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Retraction

Retracted: Optimization of College Teachers' Performance Management Using Artificial Intelligence Technology

Computational Intelligence and Neuroscience

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

In addition, our investigation has also shown that one or more of the following human-subject reporting requirements has not been met in this article: ethical approval by an Institutional Review Board (IRB) committee or equivalent, patient/participant consent to participate, and/or agreement to publish patient/participant details (where relevant).

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] Y. Liu and Y. Fang, "Optimization of College Teachers' Performance Management Using Artificial Intelligence Technology," *Computational Intelligence and Neuroscience*, vol. 2023, Article ID 4203776, 9 pages, 2023.

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Research Article

Optimization of College Teachers' Performance Management Using Artificial Intelligence Technology

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This work aims to adapt to the coming of a knowledge economy society and promote the improvement of China's higher education system. It is necessary to establish a new management mechanism of college teachers' performance evaluation to strengthen the quality of college teachers and improve the level of education and scientific research. Performance appraisal can be used to monitor the teaching staff scientifically and effectively to continuously improve and develop the college teacher system in China. This work first investigates the characteristics of performance evaluation of worldwide colleges, analyzes the development status of performance evaluation, and constructs a new performance evaluation index system through data and interviews. Then, based on the radial basis function neural network in artificial intelligence technology, a fine evaluation model of Chinese college teachers' performance is established. Network training is adopted to analyze the previous performance evaluation to ensure that the final weight is obtained to minimize the sum of previous evaluation errors. Then, the index data of 61 teachers' educational performance evaluation of *X* college from 2016 to 2021 are used for analysis and verification. The experimental results show that only 9.9% of the teachers in *X* college have excellent performance evaluation results, 29.5% of the teachers have medium evaluation results, and the statistical excellent rate is only 26.3%. Finally, the corresponding improvement suggestions and countermeasures are given for the low excellent rate of colleges.

1. Introduction

Teacher resources are colleges' most valuable resources and also a strong guarantee for their sustainable development. Excellent teachers can improve the teaching quality of colleges and cultivate talents more needed by society [1]. In October 2015, the State Council promulgated the *Overall Plan for Comprehensively Promoting the Construction of World-Class Universities and First-Class Disciplines*. The plan's core is the "double first-class" plan, that is, to build a world-class college and a first-class discipline [2]. Batch after batch of excellent teachers must be cultivated to complete the "double first-class" plan. Improving the performance evaluation of college teachers can strengthen the construction of school connotation, improve teachers' subjective initiative, and effectively strengthen the rational allocation of talent. In addition, it can promote teachers' professional skills, tap more educational potential of them, and improve the monitoring system's school teaching quality [3]. To encourage colleges to adopt more reasonable performance appraisal management methods, the Ministry of Education issued the Guiding Opinions on Deepening the Reform of College Teachers' Appraisal and Evaluation System in September 2016. The key is to carry out the reform of the teacher assessment and evaluation system. It reveals that the Ministry of Education encourages colleges to reform the teacher performance management system [4]. If the current performance evaluation cannot accurately measure the quality of teachers' work, it will cause students' low recognition of teachers with excellent performance evaluation, dissatisfaction among some teachers, and even brain drain [5]. Similarly, if the performance evaluation results cannot be effectively applied, the performance evaluation will be in vain, teachers cannot effectively position their own

work, and the teaching objectives of colleges cannot normally reach the standard. Therefore, it is necessary to reconstruct and optimize the existing teacher performance management system to strengthen the construction of teachers and improve the level of running schools [6].

At present, there are many studies on the performance appraisal of college teachers worldwide. For example, Grissom and Bartanen jointly studied the relationship between principals' efficiency and the low teacher turnover rate. The results show that excellent principals may strategically affect school teachers' composition by retaining high-performance rather than low-performance talents [7]. Dandalt and Brutus analyzed the teacher evaluation problems in Ontario's technical requirements manual for teacher performance evaluation. They concluded that the defects in the teacher evaluation system are limited to the evaluation practice and embedded in the evaluation rules [8]. Kagema and Irungu jointly studied and investigated the impact of teacher performance evaluation on the performance of middle school teachers in Kenya. They studied multiple variables through stratified and simple random sampling methods and investigated teachers' motivation for good performance in the form of comparison, interpretation, and relationship. It is found that teachers believe that the current government policies are unfavorable to their career development and the implementation of the current policies [9].

