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RESEARCH ARTICLE

A BP Neural Network-Assisted Smart Decision Method for Education Quality

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ABSTRACT Deep neural network-based decision support has been more prevalent in many cross-discipline applications, as their strong computation ability can facilitate knowledge discovery and rule mining. In this context, this work explores its utilization to the field of education quality evaluation, in order to bring more automatic elements for this purpose. Therefore, a BP neural network-assisted smart decision method for education quality is proposed in this paper. Specifically, the method of questionnaires is utilized to screen indicators, expert evaluation method is adopted to determine the weight of evaluation indexes, and a comprehensive education evaluation index system is accordingly built. After constructing a complete evaluation system, this paper establishes an evaluation model of ideological and political education by using BP neural network algorithm and takes University as an example to compare the performance of W University students before and after applying the model. This model has been applied and demonstrated, and the evaluation way of college teaching quality has been innovated. At last, some simulation experiments are carried out for further assessment, and the results show that the proposal can work well in terms of automatic education quality evaluation.

INDEX TERMS Smart evaluation, education quality, BP neural network, decision support system.

I. INTRODUCTION

College students' political education is an important part of college moral education, which has a direct impact on college's whole progress of education work, especially on the students' moral education [1]. In recent years, artificial intelligence has aroused great interest of scholars at home and abroad [2]. Many countries have done a lot of research on it, and formulated corresponding policies and strategies [3]. To improve the education quality in colleges, we must establish a sound evaluation system [4]. Taylor, a famous scholar in American education, once said, ''The analysis of educational goals, educational evaluations and educational plans are in a continuous cycle [5].

When you are evaluating the effect of educational evaluations, you will repeatedly want to correct and revise those preset educational goals [6]. After the revision of the goals and the guidance plan, the guidance method and the evaluation plan are also required to be revised [7]. They are mutually cyclical and are a dynamic process [8]. Therefore, improving the educational evaluation method can make the whole process of education has an increase [9], [10]. Therefore, the establishment of ideological and political education evaluation system in colleges must aim at promoting work in this field [11], [12]. This paper constructs the evaluation system model by using expert evaluation method and BP neural network algorithm [13].

In the aspect of theoretical value, this paper discusses the realistic problems in the humanities and social sciences [14]. In the aspect of practical value, to reform the current evaluation system in colleges, we must solve the problems of single evaluation method [15]. Through the mathematical model, the evaluation results can be quantified [16]. Hence, schools can better evaluate it objectively, and can find the problem, thus promoting its further development [17]. At the same time, through the implementation of evaluation system, a teacher reward and punishment mechanism can be established. And the enthusiasm of teachers to educate people scientifically can be improved. While building evaluation system, a corresponding incentive mechanism should be

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gradually established, so that teachers can devote themselves to the education work in this field [18].

rest of this paper is organized as follows: the second part discusses the related work, the third part constructs the evaluation index system, the fourth part designs the education quality evaluation system based on BP neural network, and the fifth part summarizes the full text.

II. RELATED WORK

Educational evaluation is a way to measure the characteristics of educational phenomena [19]. During the development of educational evaluation theory, many different explanations have emerged with the gradual deepening of understanding. A popular idea is that equating educational assessment with educational testing as a process of comparing it to an expected ideal situation or goal. Taylor's value assessment theory is a representative concept [20]. The United States and Western Europe have conducted a comprehensive assessment of teaching quality in colleges. Its evaluation direction mainly focuses on the moral evaluation. There are many assessment methods, including Hutson's morality assessment method, Cartel's 16-factor personality questionnaire method, and the cognitive school's moral judgment test method [21].

The basic idea of these methods is to obtain relevant assessment information from three aspects. First, to see what the person being assessed has said about his own situation. Second, to see what people who know the person being assessed have said to him and to see what the person being tested actually does, how he acts in a real-life environment. Then, according to certain rules or standards, the obtained data and information are analyzed and processed, and evaluation is made [22]. Some schools, at the time of the final exam, will write a conduct comment on the score report. In educational evaluation, there are many methods for evaluating students' morality, such as behavioral evaluation, behavioral addition and subtraction scoring method, examination scoring method, integral scoring method, fuzzy comprehensive evaluation method, moral situation evaluation method, OSL morality scoring method, FRC Morality Assessment Method, etc.

By summarizing the above research methods, it can provide a useful reference for the evaluation. In practice, two or three methods are generally used for comprehensive evaluation [23]. This paper analyzes several comprehensive evaluation methods commonly used at present, and they each have their own characteristics and application scope.This paper makes a comprehensive analysis of the evaluation in colleges, and believes that both qualitative and quantitative analysis are objects that will cause a general concern in the current academic circles, but there are not many achievements at present. Using expert evaluation method and BP neural network technology in the evaluation of college education, quantifying the content of the abstract evaluation indicator, and establishing a comprehensive evaluation mathematical model to achieve quantitative evaluation is the future research trend [24].

III. EVALUATION INDICATOR SYSTEMCONSTRUCTION

A. DIVERSIFIED EVALUATION SUBJECTS

To make sure that the assessment results is accurate, we must have a high quality assessment team. Firstly, the members of the evaluation group should know clearly the direction and demand of the teaching reform, the education theory, the teaching content, the orientation of evaluation, the theory and technique of the teaching assessment. Secondly, in the teaching assessment, we should focus on teaching supervision and peer evaluation, which are usually made up of experts and scholars in a particular field. Thirdly, the evaluation should be serious. The final assessment of the teaching should take into account the opinion of the majority of evaluators. Fourthly, it is necessary to enhance the assessment of students so as to make them master the assessment methods and decrease the influence of subjective factors. Currently, the teaching assessment group is made up of experts, teachers, colleagues, students, etc. In the course of assessment, each aspect has its own function. Based on the above analysis, we can set up the evaluation system as follows(Table 1).

TABLE 1. List of evaluation indicators.

