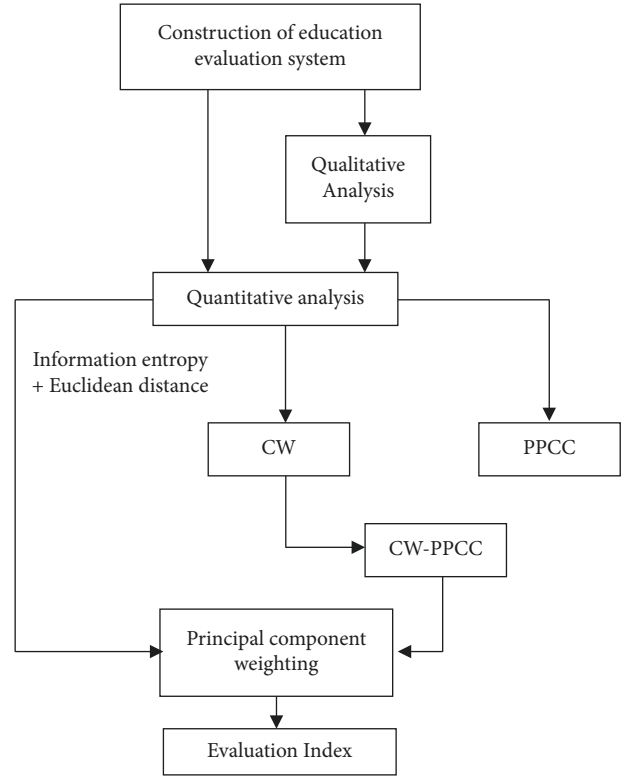


FIGURE 2: Overall system block diagram.

evaluation index Q_i of the i -th evaluation object can be calculated as follows:

$$Q_i = \sum_{j=1}^n |I_{ij}| CW_j. \quad (20)$$

So far, the corresponding evaluation score of each evaluation object can be obtained by multiplying Q by a reasonable multiple. A reasonable analysis of the evaluation score will objectively reflect the education level of the region and provide some guidance for the education reform and talent drainage of the region.

4. Result Analysis and Discussion

4.1. *Algorithm Flowchart of Education Evaluation System.* The algorithm flowchart of the education evaluation system is shown in Figure 2.

4.2. *Evaluation Indicators of Undergraduate Education Quality.* The quality of undergraduate education is often affected by many factors. Selecting appropriate evaluation indicators is often the premise to ensure the accuracy of evaluation. Taking the evaluation of undergraduate education quality in Hebei Province as an example, after fully investigating the current situation of education in Hebei Province, this study selects the following indicators as the main factors affecting the quality of undergraduate education in Hebei Province, as shown in Figure 3.