Based on the analysis of college teachers' performance evaluation characteristics in China, the development and current situation of college performance evaluation in China are described. Then, a fine evaluation model of scientific research performance based on a radial basis function (RBF) neural network is proposed. The weight and structure of the neural network are used to analyze the previous assessment results. In terms of the relative ratio scoring method, the evaluation model has the minimum evaluation error sum for all training evaluation objects. The weight value can be accurate to the decimal value, which can realize the fine evaluation.

2. Materials and Methods

2.1. Performance Management and Performance Management of College Teachers. Performance management originates in the United States. In short, it is the process of setting and realizing planned objectives or public services and systematically evaluating the achievement results. It mainly includes subprograms such as budget evaluation, goal setting, performance calculation, and performance evaluation [10]. In the 1990s, performance management was introduced in China and mainly applied in various enterprises. The traditional performance evaluation cannot objectively and fairly evaluate and review the work performance of the team and employees in the enterprise. Hence, it has also developed into a modern performance management system to improve the enterprise's competitive advantage [11]. Current performance management is divided into two types: individual and organization. Individual performance management believes that its role is to promote the effective work of employees to achieve work goals, while the latter believes that its role is to test the development goals of the enterprise to maintain a competitive advantage [12]. The performance evaluation results shall be used as the basis for everyone's position promotion, salary reward, and punishment, and the continuous improvement of the company's performance. Generally, the design principles corresponding to the company's performance appraisal indicators must comply with the SMART principle [13]. Figure 1 shows the details.

Figure 1 shows the five requirements of the SMART principle. The "specific" of performance appraisal indexes means that the work objectives should be moderately detailed and not too general. "Measurable" means that the assessment indicators must be quantifiable to obtain detailed data. "Achievable" means that the work objectives should be within the scope of the personnel to be evaluated and should not be too high or too low. "Correlation" means that performance appraisal is associated with and cannot be separated from the work of the personnel to be evaluated. The "time bound" means to set a deadline for the personnel to be evaluated to complete the performance appraisal indicators [14].

The performance management of college teachers is the first research and practice of evaluation teaching theory carried out by Harvard University based on students' evaluation of teachers' teaching. At present, the three aspects of performance evaluation of American colleges are teaching, scientific research, and service [15]. It can be concluded that performance management in western countries is mainly developmental teacher assessment. Teachers and managers can continuously exchange information throughout the performance management process, with much freedom. The corresponding human resources management should determine each teacher's position, salary level, training, and education opportunities based on the performance results. The key to college teachers' performance management process is to set reasonable performance indexes and a perfect performance evaluation implementation plan. To implement the performance management of teachers' teams, colleges should carefully deal with and improve its five links [16]. Figure 2 shows the system:

Figure 2 shows that the performance management system is a circular system. From the beginning of the performance plan, to the performance implementation and management, and to the completion of the task, the performance appraisal is carried out, and finally, the appraisal results are fed back. A more reasonable performance plan is made through the results, and a new cycle is carried out. Of course, performance management also needs to provide the basis for salary and training for each person to be evaluated according to the input of resources and strategic objectives. It can be concluded that the performance management system is an open system with both input and output.

2.2. Overview of Two Types of Performance Appraisal Methods

(1) Objective management performance appraisal method. It is the assessment method established by American management scientist Peter Drucker after

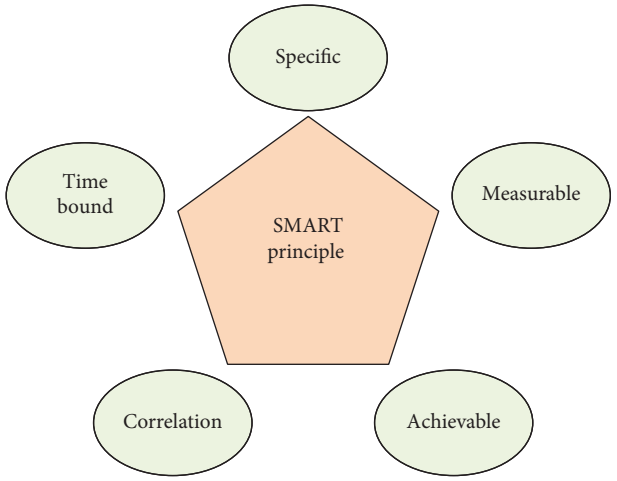

Figure 1: SMART principle.

