

Research on the model of children's health assessment based on behavioral characteristics

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Abstract. Early childhood education is the cornerstone of children's education, and traditional preschool education methods have been unable to meet parents' expectations. The concept of smart kindergarten came into being. The traditional evaluation method can no longer adapt to the development of kindergarten. Therefore, it is very important to design a more scientific and reasonable infant health assessment model. Taking a kindergarten as the background, we have established a behavioral characteristic-based children's health assessment model to create a smart kindergarten. By optimizing traditional evaluation methods and combining innovative evaluation methods, a child health development evaluation model based on AHP-BPNN and a health evaluation model based on machine learning are proposed. Finally, the infant protection experts gave a comprehensive analysis of the weight gain. The assessment mode adopted by this kindergarten now reduces the pressure on the caregivers. This evaluation model has strong applicability and can be promoted in other kindergartens.

Keywords: Behavioral Characteristics, Clustering, Classification, Evaluation Model.

1. Research background and significance

Early childhood education is the cornerstone of education, the beginning of a comprehensive and systematic education for children, and has a crucial impact on children's lifelong healthy development [1 2]. The goal of this project is to build a behavioral trait-based model for assessing children's health. This paper aims to further optimize and improve traditional evaluation methods, and at the same time combine modern new evaluation methods, with multiple intelligences theory as the theoretical background, to evaluate children's health status through children's behavioral characteristics data. . Therefore, the model is mainly divided into two parts. The first part is to optimize the traditional evaluation method, that is, to optimize the weight of the evaluation system, and propose an improved evaluation model of children's health development based on AHP-BPNN. The behavioral characteristics of children used in this part are mainly evaluated by nursing experts from social, scientific, cultural, artistic, etc. After grouping, protection experts will evaluate and give corresponding evaluation scores.

2. Status quo at home and abroad

The intelligent informatization of preschool education is the trend of social development. In recent years, under the joint exploration of domestic and foreign preschool experts, psychologists and educational scholars, the evaluation system for early childhood development has been continuously improved. The first countries to put forward the concept of teaching evaluation were the United States, Britain and Germany, and gradually formed an independent branch in the late 19th century. The teaching evaluation of modern education began to develop in the 1930s. Bloom in the United Kingdom divides education into two parts: formative education evaluation and final education evaluation. In the 1990s, British scholars conducted in-depth and comprehensive research on formative teaching, changing formative teaching into developmental teaching, and developmental teaching was divided into teacher development evaluation and student development evaluation. In the past few decades, with the rapid development of education in China, early childhood experts have paid more and more attention to the evaluation of children's healthy development. The state also

attaches great importance to the healthy growth of young children, and proposed outlines in 2001, followed by guidelines in 2012.

Based on the analysis of the literature and data, the theories related to the evaluation of the healthy development of young children, the current main educational theories are divided into three theories: the theory of multiple intelligences, the theory of constructivism and the theory of postmodernism. Gardner, a well-known developmental psychologist in the United States, put forward the theory of multiple intelligences in the 1980s. Gardner believes that children's wisdom and ability are not innate, but acquired. It can expand its corresponding intelligence ability in the environment. He divides human intelligence into seven aspects: language, logic, mathematics, space, body movement, music, interpersonal relationships, and introspection.

Experts at home and abroad have also conducted long-term explorations on the assessment strategies for the healthy development of young children, and proposed different assessment methods. Experts at home and abroad proposed the portfolio method to assess the healthy development of young children; Zhang Qiong proposed a questionnaire and child experts' scores to construct an evaluation system; Yang Lufan proposed a gray multi-level comprehensive evaluation system; Zhao Yuanyuan] proposed an early childhood development evaluation system based on AHP-fuzzy comprehensive evaluation. For the scheme proposed by the above experts, the portfolio method has the defects of long evaluation cycle; the quality of the questionnaire is difficult to guarantee, it consumes manpower and material resources and requires a lot of time, and the setting of weights is highly subjective; the analytic hierarchy process has a certain level of AHP-fuzzy comprehensive evaluation reasonably solves the ambiguity in the evaluation process and reduces the subjective awareness of individuals to a certain extent, but there may be super-fuzzy phenomena. With the great changes brought about by reform and opening up and the rapid development of social economy, people are paying more and more attention to early childhood education. Early childhood education, as the initial stage of the education industry, has a crucial impact on a child's life. The evaluation of the healthy development of children can help educators to help children grow better, and it is also of great help to parents. Therefore, the evaluation of the healthy development of young children

It is very important. How to evaluate and how to evaluate scientifically are the problems faced by educators. At present, the main evaluation methods for young children in China are still in the traditional evaluation stage and have not kept up with the rhythm of the development of the times. They have not been organically combined with the current big data technology and machine learning technology. The common evaluation methods for young children in China are: portfolio evaluation method, questionnaire evaluation method, and AHP evaluation method.