Factor Ai	A1	A2	A3	$\sum$
Weights bi				

B. WEIGHT CONSTRUCTIONMETHOD OF EVALUATION INDEX SYSTEM

1) MATHEMATICAL STATISTICAL METHOD

a: EXPERT EVALUATION METHOD

The expert evaluation method is to select a group of professionals, score the indicators, give the weights they think are reasonable, and then perform a weighted average according to the weight coefficients given by each expert, so as to obtain the weight distribution of each indicator [25]. The basic process is as follows:

The first step is to identify expert candidates. First of all, it is necessary to identify a group of experts and scholars with rich work experience, complete knowledge system, good professional ethics, and recognized by most people in the field, and set up an expert group to evaluate the weight of indicators.

The second step is the initial evaluation by experts. The determined indicator system is submitted to each expert of the expert group for review, and each expert determines the weight of each indicator in the indicator system on the premise of not affecting each other.

The third step is to gather expert opinions. After experts determine the weight of each indicator, the data is collected, organized and processed.

The fourth step is to calculate the result. Through the weighted average of each evaluation indicator, the weight distribution system of every indicator is obtained. If the evaluation conclusions are very different, then it is necessary to hold an expert meeting to adjust various indicators,

TABLE 2. Weight distribution table of each evaluation indicator.

Serial Number	A1			A2			A3		
	R1	H1	K1	R1	H1	K1	R1	H1	K1
1	0.15	1	0.055	0.22	1	0.0231	0.25	2	0.253
2	0.3	4	0.158	0.14	2	0.0411	0.17	5	0.254
3	0.44	2	0.256	0.45	5	0.125	0.34	4	0.336
4	0.65	5	0.014	0.11	4	0.147	0.45	7	0.214
5	0.47	9	0.452	0.14	5	0.556	0.12	8	0.258
6	0.2	2	0.455	0.25	7	0.745	0.47	5	0.464
7	0.11	1	0.112	0.12	7	0.147	0.21	7	0.441
$\sum$		24	1		24	1		24	1
L1 represents number of weights M1 represents frequency N1 represents rate									

and finally reach a consensus, and the final result of the weight distribution system is scientifically valid.

TABLE 3. List of evaluation indicators.

Factor Bi	B1	B2	...	BN	$\sum$
Weights bi					

b: WEIGHTED STATISTICAL METHOD

When there are not so much experts, we could choose to use the weighted average method in this sistuation [26]. If there are three different evaluation indicators of A1, A2, A3, the corresponding weights need to be given by different experts, as shown in Table 2. The weights of each indicator are determined by experts, and the weight distribution of each indicator is obtained, as shown in Table 3. Using formula $A_x = \sum_{n=1}^{6} d_i n_i$ to calculate, then the weight coefficient of each evaluation indicator can be obtained:

$$\mathrm{B} = (0.212, 0.344, 0.189) \tag{1}$$

c: FREQUENCY STATISTICAL METHODS

When the number of experts is too large, the weight set listed by the experts is processed by the frequency statistics method [27]. If there are evaluation indicators such as B1, B2, ... BN, they need to be determined by different experts, as shown in Table 4. After the calculation of experts, the weight distribution of each indicator is obtained, as shown in Table 5. According to weight distribution table proposed by each expert, we could perform univariate analysis on each of its evaluation indicators, and the weight of each indicator is obtained. how to operate is as follows:

At first, factor $B_x(x = 1, 2, \cdots n)$ represents different indicator at different situation.in its weight $b_{xn}(n = 1, 2, \cdots, l)$, find the maximum M_x and minimum M_n. This can be expressed as:

$$M_x = \max_{1<i<l} \{b_{xn}\}, \quad M_x = \min_{1<j<l} \{b_{xn}\} \tag{2}$$

And then find suitable positive integer, set the value of $\frac{M_x - M_n}{Q}$ as the group distance and arrange the weights in order from small to large, and divided into Q groups according to the group distance. Then, the Q groups are sorted in descending order, and obtained the frequency of each weight set. Finally, the largest group can be determined according to the frequency of each weight group, and take the median of the weights in the group as the weight, which can finally be expressed as follows:

$$\mathrm{b} = (b_1, b_2, \cdots, b_n) \tag{3}$$

2) FUZZY RELATIONAL EQUATION METHOD

Essentially, the problem of solving fuzzy relational equations is to find weight distribution, so now we introduce the method of fuzzy relational equations to find weight distribution [28].

$$T_{j\times o} \cdot S_{o\times n} = C_{j\times n} \tag{4}$$

As the kernel of fuzzy mathematics, the significance of fuzzy relation equation is self-evident. For this reason, we first introduce this method. because the simplicity and intuitive description, this paper only deals with the case that the evaluation index is a finite set. In the condition of finite universe, fuzzy matrix can be used as an equivalent substitute for fuzzy relation. If the fuzzy matrix $S \in \gamma_{n\times t}$, $C\epsilon\gamma_{o\times t}$ is known,the unknown fuzzy matrix y is required to satisfy:

$$Y_{o\times n} \cdot S_{n\times t} = C_{o\times t} \tag{5}$$

Or the fuzzy matrix $S\epsilon\gamma_{n\times t}$, $C\epsilon\gamma_{o\times t}$ is known,the unknown fuzzy matrix x is required to satisfy:

$$S_{o\times n} \cdot Y_{n\times t} = C_{o\times t} \tag{6}$$

If transpose both sides of the formula $S_{o\times n} \cdot Y_{n\times t} = C_{o\times t}$, then the following formula can be gotten:

$$Yt \cdot Sr = Cr \tag{7}$$

According to weight distribution requirement, this paper simply discusses the following form of fuzzy matrix.

$$(y_1, y_2, \ldots, y_o) \cdot \begin{bmatrix} s_{11} & s_{12} & \ldots & s_{1n} \\ s_{21} & s_{22} & \ldots & s_{2n} \\ \ldots & \ldots & \ldots & \ldots \\ s_{o1} & s_{o2} & \cdots & s_{on} \end{bmatrix} = (c_1, c_2, \ldots, c_n) \tag{8}$$

TABLE 4. Weight distribution table of each evaluation indicator.