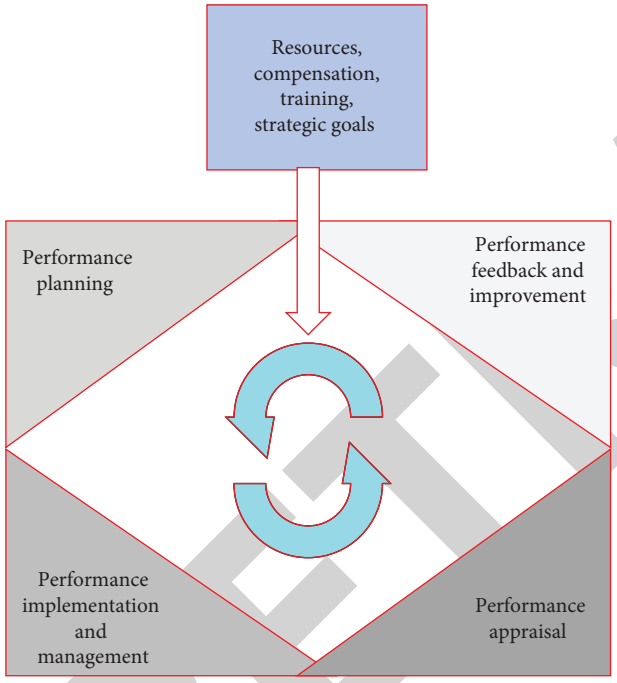

Figure 2: Performance management cycle system.

1950. The core content is that the management and employees jointly determine the specific performance objectives and then regularly check the progress of the objectives. Rewards and punishments are made according to the completion of the objectives [17]. Its advantage is that it focuses on work and allows employees to implement self-management, while management personnel only stipulate what employees do and when to finish, rather than how to do it. In this way, employees can give full play to their enthusiasm. Figure 3 presents the key steps:

(2) Balanced score card (BSC) evaluation method. This evaluation method was jointly established by Harvard professor Kaplan and Norton, founder of Renaissance Worldwide Strategy Group, in 1992. The

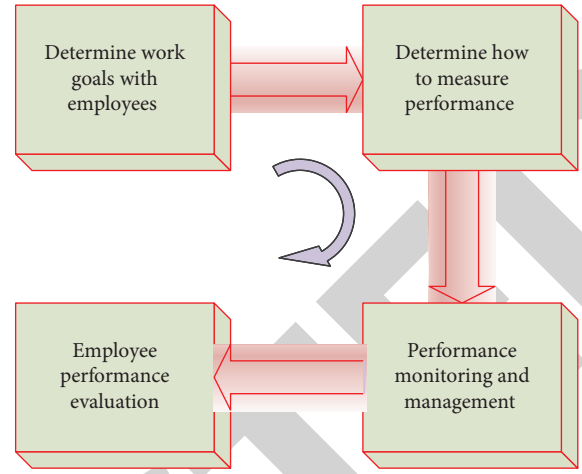

Figure 3: Steps of objective performance appraisal method.

BSC is the most common performance management system that implements the company's strategy into operational measurement indicators from four perspectives: finance, customers, internal operation, and learning and growth [18]. Figure 4 is the core framework of the BSC assessment method.

Figure 4 is the main framework of the BSC assessment method. The key steps mainly are: establishing enterprise's strategic tasks, reaching consensus with employees on strategies, determining quantitative assessment indicators, determining performance objectives and internal communication, and finally, implementing performance assessment.

2.3. Construction of an Evaluation System for the Individual Educational Performance of College Teachers

(1) Construction of performance appraisal indicators. The design of the performance appraisal index system for college teachers should follow the SMART principle, refer to the advantages of BSC, and carry out localization transformation according to the actual college education development law and the educational work characteristics. By interviewing experts, communicating with many teachers and leaders in school and combining the educational statistical indicators of the Ministry of Education, a multilevel indicator system for evaluating individual educational performance of college teachers that can reflect educational input and output has been specially constructed [19]. Figure 5 shows the details.

