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Application of Artificial Intelligence Neural Network Technology in the Evaluation in Universities

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ABSTRACT

This paper explores the application of artificial intelligence neural network technology in evaluating university education. Reviewing the latest domestic and foreign research progress shows that traditional evaluation methods suffer from subjectivity and lack of objective data support. The basic principles and successful application cases of neural network technology are elaborated to lay the foundation for its application in evaluating the effectiveness of education in universities. The paper provides a detailed introduction to the application of technologies such as deep learning, natural language processing, and data mining, as well as how to accurately assess the effectiveness of education in universities by constructing models. An experimental design is presented, and the use of data validates the feasibility and effectiveness of the proposed method. This approach is expected to promote education development and improve the quality and level of education in universities.

Keywords: Artificial Intelligence, Neural Networks, Higher Education, Data Mining

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1. Introduction

Education in universities is essential to cultivating students' comprehensive qualities and their role as builders and successors of socialism. As one of the fundamental tasks of higher education, education plays an irreplaceable role in shaping students' ideological awareness, moral character, and sense of social responsibility [1]. However, with the rapid development of society and the advancement of information technology, education in universities faces new challenges and opportunities.

Traditional methods for evaluating the effectiveness of education in universities have some issues, such as subjectivity, insufficiently objective evaluation criteria, and difficulties in quantification [2]. These problems limit education's scientific and accurate evaluation, affecting its optimization and enhancement in universities. Therefore, finding an effective evaluation method is imperative.

Artificial intelligence technology has made rapid progress in recent years, especially in the breakthroughs in neural network technology. With its powerful data processing capabilities, autonomous learning, and intelligent decision-making features, neural network technology has been successfully applied in various fields, yielding remarkable results [3]. In this context, introducing artificial intelligence neural network technology into evaluating education in universities becomes a potent approach to enhance the scientific and objective nature of the assessment.

This paper explores the application of artificial intelligence neural network technology in evaluating the effectiveness of education in universities. By reviewing the latest domestic and foreign research progress, we construct an evaluation method based on neural network technology and verify its effectiveness through experiments. Leveraging artificial intelligence technology, we aspire to bring new ideas and strategies for developing education in universities and contribute more to nurturing outstanding builders and successors of socialism. Additionally, this research provides a beneficial attempt at exploring the application of artificial intelligence technology in the field of education.

2. Evaluation of Education with Artificial Intelligence

The field of study in this research has already sparked widespread interest in foreign countries regarding the application of artificial intelligence neural network technology in evaluating the effectiveness of education in universities. Many foreign research teams are exploring how to improve the evaluation methods of teaching in universities using neural network technology [4]. Among them, the application of deep learning stands out in this field. Some foreign scholars attempt to utilize deep learning techniques for sentiment analysis and emotion recognition of students' attitudes and moral concepts. They construct sentiment classifiers based on neural networks to extract emotional information from students' written expressions, thereby assisting in evaluating the emotional guidance effect of education [5]. Furthermore, researchers have also used deep learning techniques for recognizing students' behavior patterns and evaluating the impact of education in shaping students' learning attitudes and habits through data analysis of their online learning behaviors [6]. Additionally, some foreign universities have begun to explore the application of natural language processing technology in evaluating education effectiveness. They use neural networks to conduct semantic analysis of students' papers, essays, and other texts, extracting corresponding keywords and topics to assess the alignment between students' awareness and learning content [7].

In China, research on the application of artificial intelligence neural network technology in evaluating the effectiveness of education in universities is gradually gaining momentum. Some universities and research institutions are actively exploring how to integrate artificial intelligence technology into the evaluation system of education to enhance objectivity and scientificity. Domestic scholars mainly focus on mining and analyzing students' learning behaviors. They employ neural network technology and big data analysis to model and predict students' behavioral data on online learning platforms, thereby evaluating students' participation and learning outcomes in education courses [8]. Some studies also pay attention to changes in students' psychological states. Using neural network emotion recognition technology, they investigate students' emotional changes and fluctuations during education, providing more comprehensive information support for evaluating education effectiveness [9].

However, the research on using artificial intelligence to evaluate the effectiveness of education in Chinese universities is still relatively preliminary, and challenges such as data collection and privacy protection need to be addressed [10]. Therefore, it is necessary to deepen the research further and expand the application scope of evaluation methods and technologiesto promote innovation and development in evaluating education effectiveness in universities.