Serial Number	B1			B2			BN		
	R1	H1	K1	R1	H1	K1	R1	H1	K1
1	0.15	1	0.055	0.22	1	0.0231	0.25	2	0.253
2	0.3	4	0.158	0.14	2	0.0411	0.17	5	0.254
3	0.44	2	0.256	0.45	5	0.125	0.34	4	0.336
4	0.65	5	0.014	0.11	4	0.147	0.45	7	0.214
5	0.47	9	0.452	0.14	5	0.556	0.12	8	0.258
6	0.2	2	0.455	0.25	7	0.745	0.47	5	0.464
7	0.11	1	0.112	0.12	7	0.147	0.21	7	0.441
$\sum$		24	1		24	1		24	1
L1 represents number of weights M1 represents frequency N1 represents rate									

TABLE 5. College teaching quality evaluation form (for students).

	comment content	weight	Evaluation level			
			A	B	C	D
Teaching attitude	1. Fully prepared, proficient in lectures, and full of energy	0.1				
	2. Caring, demanding, managing and responsible.	0.05				
	3. Earnest guidance, adequate amount of homework, timely correction	0.07				
Teaching content	4. The teaching goal is clear, the content is scientific, the concept is precise	0.04				
	5. Combine theory with practice, provide suitable examples, and pay attention to practice.	0.06				
	6. Highlight key points and clarify difficulties	0.05				
Teaching method	7. Rational teaching organization and efficient use of classroom time	0.07				
	8. Standard language, concise, concise, clear and beautiful	0.04				
	9. Flexible teaching methods, able to carry out two-way communication.	0.04				
Teaching effect	10. Students are attentive, interested, and have a good classroom atmosphere	0.05				
	11. Be able to better grasp and digest the theoretical knowledge in the classroom.	0.1				
Teaching and educating	12. All aspects of morality and behavior can be a model for others and lead by example	0.06				
	13. Integrate moral education in the teaching process	0.05				

TABLE 6. College teaching quality evaluation form (for experts).

	comment content	weight	Evaluation level			
			A	B	C	D
Teaching attitude	1. Fully prepared, proficient in lectures, and full of energy	0.1				
	2. Caring, demanding, managing and responsible.	0.05				
	3. Earnest guidance, adequate amount of homework, timely correction	0.07				
Teaching content	4. The teaching goal is clear, the content is scientific, the concept is precise	0.04				
	5. Combine theory with practice, provide suitable examples, and pay attention to practice.	0.06				
	6. Highlight key points and clarify difficulties	0.05				
Teaching method	7. Rational teaching organization and efficient use of classroom time	0.07				
	8. Standard language, concise, concise, clear and beautiful	0.04				
	9. Flexible teaching methods, able to carry out two-way communication.	0.04				
Teaching effect	10. Students are attentive, interested, and have a good classroom atmosphere	0.05				
	11. Be able to better grasp and digest the theoretical knowledge in the classroom.	0.1				
Instructional Documentation	12. The teaching materials and reference materials are selected with appropriate teaching content consistent with the teaching plan	0.06				
	13. Consistent teaching documents are complete (teaching plan, teaching schedule, teaching plan, etc.)	0.05				

C. EVALUATION INDEX SYSTEM

Pluralism is one of the most distinctive characteristics of wisdom evaluation methods of ideological and political theory courses in colleges and universities. Among them, the evaluation subject and the evaluation object are diversified. The traditional way of evaluation of ideological and political theory courses in colleges and universities is mainly a one-way evaluation of teachers on students, mostly using ''other evaluation'', while the wisdom evaluation of ideological and political theory courses in colleges and universities is a multi-dimensional three-dimensional evaluation with the help of the new generation of information technology such as big data and artificial intelligence.

Wisdom evaluation methods of ideological and political theory courses in colleges and universities include not only other evaluation, but also self-evaluation, other evaluation, mutual evaluation, third party evaluation and other diversified evaluation methods. Based on the interactive and personalized characteristics of information technology, the evaluation activities are carried out in the information evaluation system. The system pushes corresponding learning resources according to the individual characteristics and interests of each student, which provides a basis for improving the teaching of ideological and political theory courses in colleges and universities.

This paper carried out a well-designed questionnaire, a preliminary selection, an expert selection, and a formal questionnaire. During the release of the public ques-tionnaire, we conducted a survey of school students about the school's continuous improvement in the quality of education. Questions in the questionnaire include ''What should the school do to continuously improve the quality of teaching?'', ''How do you think we can improve the quality of your own learning?'' The questionnaire was distributed at random, and the

students were asked to give their views as much as possible. 100 questionnaires were sent out, 96 copies were obtained.

In this paper, we sorted out the major content of the open-ended questionnaire, conducted preliminary indicator screening, and solicited the opinions of education evaluation experts and school supervision experts, and put forward preliminary teaching quality evaluation indicators based on these opinions, including college teaching quality evaluation form for students, for experts, for teaching supervision and peers:

IV. EDUCATIONAL QUALITY EVALUATION SYSTEM BASED ON BP NEURAL NETWORK

A. BP NEURAL NETWORK

BP network was a kind of network that has many layer feed trained. At present, 90% of neural network models are made of BP network or its deformation. It is the major part of forward network and it is very popular adopted in the field [29]. Figure 1 illustrates a neural network model with S inputs and a hidden layer. The activation function of BP network is differentiable everywhere, so we usually use logarithm of sigmoid or tangent activation function and linear function.

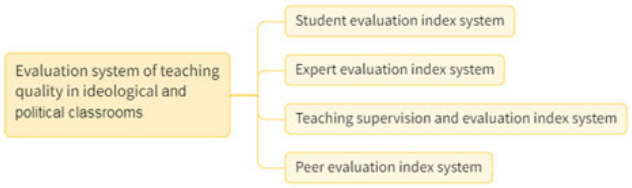

FIGURE 1. Evaluation system of college teaching quality.

In essence, the BP algorithm takes the total error of the net as an objective function, and the minimum value is obtained by the gradient method [30]. The entire learning process can be illustrated in Figure 2. These parameters are initialized with random numbers in the range of [-1, 1] to initialize the initialization parameters and learning parameters, including 5 parts.