Figure 5 shows that the evaluation index system of college teachers' individual education performance has three levels. The first level is divided into teaching, scientific research, management, social service, award-winning, and learning training. Then, it is divided into the second and third levels according to the actual situation. Although the education performance appraisal is judged according to the above-given performance indicators, the weight

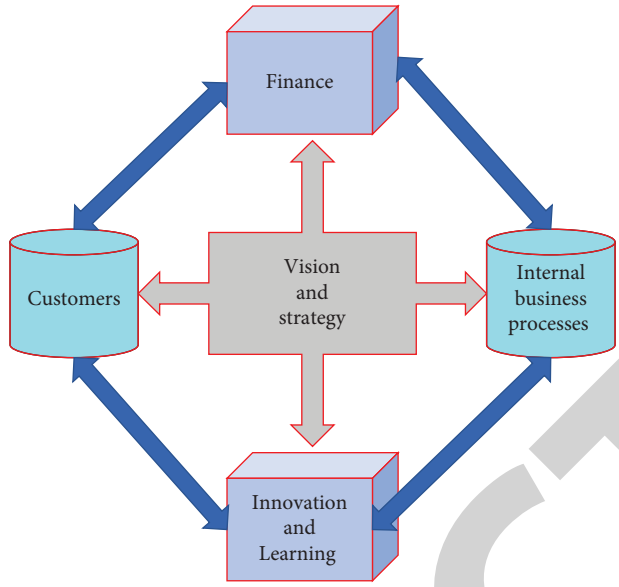

Figure 4: The core framework of the BSC assessment method.

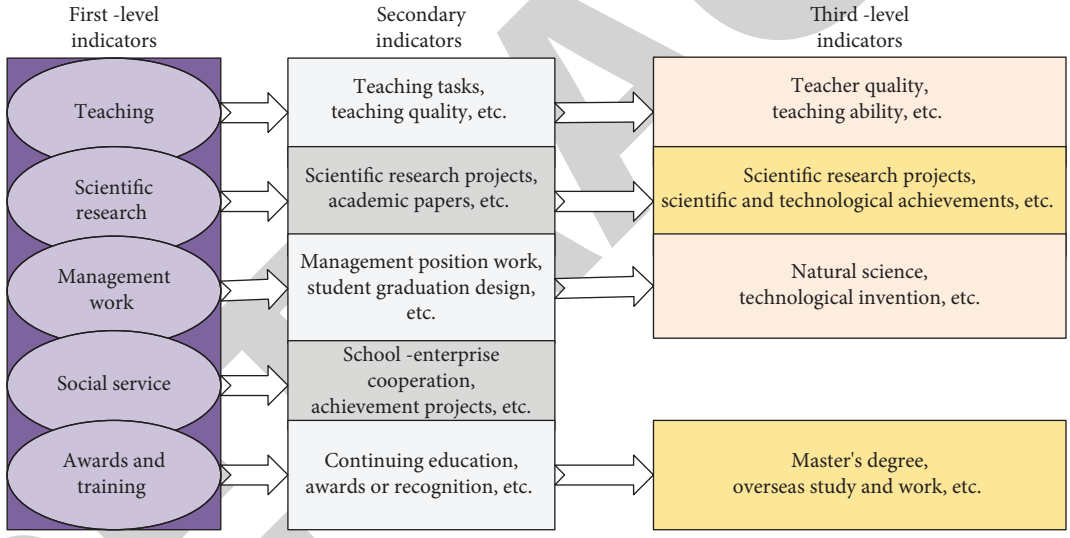

Figure 5: A multi-level index system for evaluating individual educational performance of college teachers.

to be allocated in the performance appraisal is also different due to the different importance of each assessment indicator.

(2) The weight distribution of individual educational performance indicators of college teachers. This work is mainly based on information entropy and correlation coefficient to allocate the weight of performance indicators. In order to determine the index weight more accurately and reasonably, this work uses the information entropy of performance indicators to show the information content of indicators and uses the correlation coefficient between performance indicators and assessment results to show the correlation between them. The size and relevance of the information will greatly impact the assessment results. Therefore, when allocating the weights of individual educational performance assessment indicators for college teachers, indicators with larger information entropy and correlation coefficient must be selected. In the 1940s, Shannon referred to the concept of thermodynamics, called the average information quantity after eliminating redundancy in the information as "information entropy" [20] and gave the mathematical expression for calculating information entropy as follows:

$$H(X<listaend>) = E[I(X_i)] = e\left[\log\left(2, \frac{1}{P(X_i)}\right)\right] = -\sum P(X_i)\log(2, P(X_i)), (i = 1, 2, 3, \ldots, n). \quad (1)$$

In (1), the source symbol has n values: $U_1, \ldots, U_i, \ldots, U_n$, and the corresponding probability is: $P_1, \ldots, P_i, \ldots, P_n$. Moreover, the appearance of various symbols is independent of each other. At this time, the average uncertainty of the signal source should be the statistical average (E) of the single symbol uncertainty $-\log P_i$, which can be called information entropy. The mathematical expectation of discrete state self-information is the average self-information $Hr(X)$, which is called information entropy. X represents a random variable, corresponding to the set of all possible outputs, which is defined as a symbolic set. The output of random variables is represented by x. $P(x)$ represents the output probability function. The greater the uncertainty of variables is, the greater the entropy is, and the greater the amount of information required to clarify the problem is.

