



Teaching Quality Evaluation Method of Human Resource Management Based on Big Data

Liu Li^(✉) and Cai-ming Zhang

China University of Labor Relations, Beijing 100048, China

Abstract. In view of the current teaching quality evaluation method of human resource management major, in the process of index weight calculation, the index hierarchy is less divided into grades, which leads to the low reliability of the selected indicators. This paper proposes a teaching quality evaluation method of human resource management specialty based on big data. Using big data technology, the information data of teaching quality evaluation is collected, and the evaluation indicators are obtained after screening. The evaluation index system of human resource management professional course teaching quality is constructed, and the index weight value is calculated to obtain the comprehensive evaluation set and corresponding evaluation value, determine the teaching quality grade, and realize the teaching quality evaluation of human resource management specialty. The experimental results show that the design method improves the reliability and extraction ability of index data, the index reliability is higher, and the evaluation results are more accurate.

Keywords: Big data · Teaching quality · Evaluation index · Human resources

1 Introduction

At present, domestic higher education is developing from popularization to popularization, and colleges and universities are also transforming from scale expansion to connotative development, and the further improvement of teaching quality in Colleges and universities has attracted more and more attention from all walks of life [1]. These changes have injected new impetus into the human resource management specialty, and increased the employment, innovation and entrepreneurship opportunities of human resource management graduates. Therefore, it is necessary to cultivate management talents with rich knowledge, good quality and skilled skills in human resource management major of colleges and universities, so as to lay a good foundation for students' employment and entrepreneurship [2]. Therefore, it is of great significance to evaluate the teaching quality of human resource management courses, find out the problems existing in the evaluation and analyze their causes, so as to improve the teaching quality of human resource management courses. Foreign curriculum teaching quality evaluation has a long history. The education departments of the United States, Britain, Germany, France and Japan evaluate the teaching quality on the basis of not violating the principles. The quality of the evaluation results is directly related to the amount of government

funding [3]. The domestic curriculum teaching quality evaluation has also made great progress. By using the methods of interview, investigation and quantitative analysis, this paper constructs the evaluation index system of teaching quality of human resource management major. The index system is established according to the common and basic quality standards of colleges and universities, and the weight is determined according to the hierarchical and classified standards, which reflects the unity of the teaching quality evaluation index system of various colleges and universities and differences, to achieve the classification of teaching quality evaluation. On the basis of the above theories, this paper puts forward the teaching quality evaluation method of human resource management specialty based on big data. By using big data technology, the information data of teaching quality evaluation is collected, and the evaluation index is obtained. The teaching quality evaluation index system of human resource management specialty is constructed, which improves the reliability and extraction ability of index data. Calculate the index weight value, get the comprehensive evaluation set and the corresponding evaluation value, determine the teaching quality level, realize the teaching quality evaluation of human resource management professional courses, make the evaluation results more accurate.

2 Design of Teaching Quality Evaluation Method for Human Resource Management Major Based on Big Data

2.1 Obtaining Teaching Quality Evaluation Indicators for Human Resource Management Professional Courses Based on Big Data

Obtaining Evaluation Indicators

When evaluating the teaching quality of human resource management courses, we should first construct the evaluation index system, and its construction principles are as follows: first, the goal. The designed teaching quality evaluation index system must strive to reflect the national education policy, as well as the requirements for the teaching work and personnel training of human resource management specialty, follow the education law, comprehensively and fully reflect the teaching objectives of colleges and universities, and the quality standard should conform to the school running orientation [4]. At the same time, it should also reflect the modern education concept which adapts to the requirements of education facing the world, informatization, socialization and lifelong learning and development. The second is orientation. The standard of teaching quality should be suitable for the situation of the school, and highlight the guidance. The so-called guidance is to make the teachers' teaching ideas, teaching methods and teaching effects close to the evaluation standards through evaluation. Therefore, we should pay special attention to the determination of the index weight. The third is scientific. The design of the index system should be scientific, the evaluation standard should be reasonable and conform to the teaching rules. Each index should have a clear connotation and pertinence, and the indicators should form an organic whole which is not only related, but also not inclusive or contradictory [5]. The fourth is feasibility. It is expected that there will be enough information in the process of implementation of the evaluation, and the

specified contents can be concluded through actual observation and measurement, so as to collect information objectively, analyze and statistic data objectively. The fifth is effectiveness. An important change in methodology of curriculum teaching quality evaluation is to pursue the effectiveness of evaluation. The sixth is the combination of quantitative and qualitative evaluation to improve the fairness, rationality and objectivity of the evaluation.