The training sample of network consists of 2 parts, the input vector $Y = [y_1, \ldots, y_{o1}]^U$. In this model, the next algorithm steps of hidden layer are:

$$z_i^l = g\left(\sum_{j=1}^{o1} x_{jk} \cdot y_j^l + \theta_i\right) \tag{9}$$

$$o_s^k = h\left(\sum_{i=1}^{o2} x_{it} z_i^l + \theta t\right) \tag{10}$$

In this learning algorithm, the error F needs to be calculated and then the generation algorithm in the output layer is

$$E_S = \frac{1}{2}\sum_{S=1}^{N3}\left(T_S^k - O_S^K\right) \tag{11}$$

Then we use what the the final results of error F to see if the actual output is the same as the expected number, and then the error function is like:

$$E = \frac{1}{2}\sum_{k=1}^{N}\sum_{S=1}^{N3}\left(T_S^k - O_S^K\right) \tag{12}$$

If the actual results of this algorithm is not higher than the preset limit or preset number is less than the learning times, then the progress will not move on. If it achieves the value c, the progress continue. The neuron error in both layers is calculated. If the preset value is $\mathrm{U_t} = [U_1, \ldots, U_{o3}]$, the actual value is $\mathrm{P_t} = [P_1, \ldots, P_{o3}]$. Then, the formula can be deduced:

$$e_t^k = \left(u_t^k - p_t^k\right) p_t^k \left(1 - p_t^k\right) \mathrm{t} = (1, 2, \ldots\ldots, \mathrm{O_3}) \tag{13}$$

According to the former value in the layer, we will get the resule e_t^k and whs and yh, the right number in the other layer could be calculated as:

$$e_i^l = \left[\sum_{u=1}^{o3} e_S^l w_{is}^l\right] y_i^l \left(1 - y_i^l\right) i = (1, 2, \ldots\ldots, 02) \tag{14}$$

x_{it} is adjusted first, and then x_{ji} is adjusted. The adjustment amount of the weight is:

$$\Delta x_{it} = -\eta \frac{\partial F}{\partial x_{it}} = \eta f_t^l z_i \tag{15}$$

$$\Delta x_{ji} = -\eta \frac{\partial F}{\partial x_{ji}} = \eta f_i^l y_u \tag{16}$$

The correction weight is

$$x^{l+1} = x^l + \Delta x = x^l - \eta^l \frac{\partial f^l}{\partial x^l} \tag{17}$$

The adjustment amount of the threshold is

$$\theta_i = \eta \frac{\partial F}{\partial \theta_i} \tag{18}$$

$$\theta_\mathrm{t} = \eta \frac{\partial F}{\partial \theta_\mathrm{t}} \tag{19}$$

$$\theta^{l+1} = \theta^l + \eta \frac{\partial F}{\partial \theta^l} \tag{20}$$

B. TEACHING QUALITY EVALUATION MODEL BASED ON BP NEURAL NETWORK

1) ARTIFICIAL NEURAL NETWORK STRUCTURAL FRAMEWORK

Combined with the teaching quality evaluation indicator system constructed above, this system designs four subsystems, The outputs of the 4 subsystems constitute the input of the whole network. As shown in Figure 3. Choice of network model is a key problem. A good network model can reduce the number of network training, save a lot of training time, decrease the training time of the model, and improve the total efficiency [25]. The network consists of network level and the number of nodes in every layer. The evaluation of teaching quality can be considered as a nonlinear mapping, that is, from input (teaching quality evaluation indicator) to output (the final evaluation of the teachers' teaching quality).

TABLE 7. College teaching quality evaluation form (for experts).

	comment content	weight	Evaluation level			
			A	B	C	D
Teaching attitude	1. Fully prepared, proficient in lectures, and full of energy	0.1				
	2. Caring, demanding, managing and responsible.	0.05				
	3. Earnest guidance, adequate amount of homework, timely correction	0.07				
Teaching content	4. The teaching goal is clear, the content is scientific, the concept is precise	0.04				
	5. Combine theory with practice, provide suitable examples, and pay attention to practice.	0.06				
	6. Highlight key points and clarify difficulties	0.05				
Teaching method	7. Rational teaching organization and efficient use of classroom time	0.07				
	8. Standard language, concise, concise, clear and beautiful	0.04				
	9. Flexible teaching methods, able to carry out two-way communication.	0.04				
Teaching effect	10. Students are attentive, interested, and have a good classroom atmosphere	0.05				
	11. Be able to better grasp and digest the theoretical knowledge in the classroom.	0.1				
Instructional Documentation	12. The teaching materials and reference materials are selected with appropriate teaching content consistent with the teaching plan	0.06				
	13. Consistent teaching documents are complete (teaching plan, teaching schedule, teaching plan, etc.)	0.05				
Teaching management	14. Use appropriate attendance methods to maintain classroom teaching order	0.03				

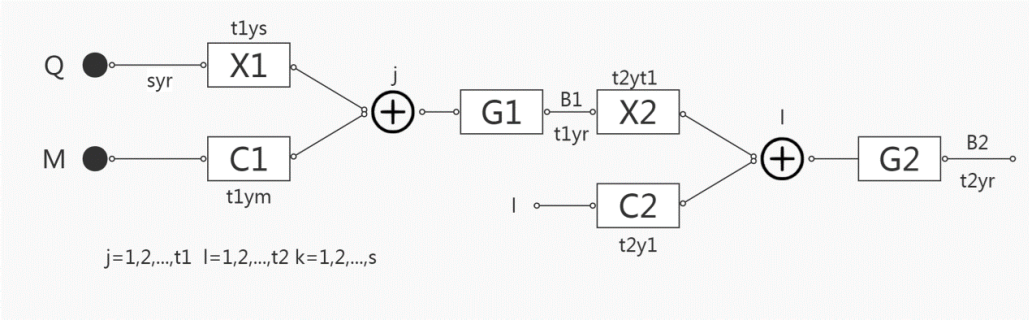

FIGURE 2. Neural network model structure diagram with one hidden layer.