According to the nature of information entropy, the larger the number of values of a performance indicator is (the larger the number of states Xi is), the more uniform the value probability is, and the greater the information entropy is. Therefore, the principle of information entropy can be adopted to investigate the educational performance indicators of most teachers to calculate the amount of information. Then, the differences of most teachers' educational performance levels can be distinguished through the value of indicators. The correlation coefficient is a statistical index first designed by statistician Karl Pearson, which is adapted to reflect the close degree of correlation between variables. According to the product difference method, the correlation between the two variables is reflected by multiplying the two deviations based on the deviation between the two variables and their respective mean values. It focuses on the linear single correlation coefficient. For random variables X and Y, the expression of the correlation coefficient ρ_{XY} reads:

$$\rho_{XY} = \frac{\mathrm{Cov}(X, Y)}{\sqrt{D(Y)}\sqrt{D(X)}}. \quad (2)$$

In (2), ρ_{XY} represents the degree of linear closeness between X and Y. Cov(X, Y) is the covariance of X and Y. $D(x)$ and $D(y)$ represent the variances of X and Y, respectively. When $|\rho_{xy}|$ is large, it means that the correlation between X and Y is good. When $\rho_{XY} = 1$, X and Y variables are linearly correlated. When $\rho_{XY} = 0$, X and Y are not related. When $\rho_{XY} > 0$, X and Y variables are positively correlated. When $\rho_{XY} < 0$, X and Y are negatively correlated.

(3) The weight algorithm design of college teachers' individual educational performance evaluation indicators. The influence of individual educational performance assessment indicators on assessment results mainly depends on the amount of information of assessment indicators and the correlation between indicators and assessment results. The former is measured by information entropy, and the latter is judged through the correlation coefficient. The specific steps are as follows. (1) Each assessment indicator is divided into D intervals according to the distribution range of indicator values. The index value is set as 10. (2) If the number of samples in the n-th interval is Nn and the total number of samples is n, the probability of occurrence of samples in this interval is $Pr = Nn/N$, and then the information entropy H of this index is calculated according to equation (1). (3) Then, the correlation coefficient ρ_{xky} between the k-th assessment indicator Xk and the assessment result Y is calculated. (4) The product $H \times \rho_{xky}$ of information entropy of Xk and correlation coefficient is calculated and denoted as U_k. (5) Finally, according to the U values of all indicators, normalization processing is carried out [21], and the weight coefficient of the assessment indicator is

$$W_K = \frac{U_K}{\Sigma U}. \quad (3)$$

In (3), the weight coefficient of the appraisal indicator is W_K, and the other variables are the data calculated above. Through the selection of performance evaluation indicators and the characteristics of educational performance, the educational performance evaluation results of 59 teachers are divided into four results: excellent, good, medium, and pass, which correspond to four different evaluation levels: 5, 4, 3, and 2. Table 1 shows some index data.

Table 1 displays the distribution of appraisal indicators and appraisal results. Then, the results are compared and analyzed. Figure 6 shows the information entropy of 13 assessment indicators and the correlation coefficient between assessment indicators and results:

Figure 6 suggests that the information entropy corresponding to different assessment indicators varies greatly. Scientific research items and academic theses have larger information entropy, and the latter indicators are teaching tasks and teaching achievements in turn. The reason is that the data distribution of these indicators is relatively scattered, and the number of samples after division is relatively uniform; that is, the values of these indicators vary from person to person, providing a large amount of information. It also reveals that the three indicators of scientific research items, academic thesis, and teaching achievements are the highest among the correlation coefficients between all indicators and assessment results. The advantages and disadvantages of the weight coefficient are measured through

Table 1: Some appraisal indicators and appraisal result data.