On the basis of the above principles, the teaching quality evaluation indicators are obtained through big data technology. Firstly, on Ckni and Internet, search keywords of teaching quality evaluation of human resource management specialty are set up to obtain the relevant literature of teaching quality evaluation, construct the web database of curriculum teaching quality evaluation, and classify and store the relevant literature. Then, by using big data technology and web application, the hidden semantic information of evaluation factors in the database is searched, and the relevant factors affecting the teaching quality of human resource management course are mined. Finally, through data mining technology and data-based literature information, we can collect hidden information that can assist course teaching quality evaluation, merge and classify similar literature, and collect and sort out the feature description of curriculum teaching quality evaluation in all mining literature [6]. Remove the similar or repetitive features of concepts, and take the remaining relevant elements as the index community of capability evaluation. The process of obtaining index community is as Fig. 1.

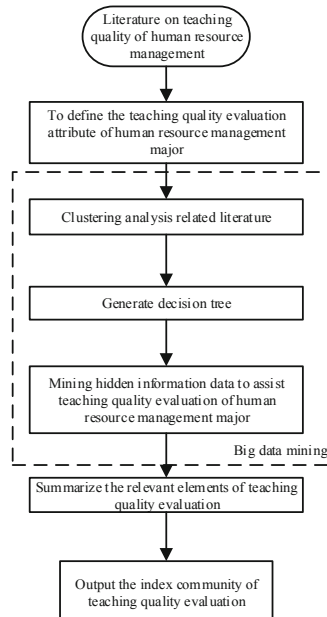


Fig. 1. Acquisition process of teaching quality evaluation indicators based on big data

Considering the development process of human resource management course teaching, the guiding ideology, teaching conditions, teachers, talent training mode and training

plan, teaching reform, management system and teaching effect are taken as the evaluation criteria of factor indicators. The remaining teaching quality evaluation elements of human resource management specialty are counted frequently, and the index community is screened for the first time, set the mining frequency of the screening index to 4, and take the index greater than the mining frequency as the alternative index [7]. So far, the acquisition of teaching quality evaluation indicators of human resource management major has been completed.

Construction of Evaluation System

Then, the expert scoring method was used to screen the candidate indexes twice. First of all, according to the index system, the department carries out self-evaluation item by item and writes the self-evaluation report. Then, an expert group composed of senior professors in teaching was set up. On the basis of carefully reading the self-evaluation reports submitted by various departments, understanding and analyzing the basic situation of teaching work in each department, the expert group went to each department to listen to the work reports made by the main leaders. It includes the basic information of the Department, the characteristics and achievements in the teaching work of human resources major courses, as well as the existing problems and solutions. The expert group goes deep into the Department to investigate the laboratory, teaching and research section, carefully consult the relevant Annex materials, check the graduation thesis, examination papers and other teaching materials, and communicate and discuss with the relevant responsible person [8]. Finally, according to the actual teaching situation of human resource management courses, the expert group scored item by item with a serious and responsible attitude, discussed the diagnosis results and evaluation opinions, formed the summary materials of the expert group on the teaching work evaluation of the Department, and fed back the diagnosis results and evaluation opinions to the departments and colleges of human resource management specialty.