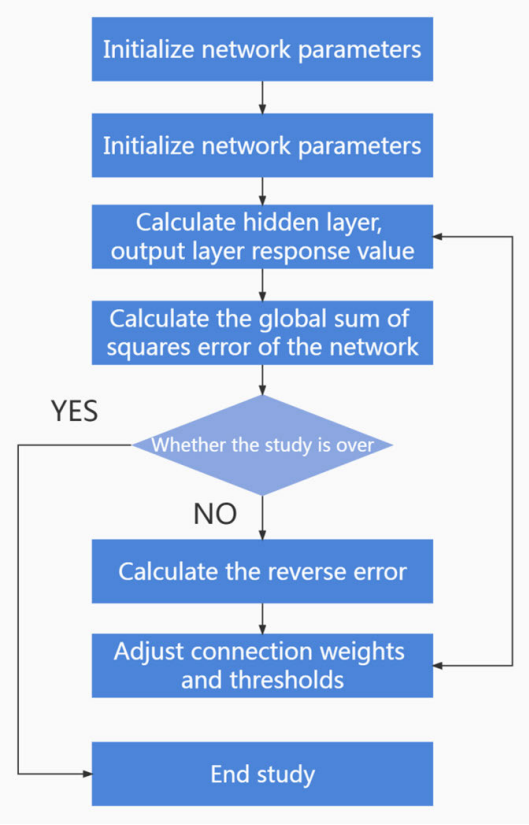

FIGURE 3. BP neural network training flow chart.

Kolmogorov's theorem pointed out that the BP network's advantage could be that it can effectively reducing the storage consumption of the network and highly improving learning efficiency [31],which is really convenient for the people who use this network. This paper's network has three layers.

2) NEURAL NETWORK MODEL STRUCTURE

Firstly, we construct this kind of network is by specifying the related numbers in each layer [32]. We decided the first parameters by continuously change the part of network, and continue to put in numbers to let the network study. After the repeating of the learning, the network became more and more stable,then the training program become more muture. When it meets the goal we set before, it will finish and stop. [33].

The concrete steps to build the model and the steps are just like the following:

(1) Determine initial value of the first layer

according to the evaluation system that build before, we could accordingly divided the progress into five first indicators and 13 secondary indicators, and then we know the node is 13.

(2)Determine the value of the second layer

Because the consequence is the just one, so we could easily set the value. In this paper we set the range to [0,1].

(3) Determining of the last layer value

The most popular used formulas to determine the last layer number are:

$$H = \sqrt{K + P} + b$$
$$H = \log_2 o$$
$$H = \sqrt{om} \tag{21}$$

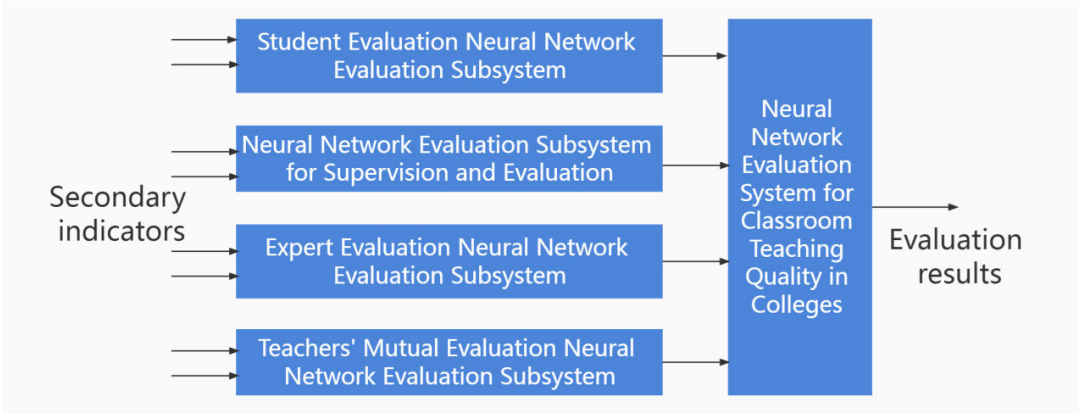

FIGURE 4. Neural Network Evaluation System for Teaching Quality in Colleges.

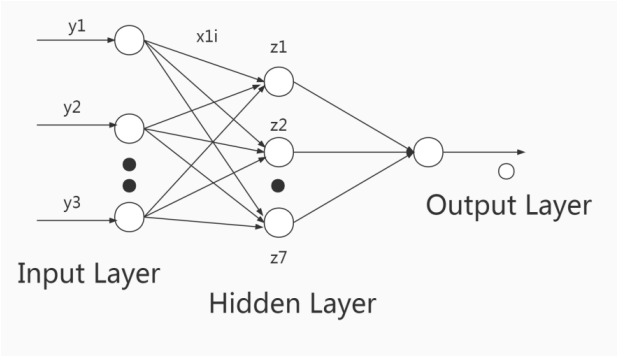

FIGURE 5. BP neural network model.

H represent the value of first layer, O represents the value of the second layer, and m represents the last layer. According to the calculating progress $n = \sqrt{o+m} + b$, the number of second layer nodes is 6 to 15, and keep testing, we get the best hidden layer node 8.

(4) Activation function selection

we use the function form as follows to determine the activation function, which is the initial function of the second layer

$$f(y) = \frac{1}{1+f^{-y}} \tag{22}$$

(5) Establishment of model

Establish the network structure as shown in Figure 4.