Serial number	Teaching task	Teaching quality	Educational reform project	Teaching achievements	Scientific research item	Academic thesis	Books and textbooks	Patent for invention	Assessment grade
1	3	4	4	7	4	4	1	0	4
2	5	6	4	6	6	4	1	0	3
3	3	8	3	5	5	4	0	2	5
4	7	5	2	4	4	3	1	1	5
5	6	7	5	5	6	5	1	0	4
6	5	5	2	3	4	6	0	1	3

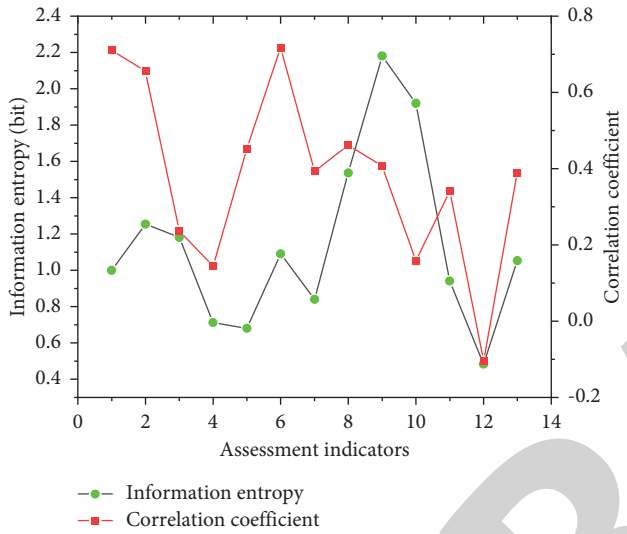

Figure 6: Information entropy of assessment indicators and correlation coefficient between indicators and results.

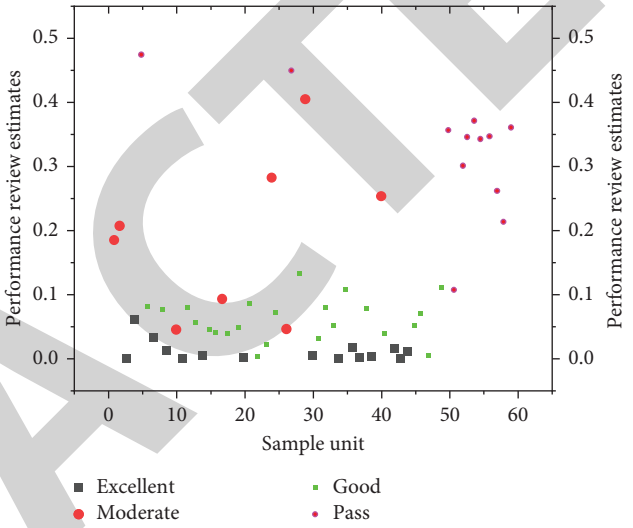

Figure 7: Sample distribution after index weighting.

the sample distribution after the assessment index is multiplied by the weight coefficient. First, each sample index is normalized to [0,1] and then multiplied by the weight coefficient [22]. Figure 7 shows the final sample distribution:

In Figure 7, the excellent, good, medium, and pass results are the assessment grades obtained according to the subjective evaluation method. The vertical coordinate represents the value obtained by multiplying the assessment index of each sample by the corresponding weight coefficient. It suggests that the sample distribution obtained by multiplying each sample by the weight coefficient is highly consistent with the assessment results, indicating that the weight coefficient at this time is reasonable [23]. Here, the above weight coefficient is adopted to weight the assessment indicators, and then the neural network is used for data training to establish the performance evaluation model.

2.4. Evaluation of Scientific Research Performance Using RBF Neural Network. RBF neural network is adopted to establish a performance appraisal model. An artificial neural network (ANN) simulates neuron activity with a mathematical model. It is an information processing system based on imitating the structure and function of the brain neural network. Among them, back propagation neural network (BPNN) is a multilayer feedforward neural network trained according to the error back propagation algorithm proposed by scientists led by Rumelhart and McClelland in 1986. It is one of the most widely used neural network models. The use process is simple and convenient, but it is easy to be limited to local minimum points. RBF has better function approximation ability, so it is more suitable for modeling of nonlinear systems [24].

(1) RBF neural network. It is a feedforward neural network using RBF as an activation function. Its output is a linear combination of input RBF and neuron parameters, generally divided into input, hidden, and output layers. The network's output is the linear weighted sum of the output of hidden nodes, and the weight coefficient is the network parameter determined by training. Although the transformation from input space to hidden layer space is nonlinear, the transformation from hidden layer space to output layer space is linear. Therefore, the RBF network can be used to approximate any nonlinear function and has a faster convergence speed. The educational performance assessment's index data of 59 teachers in college A from 2016 to 2021 are used as the input of the RBF neural network. The assessment results are divided into five grades: excellent (5), good (4), medium (3), pass (2), and fail (1). These five grades are taken as the output of the RBF neural network. First, the original data are

Table 2: Weight coefficient of some evaluation indexes.