According to the “quantitative evaluation index system of teaching quality in Colleges and departments”, the evaluation indicators are scored, and the specific scores are as follows: high quality courses refer to excellent courses of the University and above, and excellent courses above the provincial level, one course is calculated as two courses. When the core courses of human resource management major fail to meet the excellent course index of the University, this item is calculated as zero. The total number of courses refers to the sum of compulsory courses and limited optional courses offered by human resource management major. One national educational reform project is equal to five, one provincial project is equal to three, and one school key project is equal to two. One excellent textbook is equal to three, and one textbook published by national and ministerial publishing houses is equal to two. The score of teaching achievement award of human resource management specialty is calculated. The national first prize is 30 points, the national second prize and provincial first prize are 20 points, the provincial and ministerial level second prize and school level first prize are 10 points, the provincial and ministerial level third prize, school level second prize and school level third prize are 8 points and 6 points respectively. Repeated awards are calculated as the highest award. 1 provincial excellent graduation thesis, calculated as 2 excellent graduation theses at school level. Students’ scientific and technological achievements and competitions are awarded 25 points at the international level, 15 and 10 points are added to the first, second

and third prizes of the national level, 12, 10 and 8 points of the first, second and third prizes of the provincial level, 10, 8 and 6 points of the first, second and third prize of the municipal level, 6, 4 and 2 points of the first, second and third prize of the university level, 10 points of the national patent and 10 points of the publication of a thesis. The first three places in each level of competition will get the same second and third prize, and the next place will be reduced by 1 point, and repeated awards will be calculated as the highest prize. The final evaluation index is as Table 1.

Table 1. Teaching quality evaluation index of human resource management major

Primary indicators	Secondary indicators	Level three indicators
Teaching staff	Overall structure of the team	Teachers' age, educational background and degree
	Lecturer	Teacher's title, curriculum reform willingness, teaching quality
	Young teachers	Training system, teachers' level and teaching effect
Curriculum reform	Discipline construction	Construction planning and practice conditions
	Cultivation calculation	Characteristics of professional courses and cultivation of practical ability
	Curriculum system	Modern curriculum, basic teaching materials and teaching materials
Teaching effectiveness	Practical teaching	Core curriculum, laboratory, scientific research training
	Course features	Teaching reform projects, teaching resources and school running characteristics
	Course management	Management team structure, management system and teaching quality monitoring

Taking the content shown in Table 1 as the final evaluation index, the construction of the teaching quality evaluation index system of human resource management major has been completed.

2.2 Calculate the Weight of Teaching Quality Evaluation Index of Human Resource Management Major

Judge the importance of different evaluation indicators, and calculate the weight of teaching quality evaluation index of human resource management major. First of all, according to the hierarchy of evaluation indicators, the hierarchy of evaluation indicators

is established. The first level indicators are used as the target level, the second level indicators are used as the criteria layer, and the third level indicators are used as the decision-making level. The 1–9 scale method is used to compare the evaluation indicators in the three levels to judge the importance of one index relative to another index [9]. Suppose any two indicators in a certain level are i, j , then the scale judgment standard of i indicator relative to j indicator is as Table 2.

Table 2. Criteria of index scale

Scale	requirement	Scale	requirement
1	i and j have the same importance	3	i is slightly more important than j
5	i is more important than j	7	i is obviously more important than j
9	i is more important than j	Reciprocal	Contrary to the above

When the importance of two indicators is between adjacent levels, 2, 4, 6, 8 are selected as the scale of the i indicator. Suppose the scale of i index relative to j index is a_{ij} , then the scale a_{ji} of j index relative to i index is:

$$a_{ji} = \frac{1}{a_{ij}} \tag{1}$$

Construct the weight judgment matrix of the i index, use the geometric average method to calculate the geometric average value w_i of all elements in each row of the matrix, and set the total number of level evaluation indicators as n , then the formula is:

$$w_i = n \sqrt[n]{\prod_{i=1}^n a_{ij}} = (1, 2, \dots, n) \tag{2}$$

The judgment matrix is normalized to obtain the eigenvector corresponding to the maximum eigenvalue, which is used as the weight vector of the hierarchy evaluation index to obtain the weight value of each index [10]. Using fuzzy comparison method, using closeness to measure the similarity of any two indicators, set the geometric mean of j indicator as w_j , then the feature vector w of the level indicator is:

$$w = \frac{w_i}{\sum_{j=1}^n w_j} \tag{3}$$

Select the eigenvalues other than the maximum eigenvalue of the judgment matrix, process the eigenvector unit, calculate the negative average value of the eigenvalue, and realize the consistency test of the matrix [11]. Suppose the maximum characteristic value of the judgment matrix is δ , then the consistency index C is:

$$C = \frac{\delta - n}{n - 1} \tag{4}$$

Table 3. Average random consistency index values

Average matrix order	S value	Average matrix order	S value
1	0.00	5	1.24
2	0.58	6	1.32
3	0.90	7	1.41
4	1.12	8	1.45

Combined with the average random consistency index S , the value range of S is judged according to the order of the judgment matrix. The details are as Table 3.