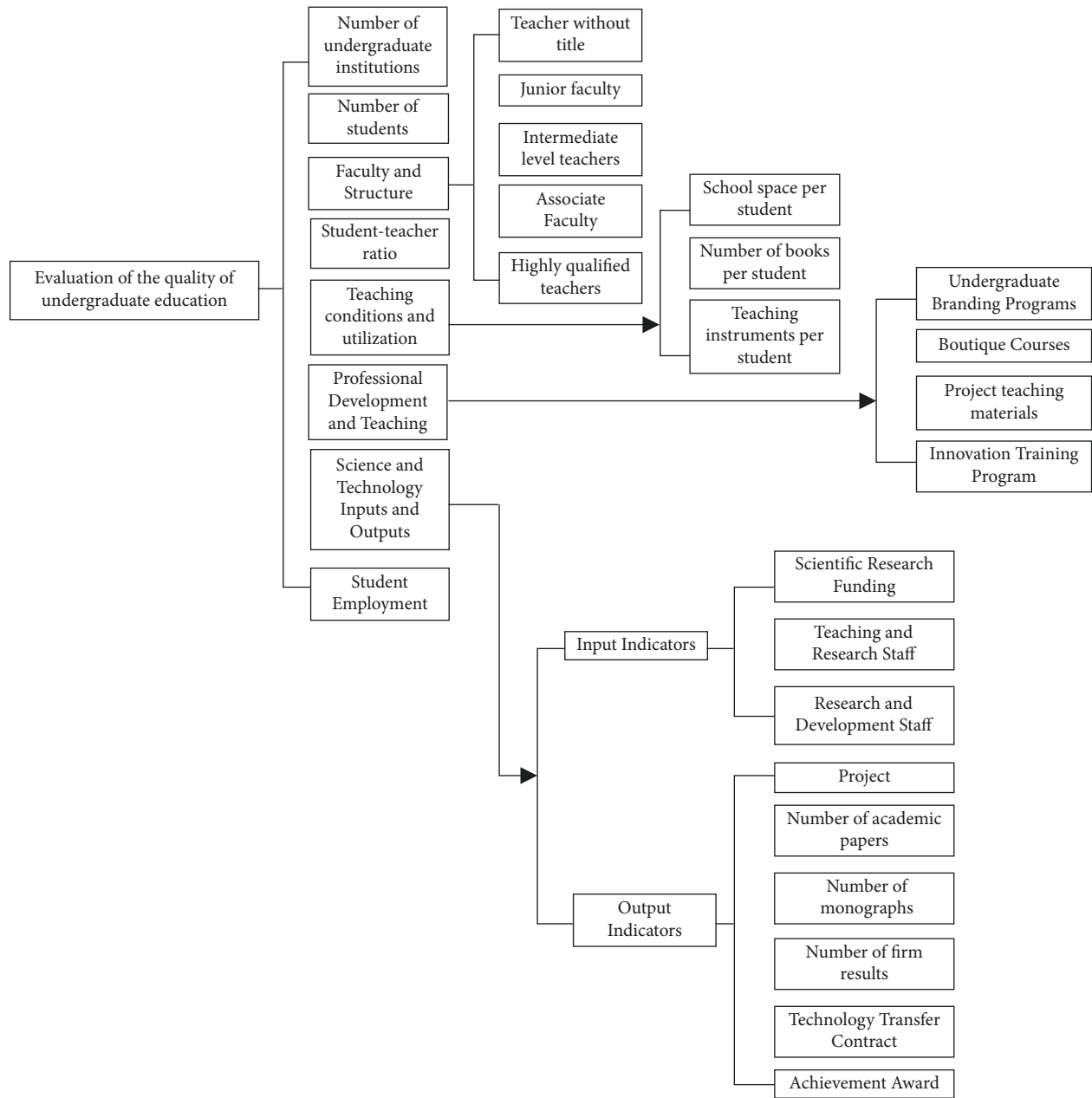


FIGURE 3: Main influencing factors of undergraduate education quality in Hebei Province.

4.3. *Index Treatment Method.* For the qualitative indicators of “teaching staff and structure,” “teaching conditions and utilization,” and “professional construction and teaching reform,” this study adopts the AHP method to quantify the qualitative indicators. The BCC algorithm in the DEA method is used to analyze “science and technology input and output,” and finally the quantitative indicators of cities in Hebei Province are obtained, as shown in Table 2.

The index quantization algorithm of “AHP + DEA” quantifies the qualitative evaluation indexes, which solves the problems that the evaluation indexes have grayscale, qualitative, and difficult to assess. The index quantization data are more objective, specific, and easy to operate, which is helpful to determine the reasonable weight.

4.4. *Determination of Weight Coefficient of Evaluation Index*

- (i) *Direct Weighting Method:* the information direct weight of each evaluation index can be obtained from each evaluation index parameter of education quality in Hebei Province according to the formula, and the weight of each evaluation index can be obtained by substituting the obtained information direct into the formula.
- (ii) *Euclidean Distance:* the virtual city is inserted according to Table 1, and the evaluation index value of the virtual city is the average value of each city in Tables 1–4.

The Euclidean distance of each evaluation index after inserting the dummy variable can be obtained through the

TABLE 2: Quantitative data of urban indicators.

	Number of undergraduate institutions	Enrollment	Faculty and structure	Teacher-student ratio	Teaching conditions and utilization	Specialty construction and teaching reform	Rate of employment	Scientific research input and output
Shijiazhuang	13	45823	2438.93	17.50	39720	347.89	93.22	0.64
Tangshan	3	12551	1007.13	18.22	5713	42.66	92.60	0.74
Qinhuangdao	3	11327	778.40	19.48	8334	115.97	94.66	0.81
Handan	2	8670	391.20	21.57	4012	83.07	87.55	0.52
Xingtai	1	3153	154.60	21.24	1878	6.59	90.42	1
Baoding	7	30124	1740.80	18.02	18439	277.49	87.91	0.49
Zhangjiakou	3	7347	486.33	19.72	6303	56.36	90.36	0.62
Chengde	2	3690	263.87	18.36	3988	40.44	89.89	1
Cangzhou	3	6299	478.20	20.46	4355	15.06	91.00	1
Langfang	9	24181	1100.07	19.37	26510	86.67	91.54	0.589
Hengshui	1	2760	99.93	20.70	2663	14.03	90.10	0.85

TABLE 3: Correlation coefficients among 8 indicators.