3. An evaluation model of children's healthy development based on AHP-BPNN

3.1 Establishment of a child evaluation system based on AHP

The AHP method is the Analytic Hierarchy Process (AHP) method, which combines qualitative and quantitative methods to accurately analyze the relationship between target criterion levels and has strong applicability to decision-making and evaluation. Because of its simplicity and practicality, it is more and more widely used in social, economic and management fields.

3.1.1 Establish an evaluation system

There is still no unified standard for the evaluation system of young children's health, but many educational psychologists divide the healthy development of young children into the following modules: health, language, society, science and art. Using AHP analytic hierarchy process can analyze complex decision-making evaluation problems. By combining quantitative and qualitative analysis, expert experience scores are used to give weights among influencing factors. Combined with the division modules of the health development assessment of educational psychologists, and combined with the long-term experience of early childhood care experts, the evaluation system as shown in Table 3.1 was constructed. The AHP method generally includes the target layer, the criterion

layer and the program layer. For each scheme layer, there is a judgment set, which is {excellent, good, medium, fair, poor}, and the corresponding value set is {5,4,3,2,1}. According to this evaluation set, the different criteria schemes are scored, and the scoring of the scheme layer is sent to the evaluation model, and the comprehensive score can be obtained.

3.1.2 Establish judgment matrix

The judgment matrix is gradually constructed from top to bottom from the target layer, the criterion layer, and the scheme layer. Constructing a reasonable judgment matrix is the key to the success of AHP. Compare the indicators at the same level with each other to determine the relative importance of each two indicators. The importance of each indicator compared with itself is 1, which means that it is equally important. Secondly, the degree that we can express can be divided into slightly important, obviously important, much more important, and extremely important, which can be expressed as 3, 5, 7, and 9 by numerical quantification. . The value between two adjacent degrees is considered to be between these two degrees. There is also a rule. If A is slightly more important than B, then the importance of A relative to B is 3. In turn, the importance of B relative to A is the reciprocal of the importance of A relative to B, which is 1/3. And so on. The judgment matrix is constructed for the criteria as shown in Figure 1.

Similarly, for the program layer, a judgment matrix is constructed for each specific evaluation program of health, language, society, science and art, and the construction process is similar to the criterion layer. After the construction is completed, the judgment matrix of 5 scheme layers can be obtained.

	A	B	C	D	E
A	1	3	5	6	8
B	1/3	1	2	4	5
C	1/5	1/2	1	3	5
D	1/6	1/4	1/3	1	3
E	1/8	1/5	1/5	1/3	1

Figure 1. Criterion layer judgment matrix

3.1.3 Calculation weight and consistency check

After the judgment matrix is established, the eigenvectors and the maximum eigenvalue of each judgment matrix are calculated. The criterion layer weights are $W = [0.4836; 0.2490; 0.1532; 0.0745; 0.0395]$; the largest eigenvalue is 5.1928. In the same way, the weights and eigenvalues of the scheme layer are obtained.

Finally, the consistency test of the matrix is carried out, and the consistency test formula is as follows:

$$CI = \frac{\lambda_{\max} - n}{n - 1}$$

$\lambda_{\max}$ is the largest eigenvalue of the matrix, and n is the order of the matrix. The CI is inversely proportional to the consistency of the matrix, the larger the CI, the greater the inconsistency, and the smaller the CI, the better the consistency. In engineering, if the random consistency ratio CR of the matrix is less than 0.1, it is considered that the matrix satisfies the consistency test of the matrix. The RI calculation formula is as follows:

$$CR = \frac{CI}{RI}$$

3.2 Establish BP neural network model

3.2.1 Improved BP Neural Network

BP neural network is the most extensive data model in neural network, with a complete theoretical system and learning mechanism. It simulates the response process of human brain neurons to external excitation signals, establishes a multi-layer perceptron model, and uses the forward propagation of signals and the learning mechanism of error reverse adjustment. Through continuous iterative learning, it successfully builds and processes nonlinear information. intelligent network model. Common BP neural network excitation functions include logsig function, tansig function, etc. The traditional BP neural network is essentially a static optimization method of steepest descent. It continuously modifies the weights according to the gradient descent method, which is not conducive to accumulating learning experience, and may lead to a local optimal situation, which is not suitable for the application scenario of this paper. In this paper, the method of adaptively adjusting the learning rate is used to improve BPNN. The adaptive adjustment decision-making scheme is: if the total error E decreases through the N th iteration, the learning rate will be increased, and vice versa. The learning rate adjustment formula is as follows:

$$v(N-1) = \begin{cases} av(N) & E(N+1) < E(N) \\ bv(N) & E(N+1) > E(N) \\ v(N) & E(N+1) = E(N) \end{cases}$$