The ratio of consistency index to S is calculated to get the random consistency ratio. When the ratio is less than 0.1, it can ensure that the judgment matrix meets the consistency index, and recognizes the eigenvector w . when the ratio is greater than 0.1 or equal to 0.1, the judgment matrix is adjusted and the weight set is recalculated. So far, we have completed the calculation of the weight of teaching quality evaluation index of human resource management major.

2.3 Evaluate the Teaching Quality of Human Resource Management

Establish the evaluation factor set $D = (M, N, P)$ of the teaching quality of human resource management professional courses, where M , N , and P are respectively the faculty, curriculum reform, and teaching effect [12]. Construct an evaluation set, divide the teaching quality evaluation grades of human resource management professional courses, classify them into very good, good, average, poor, and very poor, and use the evaluation set to fuzzy evaluation factors. Suppose the fuzzy evaluation matrix of the three-level index to the second-level index is respectively R_M, R_N, R_P , and the weight of the third-level index is respectively L_M, L_N, L_P , calculate the index evaluation vector of the decision-making layer to the criterion layer, and then obtain the evaluation matrix K of the second-level index to the first-level index as:

$$K = \begin{pmatrix} L_M \cdot R_M \\ L_N \cdot R_N \\ L_P \cdot R_P \end{pmatrix} \quad (5)$$

Supposing the evaluation weights of the first-level indicators are respectively O_M, O_N, O_P , then the comprehensive evaluation set H of the teaching quality of human resource management professional courses is:

$$H = (O_M, O_N, O_P) \cdot K \quad (6)$$

To obtain the evaluation vector H_M, H_N, H_P , of M, N, P in the evaluation set, the final evaluation value of the teaching quality of human resource management professional courses is:

$$\begin{cases} M = H_M \cdot V^T \\ N = H_N \cdot V^T \\ P = H_P \cdot V^T \end{cases} \tag{7}$$

In the formula, V is the set evaluation set, and the value is $\{96, 86, 76, 66, 56\}$, which are expressed as very good, good, fair, poor, and very bad respectively, and T is matrix transpose [13]. Calculate the average of the evaluation values of the three indicators to obtain the comprehensive evaluation value D . The evaluation level of the teaching quality of human resource management professional courses is divided into 5 sections, A, B, C, D, and E as Table 4.

Table 4. Evaluation grade of teaching quality of human resource management major

Evaluation level	D value interval	Meaning
A	(0,55]	Difference
B	(55,65]	Commonly
C	(65,75]	Preferably
D	(75,85]	Good
E	(85,100]	Excellent

According to the comprehensive evaluation value, determine the teaching quality of human resource management courses in Colleges and universities. So far, we have completed the design of teaching quality evaluation method of human resource management major based on big data.

3 Experimental Analysis

In order to verify the effectiveness of the big data based teaching quality evaluation method for human resource management major, the design method is recorded as experimental group A, and two traditional teaching quality evaluation methods of human resource management major are respectively recorded as experimental group B and experimental group C. the reliability of the evaluation indexes of the three groups of methods is compared.