In this part of system, the value that put in is $Y = (y_1, y_2, \cdots, y_{13})^U$, and value that used in the second layer is $X = (x_{12}, x_{13}, \cdots, x_{13,8})$, the value of the third layer is $Z = (z_1, z_2, \cdots, z_8)$, what we gain in this structure is $X = (x_1, x_2, \cdots, x_8)$. What we use to calculate in this model is as follows.

$$\begin{aligned} z_i 1 &= g\left(\sum_{i=1}^{13} x_{ji} \cdot y_i^l + \theta_i\right) \\ p_t 1 &= h\left(\sum_{i=1}^{8} x_i z_i^l + \theta\right) \end{aligned} \tag{23}$$

(6) Selection of network learning algorithm

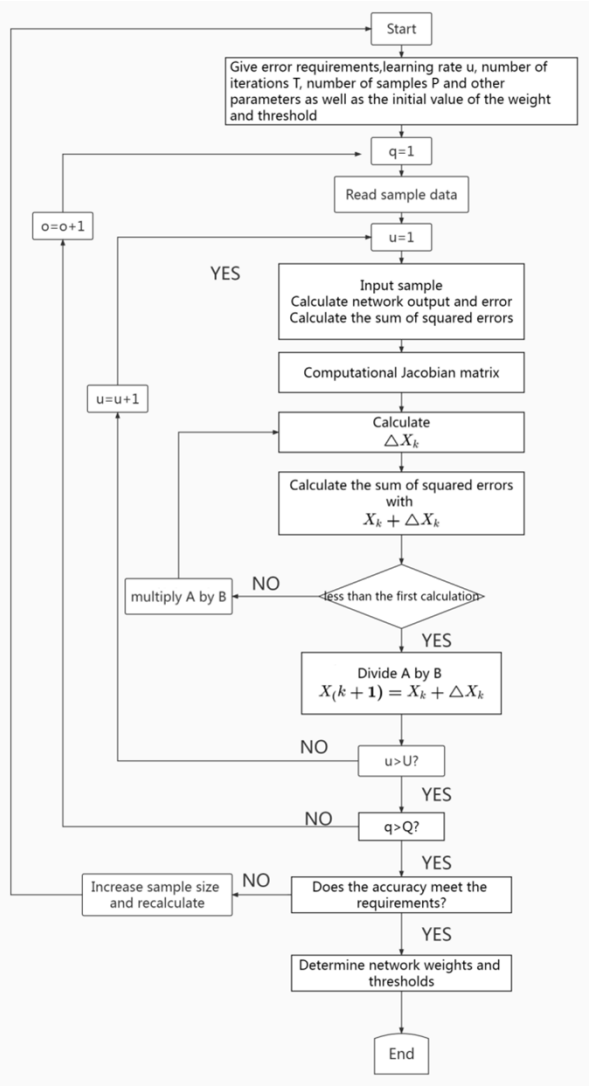

FIGURE 6. Student evaluation of teaching neural network training flow chart.

Generally BP Neural Networks use a special way to adjust the weight of network numbers, which is the advantage of

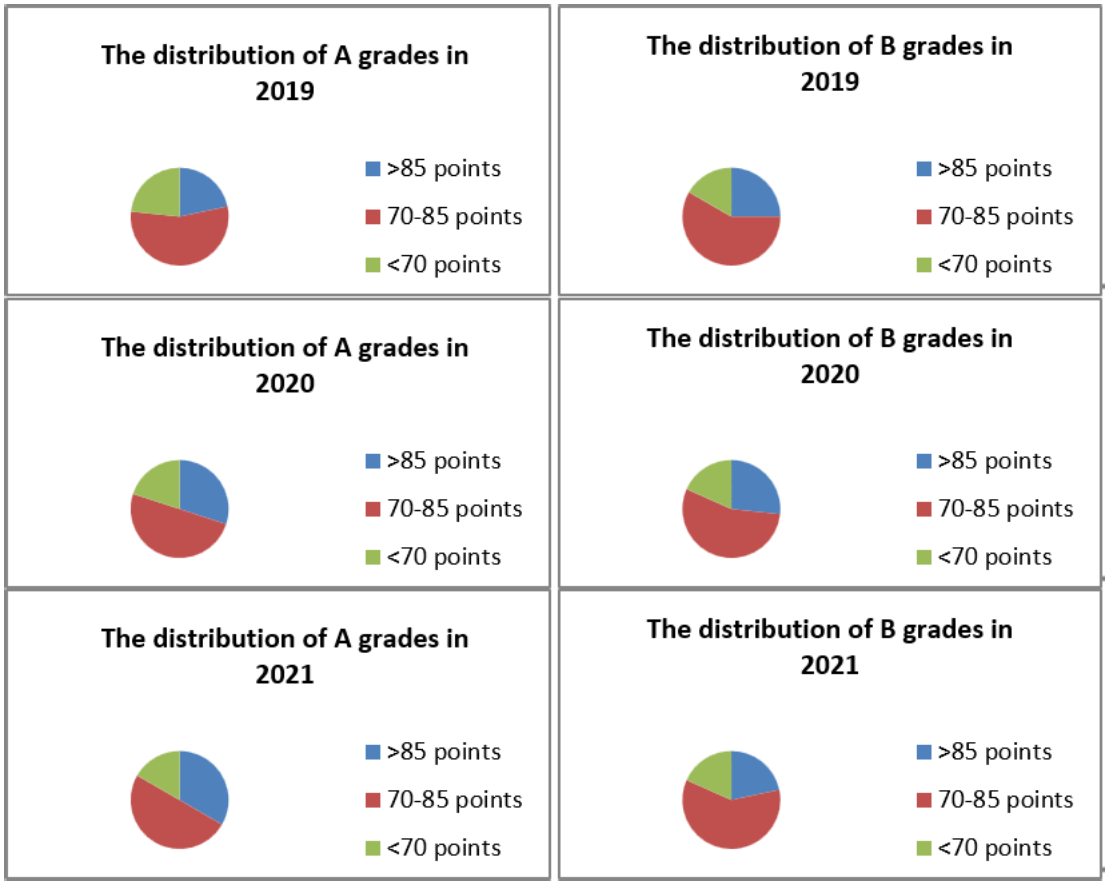

FIGURE 7. 2019-2021 W University first-year academic achievement distribution map.

BP Neural network. However, this learning method has some shortcomings of easily making mistakes during the progress of learning, which means we need a way to overcome the shortcomings of BP neural network, the solution of which is LMBP learning algorithms. LMBP is a modification of traditional learning algorithm. Compared with other algorithms, the convergence rate and precision of LMBP are closer to our needs. This paper chooses the LMBP learning algorithms to conduct the learning progress.

3) LMBP LEARNING ALGORITHMS

The training steps of LMBP are: in the first stage of training, select minimum learning speed λ: $\lambda = 0.001$, if the error F can't be reduced by a step, multiply λ by 10, and this step is repeated until F decreases. When there was a small F, multiply λ by 0.11 and continue the operation. The execution steps of the algorithm are as Figure 6.