Evaluation index	Teaching task	Teaching quality	Educational reform project	Teaching achievements	Scientific research item	Academic thesis
Weight coefficient	0.124	0.137	0.086	0.118	0.587	0.438

normalized, the interval is between 0 and 1, and the other values are obtained according to linear calculation [25]. The normalized performance index is multiplied by the weight coefficient obtained before. Table 2 shows the weight coefficients of some evaluation indicators.

Table 2 displays some indexes and corresponding weight coefficients. Among 59 samples, only 9 samples are selected as test samples, and the remaining data are used for neural network training. The function newrbe() in Matlab is adopted to train the RBF neural network, and the performance evaluation model obtained uses sim() function to test the test samples.

(2) Weight analysis in RBF network. In order to verify the rationality of the RBF model, this work analyzes the influence of the weight coefficient on output by changing the weight coefficient from the hidden layer to the output layer. The main step is to take all the sample eigenvalues as input and the corresponding assessment results as output and then train the neural network. Figure 8 shows the comparison results of assessment grades obtained from training.

Figure 8 shows that the weight coefficient is highly correlated with the training samples' corresponding assessment results. Since the output value of the RBF network is calculated by multiplying the corresponding output value of each hidden layer by the linear weighted sum of the corresponding weight coefficient, the weight coefficient represents the contribution of this sample to the final performance evaluation and is closely related to the corresponding assessment results. The weight difference obtained through continuous training can further refine the level of indicators at the same level and correct the wrong evaluation of individual samples [26]. The relative ratio is a common scoring method in performance appraisal. Each indicator's score is accumulated as the total score of the personnel evaluated. Then, the rating of the person evaluated is determined. The performance evaluation method improves the scoring method's subjective and rough evaluation index score. It can minimize the evaluation error sum and achieve more objective and refined evaluation through the weight and structure of the neural network.

3. Results and Discussion

3.1. Model Validation Analysis. The weight coefficient of the evaluation index is obtained from the RBF network training mentioned above. The index data of the education performance appraisal of 61 teachers of Tianjin Normal University from 2016 to 2021 are input into the teacher's personal education performance appraisal system. Figure 9 shows the evaluation results:

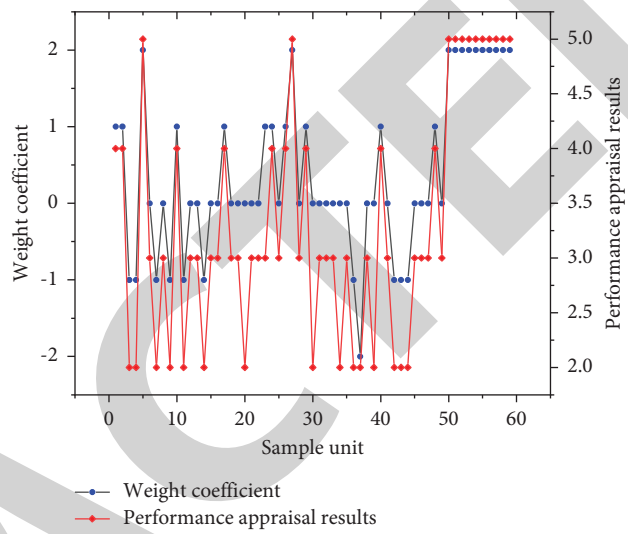

Figure 8: Comparison of assessment results and weight coefficient.

Figure 9 shows that the final evaluation results of 9 evaluation units are excellent, 10 are good, 18 are medium, and the rest are all qualified.

3.2. Analysis of Evaluation Results. Figure 10 is a summary of the performance evaluation results of all the above-given teachers:

Figure 10 displays that only 9.9% of the teachers' evaluation results are excellent, while 16.4% are good and 29.5% are moderate. The statistical excellent rate is only 26.3%.

According to Figure 10, the educational performance evaluation results of 61 teachers of college X from 2016 to 2021 are obtained (Table 3):

Table 3 shows that the statistical excellent rate of the performance evaluation results of teachers in college X is only 26.3%, and the improvement suggestions and countermeasures are given for the above-given low excellent rate.