3.1 Experimental Process

Taking the human resource management major of a university as an example, three methods are used to evaluate the teaching quality of the major. Experimental group A

establishes different levels of evaluation index sets: the target level is $U = \{U_1, U_2, U_3\}$; the criterion level is $U_1 = \{U_{11}, U_{12}, U_{13}\}$, $U_2 = \{U_{21}, U_{22}, U_{23}\}$, $U_3 = \{U_{31}, U_{32}, U_{33}\}$; the decision level is $U_{11} = \{U_{111}, U_{112}, U_{113}\}$, $U_{12} = \{U_{121}, U_{122}, U_{123}\}$, $U_{13} = \{U_{131}, U_{132}, U_{133}\}$, $U_{21} = \{U_{211}, U_{212}\}$, $U_{22} = \{U_{221}, U_{222}\}$, $U_{23} = \{U_{231}, U_{232}, U_{233}, U_{234}\}$, $U_{31} = \{U_{311}, U_{312}, U_{313}\}$, $U_{32} = \{U_{321}, U_{322}, U_{323}\}$, $U_{33} = \{U_{331}, U_{332}, U_{333}\}$ and the specific meanings are as Table 1.

The importance of the course teaching quality factors of this major is judged, and the three-level index weight vector is calculated: the index weight of the teacher team is $\{U_{111}, U_{112}, U_{113}\} = [0.319, 0.407, 0.274]$, $\{U_{121}, U_{122}, U_{123}\} = [0.324, 0.287, 0.389]$, $\{U_{131}, U_{132}, U_{133}\} = [0.417, 0.307, 0.276]$, and the index weight of the curriculum reform is $\{U_{211}, U_{212}\} = [0.623, 0.377]$, $\{U_{221}, U_{222}\} = [0.461, 0.539]$, $\{U_{231}, U_{232}, U_{233}, U_{234}\} = [0.219, 0.278, 0.207, 0.296]$, the index of teaching effect the weight values are $\{U_{311}, U_{312}, U_{313}\} = [0.209, 0.342, 0.449]$, $\{U_{321}, U_{322}, U_{323}\} = [0.317, 0.483, 0.200]$, $\{U_{331}, U_{332}, U_{333}\} = [0.417, 0.231, 0.352]$. According to the weight value of the three-level matrix, the judgment matrix of the criterion layer index can be obtained as Table 5.

Table 5. Secondary index judgment matrix

	U_{11}	U_{12}	U_{13}	U_{21}	U_{22}	U_{23}	U_{21}	U_{22}	U_{23}
U_{11}	1	3/4	6/5	1	5/6	4/3	3/4	1	4/3
U_{12}	4/3	1/2	5/6	6/7	3/4	1	4/3	4/3	1/2
U_{13}	1	5/6	3/4	1	1	4/3	4/3	3/4	6/5
U_{21}	5/6	3/4	1	1	4/3	4/3	3/4	6/5	1
U_{22}	3/4	1	1	4/3	4/3	3/4	1	1	3/2
U_{23}	1	3/2	3/4	1	1	4/3	4/3	1/2	5/6
U_{21}	1	4/3	4/3	1/2	5/6	6/7	3/4	1	4/3
U_{22}	4/7	1	4/3	4/3	3/4	3/2	1	4/3	4/3
U_{23}	1	4/3	4/3	3/4	6/5	1/2	4/3	1	4/3

From Table 5, we can get the weight vector of the secondary index of curriculum teaching quality for this human resource management major: the index weight of the faculty is $\{U_{11}, U_{12}, U_{13}\} = [0.328, 0.207, 0.302]$, the index weight of curriculum reform is $\{U_{31}, U_{32}, U_{33}\} = [0.198, 0.389, 0.413]$, and the index weight of teaching effect is $\{U_{21}, U_{22}, U_{23}\} = [0.411, 0.402, 0.187]$. According to the index weight of the criterion layer, the judgment matrix of the first level index of the index set can be obtained as Table 6.

The fuzzy comprehensive evaluation of the teaching quality of human resource management professional courses is performed, and the comprehensive evaluation results of the teaching quality can be obtained as Table 7.