C. APPLICATION OF TEACHING QUALITY EVALUATION MODEL

This model takes W University as an example, through the investigation and comparison of W University students' performance before and after the application of the model. There are four grades in W University. Six classes were selected from the freshmen of the 2019 class, and 30 students were randomly selected from each class, with a total sample of 180 students. The teaching quality evaluation model is applied in 3 classes, and the 90 sample student groups applying the model are denoted by A, the other 3 classes do not apply this model, and the 90 sample student groups that do not apply the model are denoted by B. The grades of the three-year statistical sample students were compared and verified, and the results are as follows.

It can be clearly seen that the scores of students A who have applied the model have a larger increase than the scores of students B who have not applied the model, and the learning effect is very good.

V. CONCLUSION

This paper selects the indicators through the method of questionnaires, determines the weight of the evaluation indexes by the AHP method, and builds a comprehensive ideological and political education evaluation index system. After constructing a complete evaluation system, this paper establishes an evaluation model by applying the BP neural

network algorithm, and takes W University as an example to compare the performance of W University students before and after applying the model.

This model has been applied and demonstrated, and the evaluation method of college teaching quality has been innovated. The most value part of this paper is to use the AHP method and BP network algorithm in the system construction, which is convenient for the college to improve their teaching quality, quantifying the content of the abstract evaluation index, and establishing a comprehensive evaluation mathematical model to achieve quantitative evaluation is the future research trend.

The evaluation of ideological and political theory courses in colleges and universities urgently needs to transform to wisdom evaluation which is one of the core elements of wisdom education. It plays a driving role in the optimization of education ecology, which is the result of the comprehensive effect of the development of science and technology and the innovation of technology. It is a new realm and a new paradigm of the innovation and reform of the way of education evaluation.

It is imperative to iterate and upgrade to the wisdom evaluation method that adapts to the development requirements of the new era. In this paper, the topic is closely combined with the actual needs of the new era of educational evaluation reform, focusing on hot issues. However, the current theoretical and empirical research on wisdom evaluation is still in the preliminary exploration stage, and the relevant literature materials are limited.

In addition to the limited research ability of my own, there are still deficiencies in the depth and breadth of the theoretical content of this topic. We will continue to make efforts to conduct deeper research in the future. It is expected that the research on this topic can arouse the academic resonance of the majority of education scholars and enrich the theoretical think tanks on wisdom evaluation methods of ideological and political theory courses in colleges and universities.

REFERENCES

[1] Z. Guo, K. Yu, A. K. Bashir, D. Zhang, Y. D. Al-Otaibi, and M. Guizani, "Deep information fusion-driven POI scheduling for mobile social networks," *IEEE Netw.*, vol. 36, no. 4, pp. 210–216, Jul. 2022.

[2] S. López-Pernas, A. Gordillo, E. Barra, and J. Quemada, "Examining the use of an educational escape room for teaching programming in a higher education setting," *IEEE Access*, vol. 7, pp. 31723–31737, 2019.

[3] Z. Guo, K. Yu, A. Jolfaei, G. Li, F. Ding, and A. Beheshti, "Mixed graph neural network-based fake news detection for sustainable vehicular social networks," *IEEE Trans. Intell. Transp. Syst.*, early access, Jul. 7, 2022, doi: 10.1109/TITS.2022.3185013.

[4] K. L. Thompson, A. N. Kuchera, and J. N. Yukich, "Teaching college writing from a physicist's perspective," *Amer. J. Phys.*, vol. 89, no. 1, pp. 61–66, Jan. 2021.

[5] T. Kwiatkowski, J. Palomaki, O. Redfield, M. Collins, A. P. Parikh, C. Alberti, D. Epstein, I. Polosukhin, J. Devlin, K. Lee, K. Toutanova, L. Jones, M. Kelcey, M. Chang, A. M. Dai, J. Uszkoreit, Q. Le, and S. Petrov, "Natural questions: A benchmark for question answering research," *Trans. Assoc. Comput. Linguistics*, vol. 7, pp. 452–466, Aug. 2019.

[6] S. López-Pernas, A. Gordillo, E. Barra, and J. Quemada, "Escapp: A web platform for conducting educational escape rooms," *IEEE Access*, vol. 9, pp. 38062–38077, 2021.

[7] A. Gordillo, E. Barra, and J. Quemada, "An easy to use open source authoring tool to create effective and reusable learning objects," *Comput. Appl. Eng. Educ.*, vol. 25, no. 2, pp. 188–199, Mar. 2017.

[8] M. A. M. Nieto, P. D. V. Mora, J. De La Calleja Mora, M. T. Vidal, E. L. Domínguez, D. A. Díaz, and I. E. B. Patiño, "Web service to retrieve and semantically enrich datasets for theses from open educational repositories," *IEEE Access*, vol. 8, pp. 171933–171944, 2020.

[9] D. A. Koutsomitropoulos, "Semantic annotation and harvesting of federated scholarly data using ontologies," *Digit. Library Perspect.*, vol. 35, no. 3/4, pp. 157–171, Nov. 2019.

[10] Q. Li, L. Liu, Z. Guo, P. Vijayakumar, F. Taghizadeh-Hesary, and K. Yu, "Smart assessment and forecasting framework for healthy development index in urban cities," *Cities*, vol. 131, Dec. 2022, Art. no. 103971.

[11] M. Joshi, D. Chen, Y. Liu, D. S. Weld, L. Zettlemoyer, and O. Levy, "SpanBERT: Improving pre-training by representing and predicting spans," *Trans. Assoc. Comput. Linguistics*, vol. 8, pp. 64–77, Dec. 2020.

[12] Q. Zhang, Z. Guo, Y. Zhu, P. Vijayakumar, A. Castiglione, and B. B. Gupta, "A deep learning-based fast fake news detection model for cyber-physical social services," *Pattern Recognit. Lett.*, vol. 168, pp. 31–38, Apr. 2023.