For formula (3.3), v is the learning rate, N is the number of training times, and E is the error function. The initial learning rate $v(0)$ is generally selected randomly or given an empirical value. This method enables the network to maintain a relatively stable learning rate enables the network to maintain a relatively stable learning rate. When a larger learning rate is used, if the error increases, the learning rate is reduced; when a smaller learning rate is used, if The error is in a decreasing trend, then increase the rate, and iterate continuously in this way. Finally, stop the iteration when the network error reaches an ideal value, or stop the iteration after all the iterations are executed, and adjust the parameters through continuous experiments to make the network reach an ideal state. The improved BPNN model is shown in Figure 2. This adaptive adjustment method enables the BP neural network to train the training set at the maximum learning rate, which effectively improves the convergence rate of BPNN and improves the performance of the algorithm.

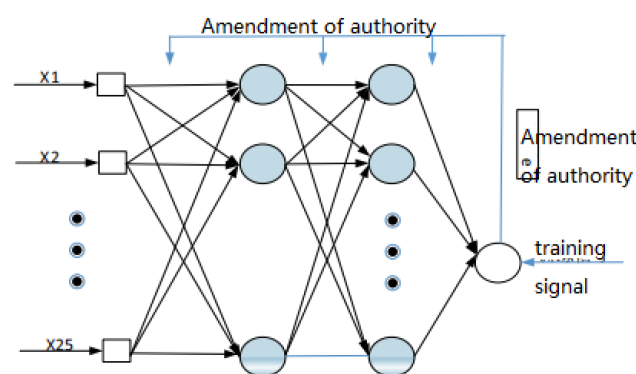


Figure 2. BPNN model

3.2.2 Improved AHP-BP Neural Network Algorithm

For the modeling of some complex systems, it is not clear which independent variables have a greater impact on the dependent variable, and the existing knowledge cannot be fully and reasonably explained, and the selection or weight of some independent variables cannot be clearly defined. Although the AHP method can quantify the importance of multiple independent variables, it is not accurate enough in nonlinear fitting. BP neural network has good function approximation ability, and can also derive a good network model for nonlinear relations. Therefore, AHP and BPNN are combined, the results obtained by AHP are used as the learning and training samples of BP neural

network, and the feedback data of children's learning ability and learning habits are used as the input of BP.

The AHP-BPNN model is established, and its flowchart is shown in Figure 2. The basic steps are as follows:

- 1) Establish an evaluation system, construct a judgment matrix, verify the consistency, and obtain the initial weight as the input variable of BPNN, and the number of input nodes is 25.
- 2) Set the number of output layer nodes to 1, that is, the evaluation score of children. And initialize the learning accuracy, the number of iteration steps, the number of hidden layers, the number of hidden nodes, and the initial weights between nodes.
- 3) Score each indicator and calculate the total score;
- 4) Preprocess the data obtained in step (3);
- 5) Use the improved BP algorithm to train the network and iteratively update the weights;
- 6) The algorithm terminates when the learning accuracy is reached, otherwise it continues to iterate the BP network, that is, go back to step (5).

Using the improved AHP-BP neural network algorithm, a relatively stable evaluation model for the healthy development of young children is finally obtained, and with the enrichment of data, the model will be continuously improved and perfected, which can greatly reduce personal subjective awareness and improve the work efficiency of evaluation.

4. Experiment analysis

In this experiment, the performance evaluation form of some students in a kindergarten in Northeast China is used as training and test data, of which 170 people's data are used to train the network model, and 44 people's data are used as test cases to test the applicability of the model. An ideal model is obtained through multiple fittings, and the model is applied to the test data. The predicted output and expected output are shown in Figure 3, and the BP prediction error trend is shown. As can be seen from the figure, the expected output is basically close to the predicted output, and the error range is basically controlled within plus or minus 0.1.