Index layer	Number of undergraduate institutions	Enrollment	Faculty and structure	Teacher-student ratio	Teaching conditions and utilization	Specialty construction and teaching reform	Rate of employment
Number of undergraduate institutions	1.0000	0.9658	0.9222	0.6596	0.9934	0.8365	0.2831
Enrollment	0.9658	1.0000	0.9807	0.7003	0.9594	0.9323	0.2241
Faculty and structure	0.9222	0.9807	1.0000	0.7768	0.9042	0.9310	0.2842
Teacher-student ratio	0.6596	0.7003	0.7768	1.0000	0.6349	0.6804	0.3274
Teaching conditions and utilization	0.9934	0.9594	0.9042	0.6349	1.0000	0.8355	0.3100
Specialty construction and teaching reform	0.8365	0.9323	0.9310	0.6804	0.8355	1.0000	0.1022
Rate of employment	0.2831	0.2241	0.2842	0.3274	0.3056	0.1022	1.0000
Scientific research input and output	0.4876	0.5681	0.5276	0.2104	0.4699	0.5893	0.3957

TABLE 4: Euclidean distance of comprehensive score before and after adjusting 8 indexes.

Index layer	Di	Wi	CWi
Number of undergraduate institutions	1.4882	0.1458	0.21697956
Enrollment	1.3856	0.1557	0.21573792
Faculty and structure	0.7761	0.1185	0.09143460
Teacher-student ratio	1.7431	0.0724	0.12620044
Teaching conditions and utilization	2.2434	0.1734	0.38900556
Specialty construction and teaching reform	1.9946	1.1534	0.30597164
Rate of employment	1.7718	0.0619	0.10967442
Scientific research input and output	4.5147	0.1188	0.53634636

formula. Table 4 shows the Euclidean distance before and after adjusting the comprehensive scores of 8 indexes.

The combined weighting method based on direct weight and Euclidean distance ensures the objectivity of the evaluation index; this study creatively proposes to

introduce dummy variables to consider the influence degree of each evaluation index on the evaluation object and quantify this influence degree by Euclidean distance, so as to make the weight assignment of evaluation index more accurate.

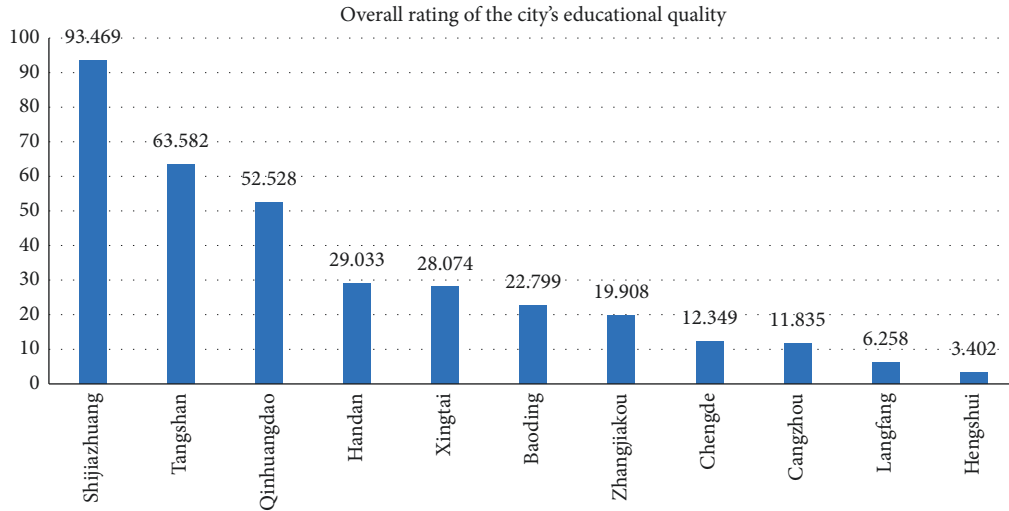


FIGURE 4: Comprehensive score and ranking of education quality in 11 cities.

4.5. CW PPCC Algorithm Analysis

(i) Pearson's Product-Distance Correlation Coefficient Matrix

The quantitative data of 8 evaluation indexes obtained in Tables 4-3 are recorded as $x_{i1}, x_{i2}, \dots, x_{i8}$, which bring the data into the formula to obtain the correlation coefficient between the eight indexes, as shown in Table 4.

The correlation coefficient in Table 4 shows the degree of mutual influence between different indicators. For the two indicators with a high degree of influence, the repeated influence caused by these two indicators can be effectively eliminated by weighting the coefficient matrix.

- (ii) The undergraduate education quality evaluation index of each city in Hebei Province can be obtained by using the correlation coefficient matrix. Since the calculated education quality evaluation indexes of 11 cities are within the range of [0.0619, 0.1458], for the convenience of observation, the quality evaluation indexes of 11 cities are multiplied by a coefficient of 100. The results are shown in Figure 4.

4.6. Algorithm Accuracy Test. By using the virtual control test model method, the teachers and structure index in the virtual control city can be expanded by 20%, and the comprehensive evaluation score of urban education can be obtained, as shown in Table 5.