Table 6. First level index judgment matrix

	U_1	U_2	U_3	Weight
U_1	1	3/4	2/3	0.327
U_2	4/3	1	5/2	0.470
U_3	2/3	2/5	1	0.203

Table 7. Comprehensive evaluation results of teaching quality

	Teachers	Curriculum reform	Teaching effectiveness	Comprehensive
V_1 well	0.072	0.075	0.077	0.075
V_2 preferably	0.089	0.313	0.314	0.239
V_3 commonly	0.307	0.289	0.229	0.275
V_4 Poor	0.281	0.233	0.083	0.597
V_5 Very bad	0.250	0.089	0.314	0.218
Evaluation value	80.2	87.6	79.4	82.4
Grade	Good	Excellent	Good	Good

3.2 Experimental Results

Results of the First Group of Experiments

In order to improve the persuasion of the experimental results, 10 experiments were carried out respectively, and the average value of 10 experiments was taken to ensure that the environment of the control group and the experimental group was consistent. The statistical software spss23.0 was used to analyze the test indicators of the three groups of systems to test the reliability coefficient of the indicator set. Reliability is reliability, which refers to the consistency of the results obtained when the same object is measured repeatedly by the same method. The reliability index is usually expressed by correlation coefficient, that is, the correlation coefficient of two groups of data obtained from the same sample is used as the index of measurement consistency, which is called reliability coefficient. The reliability coefficient refers to the proportion of the real score which can be attributed to the change of the real score of the tested person, and can also be defined as the correlation between two parallel tests. The higher the reliability coefficient, the higher the data reliability of the indicator. The calculation formula of the reliability coefficient α is:

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum_{i=1}^k \sigma_i^2}{\sigma^2} \right) \tag{8}$$

In the formula, k is the total number of indicators, σ_i is the value variance of the σ^2 indicator data, and k is the value variance of all indicator data. The coefficient α is between 0.80 and 0.90, the effect is the best, between 0.70 and 0.80, the effect is quite good, between 0.65 and 0.70, the effect is only acceptable, between 0.60 and 0.65, the effect is the worst. Record and sort out the index data of the three groups of experiments, change the total amount of the evaluation index data, that is, change the number of students to get the reliability coefficient of the index data. The comparison results are as Fig. 2.

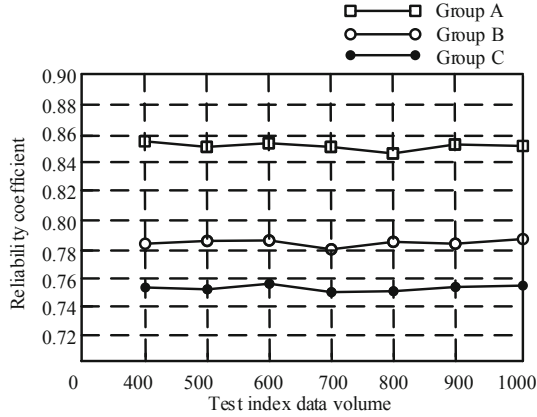


Fig. 2. Comparison results of reliability coefficient

According to 2, the reliability coefficient of the index coefficient of group A is always higher than that of group B and group C. The average reliability coefficient of group A is 0.857, which is the best. The average reliability coefficient of group B is 0.786, and the effect is quite good. Compared with group B and group C, the reliability coefficient of group A is 0.071 and 0.103 respectively.

Results of the Second Group of Experiments

Then use the statistical software spss23.0 to test the validity of the three sets of system test index data. Validity is validity, which refers to the degree to which measurement tools or means can accurately measure the things that need to be measured. Validity refers to the extent to which the measured results reflect the content to be investigated. The higher the validity value, the higher the information extraction level of the test index. The validity value calculation formula β is:

$$\beta = \frac{v^2}{\tau^2 + \rho^2 + \gamma^2} \quad (9)$$

In the formula, v is the variance of the index data value with errors, and τ , ρ , and γ are the value variances of the index data of the first, second and third levels respectively. The result value is greater than 0.8, the index data validity is high, ranging from 0.7 to 0.8, the validity is good, the validity is between 0.6 and 0.7, the validity is acceptable,

less than 0.6, the validity is poor. The comparison results of validity values of the three groups of experimental index data are as Fig. 3.