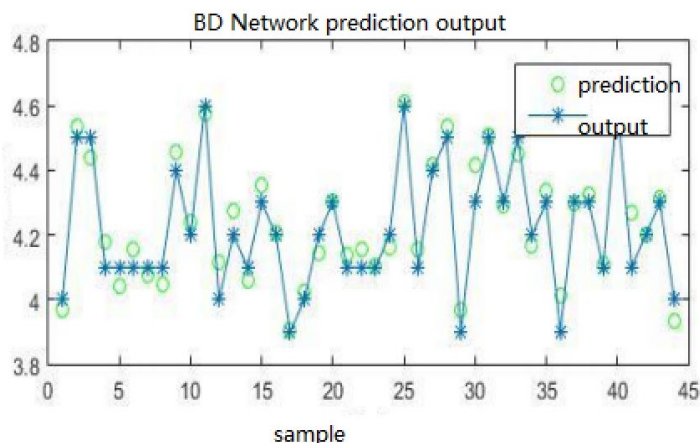


Figure 3 AHP-BP Predictive output and expected output

Compared with the traditional evaluation method, the portfolio method has a long evaluation cycle, and the evaluation of early childhood development is not comprehensive enough, and the evaluation results are greatly affected by personal subjective consciousness. The introduction of the AHP method made the evaluation more comprehensive, but did not improve the factors affecting individual subjective perception. AHP fuzzy integrates the influencing factors of multiple evaluation individuals, solves the ambiguity of the evaluation process, and improves the accuracy and credibility of the evaluation to a certain extent. The AHP fuzzy method is used to analyze the output and expected output of the AHP-BP test set. As shown in Figure 3, the AHP-fuzzy prediction error is shown in Figure 4. From the comparison of Figure 3 and Figure 4, AHP-BP is closer to the expected output

than AHP-fuzzy prediction output. Comparing the prediction errors obtained by the two methods in the AHP-BP error is relatively more stable and the basic control is within 0.1, while the error range of AHP-fuzzy is wider and the fluctuation is larger.

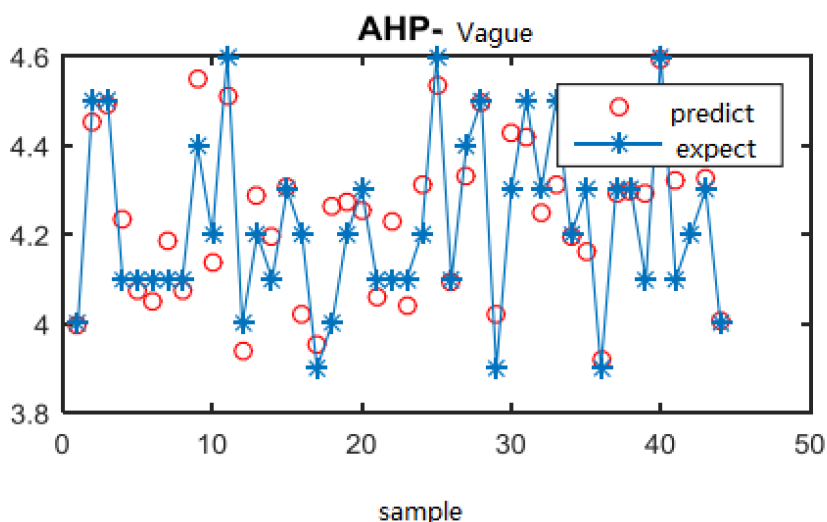


Figure 4 AHP-Vague Predictive output and expected output

Through analysis and comparison, compared with other methods, AHP-BP has a shorter evaluation period, more comprehensive development of young children, and greatly reduces the impact of personal subjective consciousness, and has a greater improvement in evaluation performance. In terms of practical application, it is fully recognized by conservation experts and evaluation teachers. With the continuous enrichment of database data, the evaluation model can be more mature, and can be fully applied in the evaluation of children in the future, as long as the corresponding index data is input, the results can be obtained.

5. Conclusion

In this section, AHP-BPNN evaluation model is constructed for the healthy development of children's physiology and psychology by combining the AHP analytic hierarchy process with the improved BP neural network. The structure of the three-tier evaluation system is determined, and the judgment matrix and weights are analyzed to test the consistency. At the same time, according to the characteristics of the evaluation indicators, the corresponding BP neural network is constructed and trained through the training set data to make it reach the ideal fitting level. The MATLAB simulation analysis experiment shows that the AHP-BPNN evaluation model has better stability, reduces the cycle of children's healthy development evaluation, and the evaluation indicators become more abundant, reducing the subjective evaluation consciousness of preschool education. The assessment of the physical and mental health of young children is more scientific and reasonable, and can be used to assess the healthy development of young children.

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