3. Introduction to Artificial Intelligence Neural Networks and Selection of Algorithms

3.1 Neural Network Algorithm

Artificial Intelligence Neural Networks, commonly known as neural networks, are computational models that simulate the structure and functions of biological neural systems. They are an essential technology in artificial intelligence and form the foundation of deep learning. Neural networks consist of many basic units called neurons, which communicate with each other through connections known as weights. Each neuron receives inputs from other neurons, processes them with weighted calculations, and generates an output. This structure and information transmission process resemble that of biological neural networks. The training process of neural networks involves learning from many samples of input data and expected output data to adjust the weights between neurons. In this way, the neural network gradually learns the complex mapping relationship between input and output, enabling predictions or classifications of unknown data. In deep learning, neural networks consist of multiple hierarchical layers, known as deep neural networks. Each layer contains a set of neurons and full connections between layers. Information flows from the input to the output layer, undergoing processing through multiple hidden layers. The depth in deep learning refers to the number of hidden layers in the neural network. Neural networks have made significant breakthroughs in image recognition, natural language processing, speech recognition, and other fields, becoming a core technology in artificial intelligence applications. Through neural networks, computers can simulate the structure of the human brain's neural network, gaining more powerful learning and processing capabilities and providing a novel approach to solving complex problems.

3.2 Backpropagation Algorithm

The backpropagation algorithm is a common supervised learning algorithm widely used in tasks such as pattern recognition, classification, regression, and function approximation. It has several advantages: The backpropagation algorithm applies to various types of data, including numerical, textual, and image data. Its network structure can be flexibly adjusted to adapt to the complexity and features of different problems. It possesses intense learning and approximation capabilities and can handle non-linear and highly complex issues. Through the training process, the neural network can automatically adjust weights and biases, optimizing the model to better adapt to the characteristics of the input data. The connections between neurons in backpropagation can be computed in parallel, resulting in higher computational efficiency when dealing with large-scale data. This parallel computing advantage makes backpropagation advantageous in hardware acceleration and large-scale data processing. It can adaptively learn and adapt to new data patterns, exhibiting good generalization capabilities. Once trained, it can make reasonably accurate predictions for unseen data, making it applicable in practical scenarios. Compared to other complex deep learning models, backpropagation is relatively easier to interpret due to its shallow network structure. It allows a clearer understanding of the feature representations and data processing between different layers.The backpropagation neural network involves two processes: forward propagation of correct signals and backward propagation of error signals. It can utilize error backpropagation for multiple training cycles and is a typical multi-layer feedforward network. The backpropagation involves gradient search techniques, using gradient descent to find the minimum mean square error between desired output and actual output to achieve optimal solutions. To perform the functionalities described above, the structure of a backpropagation neural network is depicted in Figure 1.

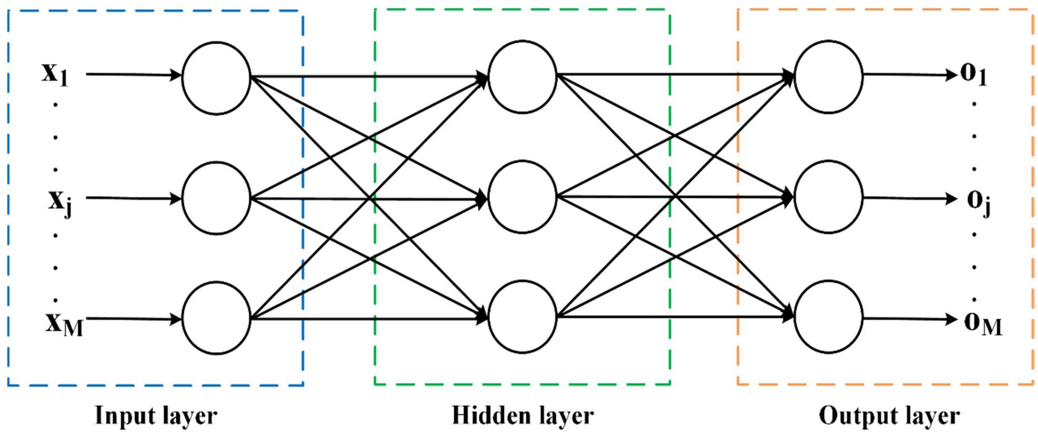

Figure 1. Basic Structure of the Backpropagation Neural Network

As can be seen, it consists of three parts: the input layer, the hidden layer, and the output layer. When the quantity of desired output data is determined, the number of nodes in the input layer is also fixed. The hidden layer, situated in the middle, needs to be determined through actual experimental operations. Once the hidden layer is determined and the results are computed, the number of nodes in the output layer can be determined. Data training can be performed after selecting the number of nodes in all three layers. The training process involves mapping the output data to the input data through several nodes. When the actual output values are obtained for the first time, they are compared with the expected output values to calculate the error. If the error is significant, the nodes in the neural network undergo spontaneous adjustments and changes after the direction propagation. The calculation is repeated to obtain the second set of actual output values. This cycle continues for an uncertain number of times until the mean square error between the actual and expected output values falls within an acceptable range. This is the training process that utilizes the adaptability of the neural network. This adaptability is the most significant advantage of the backpropagation neural network compared to other methods and is one of the critical focuses of this research. By relying on this characteristic, the network minimizes errors and obtains scientifically effective evaluations of education in universities.