3.3. Suggestions and Countermeasures for Improving Teachers' Individual Performance. The analysis of the evaluation results shows that the overall performance level of teachers is low, so it is essential to establish an effective reward and punishment mechanism to encourage teachers to give full play to their potential and improve the overall education level. First, colleges should formulate the assessment standards corresponding to the professional title and the corresponding salary treatment and promote the formation of a competitive incentive mechanism with dynamic changes in

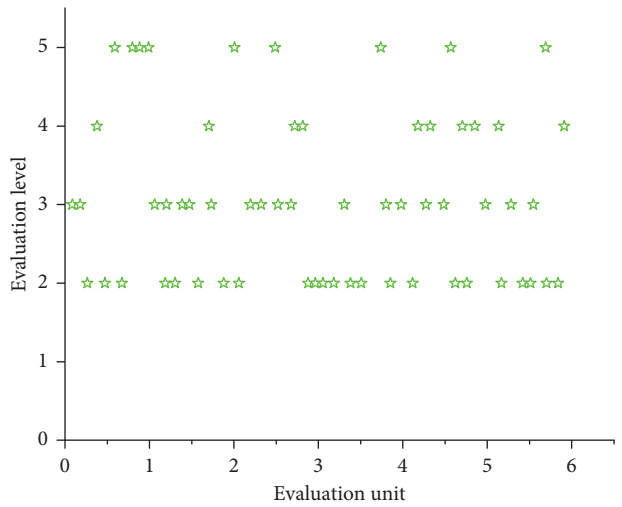

Figure 9: Evaluation results of 61 teachers of Tianjin normal university from 2016 to 2021.

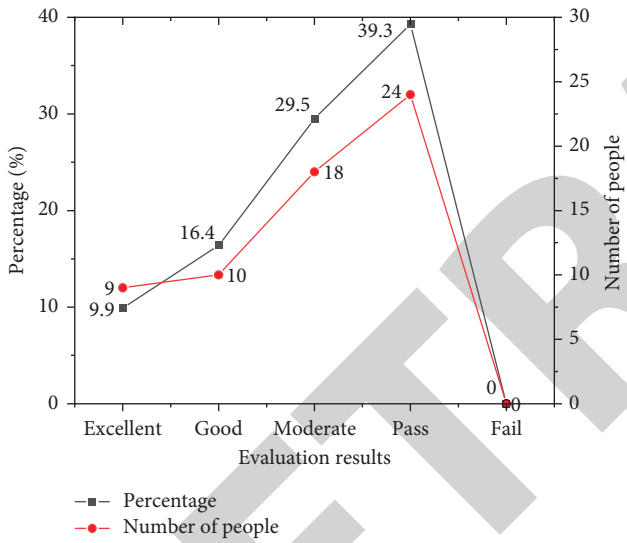

Figure 10: Educational performance assessment results of 61 teachers of Tianjin normal university from 2016 to 2021.

Table 3: Educational performance evaluation results of 61 teachers of college *X* from 2016 to 2021.

Evaluation results	Excellent	Good	Moderate	Pass	Fail
Number of teachers	9	10	18	24	0
Percentage (%)	9.9	16.4	29.5	39.3	0

personnel, positions, and treatment. On the one hand, it can mobilize the enthusiasm of teachers. On the other hand, it can also reduce the brain drain rate. Next, it is suggested to implement classified assessment, which can be divided into teaching, scientific research, and other types to help teachers clarify their own development goals and set specific career goals in combination with their own goals. Besides, it is necessary to pay attention to the combination with college strategies to promote teachers' professional ability and give full play to their subjective initiative to make them achieve more reasonable life planning. Colleges should pay attention to the dynamic and updating of performance appraisal and timely feedback on performance appraisal results to help appraisal teachers understand their own advantages and disadvantages and promote their continuous improvement.

4. Conclusion

This work studies the management optimization of university teachers' performance through the application of the RBF neural network. The index data of the educational performance appraisal of 59 teachers in college A from 2016 to 2021 are used as the training sample data, and the weight coefficient of the evaluation index is obtained. Then, the index data of educational performance appraisal of 61 teachers in college *X* from 2016 to 2021 are used for analysis and verification. Due to the lack of time and personal ability, the training sample size and the weight coefficient of evaluation indicators are not accurate enough. It is hoped that such issues can be further studied through the efforts of individuals and teams in the future, and the leading role of teachers in the performance management system can be highlighted to give full play to the potential of teachers in teaching and scientific research.

Data Availability

The figures and data used to support the findings of this study are included in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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