[13] Z. Guo, K. Yu, Z. Lv, K. R. Choo, P. Shi, and J. J. P. C. Rodrigues, "Deep federated learning enhanced secure POI microservices for cyber-physical systems," *IEEE Wireless Commun.*, vol. 29, no. 2, pp. 22–29, Apr. 2022.

[14] U. Tokac, E. Novak, and C. G. Thompson, "Effects of game-based learning on students' mathematics achievement: A meta-analysis," *J. Comput. Assist. Learn.*, vol. 35, no. 3, pp. 407–420, Jun. 2019.

[15] A. Gordillo, D. López-Fernández, S. López-Pernas, and J. Quemada, "Evaluating an educational escape room conducted remotely for teaching software engineering," *IEEE Access*, vol. 8, pp. 225032–225051, 2020.

[16] Z. Guo, K. Yu, N. Kumar, W. Wei, S. Mumtaz, and M. Guizani, "Deep-distributed-learning-based poi recommendation under mobile-edge networks," *IEEE Internet Things J.*, vol. 10, no. 1, pp. 303–317, Jan. 2023.

[17] E. Yin, Q. Li, and Y. Xuan, "One-day performance evaluation of photovoltaic-thermoelectric hybrid system," *Energy*, vol. 143, pp. 337–346, Jan. 2018.

[18] Q. Zhang, K. Yu, Z. Guo, S. Garg, J. J. P. C. Rodrigues, M. M. Hassan, and M. Guizani, "Graph neural network-driven traffic forecasting for the connected Internet of Vehicles," *IEEE Trans. Netw. Sci. Eng.*, vol. 9, no. 5, pp. 3015–3027, Sep. 2022.

[19] E. E. Ebert, M. J. Manton, P. A. Arkin, R. J. Allam, G. E. Holpin, and A. Gruber, "Results from the GPCP algorithm intercomparison programme," *Bull. Amer. Meteorological Soc.*, vol. 77, no. 12, pp. 2875–2888, 1996.

[20] J. K. Kalaga, M. W. Jarosik, R. Szczesniak, and W. Leonski, "Generation of squeezed states in a system of nonlinear quantum oscillator as an indicator of the quantum-chaotic dynamics," *Acta Phys. Polonica A*, vol. 135, no. 2, pp. 270–272, Feb. 2019.

[21] W. Wang, R. Tang, C. Li, P. Liu, and L. Luo, "A BP neural network model optimized by mind evolutionary algorithm for predicting the ocean wave heights," *Ocean Eng.*, vol. 162, pp. 98–107, Aug. 2018.

[22] S. Zhou, C.-Y. Shen, L. Zhang, N.-W. Liu, T.-B. He, B.-L. Yu, and J.-S. Li, "Dual-optimized adaptive Kalman filtering algorithm based on bp neural network and variance compensation for laser absorption spectroscopy," *Opt. Exp.*, vol. 27, no. 22, pp. 31874–31888, 2019.

[23] B. A.Wielicki, B. R. Barkstrom, B. A. Baum, T. P. Charlock, R. N. Green, D. P. Kratz, R. B. Lee, P. Minnis, G. L. Smith, and T. Wong, "Clouds and the Earth's Radiant Energy System (CERES): Algorithm overview," *IEEE Trans. Geosci. Remote Sens.*, vol. 36, no. 4, pp. 1127–1141, Jul. 1998.

[24] Y. Chen, "Prediction algorithm of PM2.5 mass concentration based on adaptive BP neural network," *Computing*, vol. 100, no. 8, pp. 825–838, Aug. 2018.

[25] M. Mangaraj, A. K. Panda, T. Penthia, and A. R. Dash, "Adaptive LMBP training-based icosϕ control technique for DSTATCOM," *IET Gener., Transmiss. Distrib.*, vol. 14, no. 3, pp. 516–524, Feb. 2020.

[26] K. Ohkura, Y. Tatematsu, and A. Tabata, "Construction of a drug release evaluation system: Application of mitochondrial respiration to monitor drug release," *Anticancer Res.*, vol. 41, no. 8, pp. 4083–4088, Aug. 2021.

[27] J. H. Derzon, N. Clarke, A. Alford, I. Gross, A. Shander, and R. Thurer, "Restrictive transfusion strategy and clinical decision support practices for reducing RBC transfusion overuse: A laboratory medicine best practice systematic review and meta-analysis," *Amer. J. Clin. Pathol.*, vol. 152, no. 5, pp. 544–557, 2019.
[28] G. M. Morris, D. S. Goodsell, R. S. Halliday, R. Huey, W. E. Hart, R. K. Belew, and A. J. Olson, "Automated docking using a Lamarckian genetic algorithm and an empirical binding free energy function," *J. Comput. Chem.*, vol. 19, no. 14, pp. 1639–1662, Nov. 1998.
[29] G. R. Orangio, "Expert commentary on the evaluation and management of hemorrhoids," *Diseases Colon Rectum*, vol. 63, no. 4, pp. 424–426, 2020.
[30] J. Barnes and P. Hut, "A hierarchical O(N log N) force-calculation algorithm," *Nature*, vol. 324, no. 6096, pp. 446–449, Dec. 1986.
[31] J. Overberg, A. Broens, A. Gunther, C. Stroth, R. Knecht, M. Golba, and H. Röbken, "Internal quality management in competence-based higher education—An interdisciplinary pilot study conducted in a postgraduate programme in renewable energy," *Sol. Energy*, vol. 177, pp. 337–346, Jan. 2019.
[32] J. Livio and R. Hodhod, "AI cupper: A fuzzy expert system for sensorial evaluation of coffee bean attributes to derive quality scoring," *IEEE Trans. Fuzzy Syst.*, vol. 26, no. 6, pp. 3418–3427, Dec. 2018.
[33] S. J. Wolf, S. A. Hahn, L. M. Nentwich, A. S. Raja, S. M. Silvers, and M. D. Brown, "Clinical policy: Critical issues in the evaluation and management of adult patients presenting to the emergency department with suspected acute venous thromboembolic disease," *Ann. Emergency Med.*, vol. 71, no. 5, pp. 59–109, May 2018.

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