3.3 Model Establishment Based on the Algorithm

To enable the backpropagation network to have predictive and associative memory capabilities, it is necessary to output the weights from the input layer to the hidden layer and from the hidden layer to the output layer in advance. Then, the threshold of the hidden layer can be calculated using the formula as shown in (1): [formula omitted for brevity]

$$H_j = f\left(\sum_{i=1}^{n} w_{ij} x_i - a_j\right) \qquad (1)$$

The formula represents the initial set of weight values, is the activation function in the algorithm, and is used to calculate the threshold value of the hidden layer. The next step is to calculate the threshold value of the output layer, as shown in formula (2):

$$M_k = \sum_{j=1} H_j w_{jk} - b_k \tag{2}$$

The corresponding forward propagation threshold formula is shown in formula (3):

$$\Delta a_j = -\eta \frac{\partial E}{\partial a_j} = -\eta \frac{\partial E}{\partial O_j} \frac{\partial O_j}{\partial net_j} \frac{\partial net_j}{\partial a_j} \tag{3}$$

The corresponding forward propagation threshold formula is shown in formula (3):

$$\Delta \beta_k = -\eta \frac{\partial E}{\partial \beta_k} = -\eta \frac{\partial E}{\partial O_k} \frac{\partial O_k}{\partial net_k} \frac{\partial net_k}{\partial \beta_k} \tag{4}$$

From all the above formulas, it can be observed that the three-layer structure of the backpropagation neural network is interrelated and mutually influential, while nodes within the same layer have no direct connections.

4. Application of Algorithm Models in Educational Effectiveness

It is first necessary to determine the evaluation objectives and indicators to evaluate the effectiveness of education based on reverse neural networks. Considering education's complexity and multidimensional nature, the following indicators can be evaluated to assess changes in students' ideological awareness, values, social responsibility, and other aspects. Assess students' academic performance in education courses, such as exam scores and homework completion. Analyze students' learning participation and enthusiasm in education courses. Collect students' feedback and evaluation on education courses to understand teaching quality and satisfaction. For students who use online education platforms, they can also analyze their online learning behavior, such as learning duration, video viewing frequency, etc.

Next, it is necessary to collect relevant data and preprocess it to train the neural network. A feature vector containing selected indicator data should be established for each student. At the same time, each student should be labeled with a corresponding label for the effectiveness of education, such as evaluating them as excellent, good, pass, or fail based on their overall performance. After selecting the structure and parameters of the reverse neural network, the network was trained using data from 150 students. During the training process, by continuously adjusting weights and biases, the neural network can gradually and accurately predict the effectiveness of education. After the training, another portion of student data will be used for model testing and evaluation. The accuracy and generalization ability of the reverse neural network in evaluating the effectiveness of education can be assessed by comparing the predicted results of the test set data with the real labels. Finally, based on the experimental results and analysis, a conclusion is drawn on evaluating the effectiveness of education. The importance of neural network models in different indicators is analyzed, and suggestions for optimizing education are provided to provide effective reference and guidance for the education work of universities in the northern region.

One hundred fifty students were selected for the experiment in this top ranked school in the northern region, and a questionnaire was first distributed to conduct an introductory survey of these 150 university students. According to the survey results, 52 students maintained a positive attitude towards the courses they received and enjoyed the relevant teaching. Thirty students showed negative emotions, believing that these courses were not helpful for life and learning, and were unwilling to acquire this knowledge actively. The remaining students maintain a neutral attitude. From this, it can be seen that many students are not interested in or do not attach enough importance to courses. As shown in Figure 2, the survey results show why college students like and dislike a few courses.