Through the test of the virtual control test model method, it is known that after the change of teachers and structural indicators, the comprehensive evaluation score of undergraduate education in each city greatly fluctuates compared with other indicators. Therefore, teachers and structural indicators play a relatively key role in the comprehensive evaluation of undergraduate education quality in each city of Hebei Province.

TABLE 5: Algorithm accuracy test.

	Q	Q'	$ Q_i - Q'_i $
Shijiazhuang	93.4732	93.0717	0.161202
Tangshan	28.0731	29.9535	3.535904
Qinhuangdao	29.0248	30.6746	2.72184
Handan	19.9103	19.6848	0.05085
Xingtai	3.4008	4.1494	0.560402
Baoding	63.5298	63.1968	0.156816
Zhangjiakou	22.8001	23.6898	0.791566
Chengde	12.3497	13.7179	1.871971
Cangzhou	11.8333	12.7166	0.780219
Langfang	52.5294	52.5487	0.000372
Hengshui	6.2575	7.0761	0.670106

4.7. Coping Strategies of College Students' Education Management in the Era of Big Data

- (1) Make Every Effort to Build a Common Big Data Education and Management Carrier.

We fully integrate the big data resources of decentralized units and departments such as social institutions, education departments, schools, departments, and classes, so as to form the co-construction and interconnection of platforms and the sharing of data.

- (2) Actively Explore Education Management Methods Based on Big Data.

Using data mining, statistical analysis, and other methods, this study analyzes the big data modeling of school education management, studies and constructs the relevant models of big data education decision-making, management, and evaluation optimization, and studies the big data management mechanism and scientific path of prediction and prevention, process control, dynamic regulation, tracking feedback, evaluation, and incentive.

(3) Vigorously Improve the Big Data Management Literacy of Educational Subjects

Training includes education managers' data awareness, data positioning and collection ability, data analysis and interpretation ability, data reflection, and decision-making ability [21]. We establish the concept of knowing from a small point of view, actively collect and sort out data information and carefully analyze it, deeply excavate the relevance of data information of management objects, enhance the foresight and predictability of education work, and improve the sensitivity to data information.

(4) Effectively Form a Situation of Data Sharing, CO Governance and Coordinated Development

On the one hand, we should promote data sharing; big data should not be monopolized by a few people but should be shared through legal channels. On the other hand, "promoting cyberspace connectivity and shared governance," effectively strengthens the protection of data in the process of education and management, pays attention to risk prevention, prevents data leakage, pays attention to the protection of personal privacy, promotes big data legislation, and forms a legal restraint mechanism for the use of big data.

Objective evaluation of students' learning effect is a complex comprehensive evaluation problem. Combining the test paper quality index with the test result and evaluating the learning effect with the neural network method is not only more objective than evaluating the learning effect only through the test result but also convenient for computer implementation.

5. Conclusions

As a scientific concept, educational evaluation originated from the "eight-year research" of the new educational curriculum reform experiment of the American Progressive Education Alliance in the 1930s. Since its birth, educational evaluation has gradually formed a relatively complete theoretical system through the efforts of researchers. Its evaluation object covers not only the early learning effect on students but also educational plans, educational activities, and even the whole educational process. The methods used in the evaluation include linear programming, dynamic programming, data envelopment analysis, analytic hierarchy process, regression analysis, factor analysis, cluster analysis, homogeneous Markov chain, and so on.

- (i) There are many factors affecting the level of higher education, and most of them are qualitative indicators. Therefore, this study proposes an index quantization algorithm of "AHP + DEA." The qualitative indexes such as faculty and structure, teaching conditions and utilization, specialty construction and teaching reform, and scientific research input and output are quantified. This ensures

the scientific degree and effectiveness of the evaluation index.

- (ii) The combined weighting method based on direct weight and Euclidean distance ensures the objectivity of the evaluation index, which not only avoids the excessive subjectivity of the AHP quantitative index, but also makes up for the absoluteness of single weight distribution, and further improves the accuracy of education evaluation index.
- (iii) In this study, the influence of Euclidean distance on the evaluation object is more accurately considered, and the influence degree of Euclidean distance is introduced as the evaluation index. Then, the virtual variables are used to test the actual problems. It can be seen that the scientific research input and output have a great influence on the education level of Hebei Province.
- (iv) In practical problems, there is often a certain correlation between various indicators, and some indicators are often repeatedly implicitly calculated when assessing the weight. Therefore, this study puts forward the correlation coefficient matrix of Pitt product distance so that the final evaluation index has high accuracy.
- (v) The evaluation algorithm of CW-PPCC based on "AHP + DEA" has a solid theoretical foundation, which is difficult for some in real life.

Data Availability

The datasets used in the manuscript are freely available in the literature and the relevant references have been provided in the text.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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