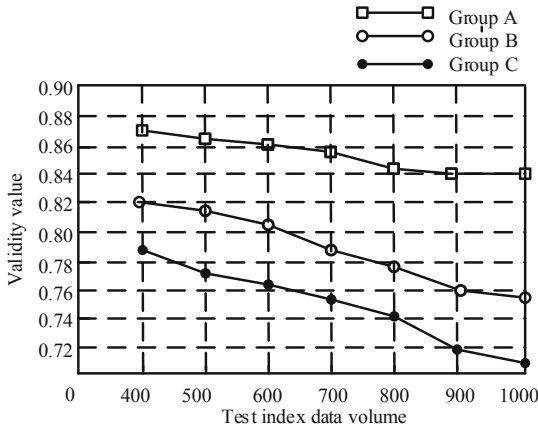


Fig. 3. Comparison results of validity values

According to Fig. 3, when the amount of index data increases, the validity value of the three groups of experimental index data decreases, but the validity value of experimental group A is also higher than that of group B and group C. The average validity value of group A is 0.853, and the index data validity is high. The average validity value of group B and group C is 0.784 and 0.749, respectively. The validity of index data is good, and the validity value of group A is increased by 0.069 and 0.104 respectively. To sum up, this design method improves the reliability and extraction ability of index data, and the reliability of evaluation index is better than the traditional method, which improves the teaching quality and accuracy of evaluation grade of human resource management major.

4 Conclusion

The design method gives full play to the advantages of big data technology, the comprehensive evaluation results of teaching quality are better, the reliability coefficient and validity value are higher, the reliability of evaluation index is improved, and the evaluation results are more accurate. However, there are still some deficiencies in this study. In the future research, new network technology and modern information technology are used to further improve the efficiency and quality of evaluation.

References

1. Lin, G.U.: Multimedia teaching quality assessment based on grey relational analysis and neural network. *Modern Electron. Tech.* **43**(9), 183–186 (2020)

2. Xu, X.: Research on teaching quality evaluation of online courses in higher vocational colleges based on fuzzy analytic hierarchy process. *J. Wuxi Inst. Technol.* **20**(4), 90–93+112 (2020)
3. Wei, L.I., Ying, X.U., Shuhai, C.H.E.N.: Research on teaching quality assurance and evaluation system based on college students' learning achievements. *Theor. Pract. Contemp. Educ.* **12**(2), 71–77 (2020)
4. Zhenyuan, Q.U.: Normalization construction of review and evaluation on the undergraduate teaching. *ChongQing High. Educ. Res.* **8**(3), 5–10 (2020)
5. Wang, J.: Analysis of teaching quality assurance system from the perspective of auditing and evaluation——taking the college of economics and management, Shihezi University as an example. *J. Bingtuan Educ. Inst.* **29**(1), 43–46+59 (2019)
6. Zhongkui, W.A.N.G., Jing, G.U.O., Xiaotian, H.U.: An analysis of performance-oriented undergraduate teaching quality evaluation model——based on technical analysis of british teaching excellence framework. *Stud. Foreign Educ.* **46**(3), 58–74 (2019)
7. Yihui, S.H.E.N.: Evaluation and analysis of junior college education quality based on deep belief network. *Fujian Comput.* **35**(11), 81–83 (2019)
8. Li, M., Zhong, S., Li, Q., et al.: Exploration and practice of course teaching quality assessment. *J. Hubei Polytech. Univ. (Humanit. Soc. Sci.)*, **35**(2), 79–82:88 (2018)
9. Yu, L.I., Lan, H.U.: On practice of vocational schools to construct teaching quality evaluation system in shanghai. *Vocat. Tech. Educ.* **39**(27), 64–68 (2018)
10. Hou, R., Li, J.: Multi-dimensional big data intelligent classificati simulation under multi-layer perception learning. *Comput. Simula Retrievaltion*, **37**(5), 345–348+447 (2020)
11. Fu, W., Liu, S., Srivastava, G.: Optimization of big data scheduling in social networks. *Entropy* **21**(9), 902 (2019)
12. Liu, S., Li, Z., Zhang, Y., et al.: Introduction of key problems in long-distance learning and training. *Mobile Networks Appl.* **24**(1), 1–4 (2019)
13. Liu, S., Glowatz, M., Zappatore, M., et al. (Eds.): *E-Learning, E-Education, and Online Training*. Springer International Publishing, 1–374 (2018). <https://doi.org/10.1007/978-3-030-63952-5>