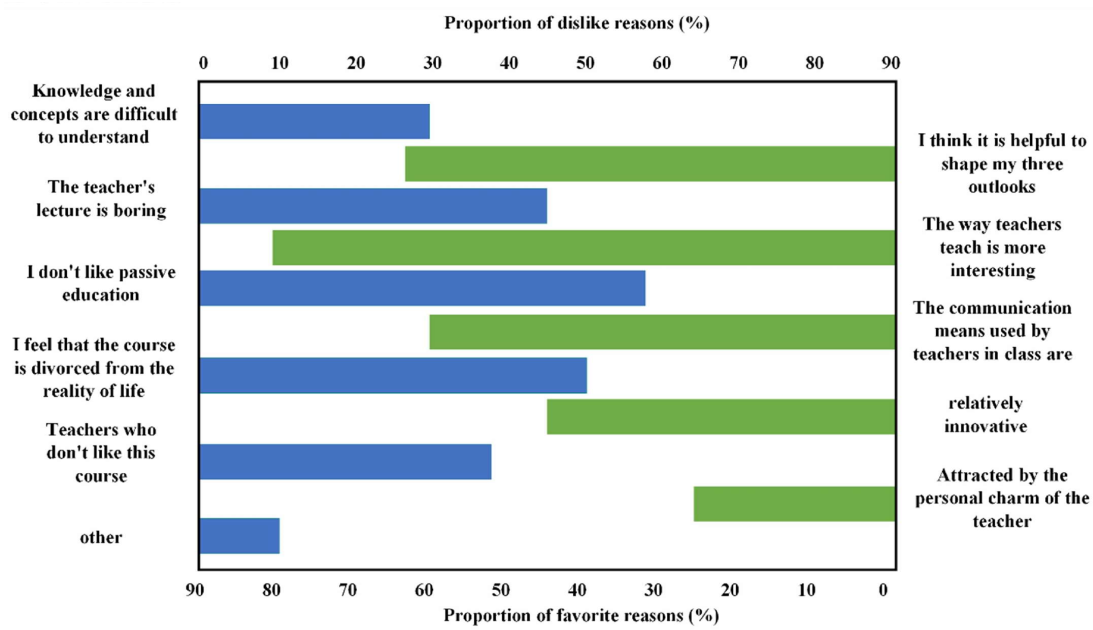

Figure 2. Survey Results on the Reasons for University Students' Likes and Dislikes of Courses

After completing the preliminary preparations, the established model will be practically applied to predict the effectiveness of classroom teaching in selected universities. The results shown in Figure 3 can be obtained by comparing the predicted results with the actual teaching outcomes.

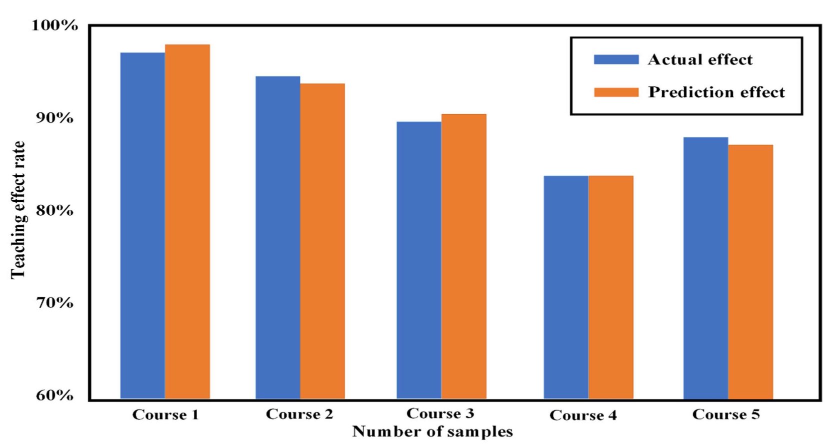

Figure 3. Comparison of Predicted and Actual Results of the Predictive Model for Classroom Effectiveness

The graph shows that the actual teaching effectiveness of courses using different textbooks is above 85%, indicating a significant improvement in the education effectiveness at this university after years of effort. It can also be observed that the largest difference between the actual and predicted effectiveness is 2%. In the artificial intelligence neural network algorithm prediction model, the allowed range for prediction differences is 0% to 6%, and the 2% result falls within the accurate prediction range. These results collectively demonstrate that the predictive model established in this study is scientifically reliable when applied to evaluating the effectiveness of classroom teaching.

5. Conclusions

This study explores the application of artificial intelligence neural network technology in evaluating the effectiveness of education in universities. By selecting a highly-ranked university in the northern region and conducting experiments with 150 students, a backpropagation neural network-based model for evaluating education effectiveness was established. The model construction process determined multidimensional evaluation indicators, including education effectiveness, academic performance, learning behaviours, feedback surveys, and online learning behaviours.

The backpropagation neural network was trained through data collection, preprocessing, and feature extraction of student data. During the training process, adjustments to the network's weights and biases were made to gradually improve its accuracy in predicting students' education effectiveness. After the training, the model was evaluated using test set data, confirming its accuracy and generalization ability in evaluating educational effectiveness.

The research results indicate that artificial intelligence neural network technology exhibits high flexibility and learning ability in evaluating the effectiveness of education in universities, effectively enhancing objectivity and scientificity in the evaluation process. The neural network model's analysis allows a deeper understanding of students' education performance and provides valuable references and suggestions for optimizing education. However, the study also faces challenges such as data collection, processing complexity, and long training times for the neural network model. Future research can focus on further optimizing the model's structure and parameters to improve its performance and efficiency.

In conclusion, artificial intelligence neural network technology holds significant application prospects in evaluating the effectiveness of education in universities. Through continuous exploration and innovation, AI technology is believed to provide more effective support for education in universities, cultivating outstanding socialist builders and successors and making more significant contributions to social progress and development.

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