



The Mixed Teaching Quality Evaluation Model of Applied Mathematics Courses in Higher Vocational Education Based on Artificial Intelligence

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Abstract. With the deepening of research on the mixed teaching of Applied Mathematics Course in higher vocational colleges, and the requirements for teaching quality are constantly improved, so it is necessary to conduct a comprehensive evaluation on it. However, due to the backward processing technology of evaluation indicators in traditional evaluation model, the calculation error of evaluation results is relatively large. Therefore, this paper designs the evaluation model of mixed teaching quality of Applied Mathematics Course in Higher Vocational Colleges Based on artificial intelligence. This paper constructs the evaluation index system of mixed teaching quality of Applied Mathematics Course in higher vocational colleges, and completes the consistency calculation. According to the results of the index selection, the neural network of artificial intelligence technology combined with fuzzy evaluation method is used to construct the hybrid teaching quality evaluation model. After the evaluation results are obtained, the evaluation results are classified. At this point, the design of the mixed teaching quality evaluation model for higher vocational applied mathematics courses based on artificial intelligence is completed. Constructing the experimental results, by comparing the experimental indicators, we can see that the evaluation error of this model is lower than that of the traditional model. It can be seen that this model works best.

Keywords: Artificial intelligence · Neural network · Teaching quality evaluation · Mixed teaching

1 Introduction

Since the 20th century, mixed teaching quality evaluation has been systematically studied as an independent research field. In particular, the “eight-year study” conducted by the American Association for Progressive Education from 1934 to 1942 has made the field of curriculum quality evaluation mature, and the most The focus of attention is that the mixed teaching quality assessment of applied mathematics courses is more extensive [1, 2]. In recent years, my country’s higher education has developed rapidly, and the number of higher vocational teachers has increased significantly. The effect of higher vocational education has also improved the country’s economy. The development has

had a significant impact, among which the education of applied mathematics is one of the fundamentals [3]. Higher vocational applied mathematics teachers are both educators and researchers. All kinds of requirements for teachers have reached a new height. It is the fundamental plan of educational reform and development to establish a teacher team with good political professional quality, reasonable structure and relatively stable. Establishing an objective, scientific and intelligent teacher management system is of great significance to strengthening teacher management, promoting the development of teachers, schools and society. In order to make the teaching quality evaluation management systematization, office automation and informatization of Applied Mathematics Course in higher vocational colleges, it is necessary to carry out research and discussion in various aspects. The content and system of mixed teaching quality evaluation, as well as the processing and analysis of the data of mixed teaching quality evaluation need further research. The purpose of mixed teaching quality evaluation is to promote curriculum construction, promote curriculum reform, improve teaching work, and improve curriculum teaching quality.

The application of mathematics curriculum mixed teaching quality evaluation model in China's education evaluation is carried out earlier, more and has obvious effect, and is generally welcomed. In Ref. [4], in order to improve the effectiveness and accuracy of teaching quality evaluation, a teaching quality evaluation model based on hybrid intelligent optimization algorithm is proposed. Entropy weight method is introduced to objectively determine the index weight and initial evaluation results of teaching quality evaluation system. The parameters of BP neural network are optimized by genetic algorithm based on adaptive mutation, and the teaching quality evaluation model is established. Compared with BP neural network and GA-BPNN (genetic algorithm back propagation neural network) model, the prediction accuracy is improved by 15.04% and 5.41% respectively. At the same time, the convergence speed of the algorithm is improved. Reference [5] first proposed a general mathematical model for data quality detection and evaluation. On the basis of this model, ontology technology was used to define the mapping of conversion rules from general mathematical model to ontology model. Considering that most of the data is stored in relational database, taking relational database as an example, according to the proposed mathematical model and conversion rules, The extraction and construction of data quality evaluation ontology and the definition of complex quality rules are realized. Finally, an application system is implemented to verify the correctness and scientificity of the system. The model is reasonable and extensible, It is universal. However, the research and practice of the mixed teaching quality evaluation model system based on artificial intelligence technology for applied mathematics course has been from the 21st century. With the popularization of artificial intelligence applications, the network has entered into thousands of households and penetrated into people's life, study, work and other aspects. The mixed teaching quality evaluation model of Applied Mathematics Course in Higher Vocational Colleges Based on artificial intelligence has attracted much attention because of its strong interactivity, wide spread range, open space-time, convenient data collection and management, personalized information exchange, and fast data statistics and analysis functions. The evaluation content should be practical. The mixed teaching quality evaluation method is

practical, technical, advanced, diversified, flexible and so on. The evaluation results are scientific, objective and fair.

2 Design of Mixed Teaching Quality Evaluation Model for Higher Vocational Applied Mathematics Course Based on Artificial Intelligence

Based on the artificial intelligence environment, the system process of setting the mixed teaching quality evaluation model of higher vocational applied mathematics is analyzed, and the teaching quality evaluation model is completed according to the following process (Fig. 1).

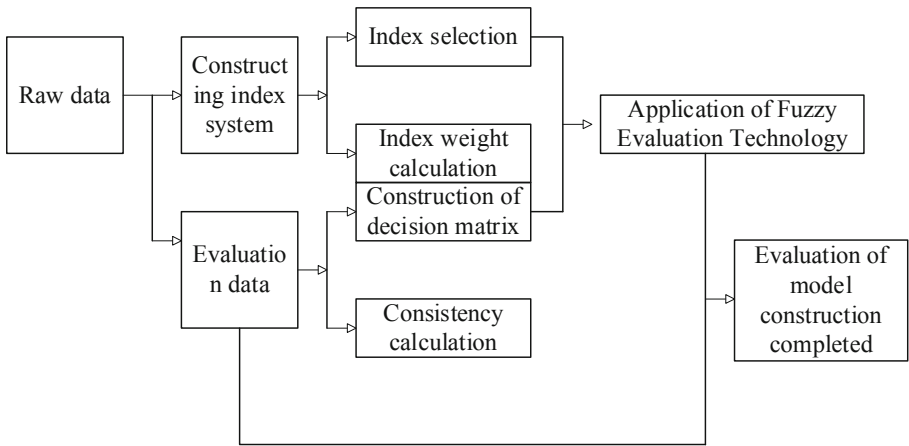


Fig. 1. Design path of the mixed teaching quality evaluation model of applied mathematics courses in higher vocational education based on artificial intelligence

According to the above-mentioned process, the design process of the mixed teaching quality evaluation model of Higher Vocational Applied Mathematics Course Based on artificial intelligence is completed, and the corresponding experimental links are set to determine the use effect of the design model in this paper.

2.1 Constructing the Mixed Teaching Quality Evaluation Index System of Applied Mathematics Course in Higher Vocational Education

This paper collects a lot of literature related to the research, and looks through the teaching evaluation table of teaching quality in many colleges and universities. In addition, it also makes a comprehensive analysis of the existing research results. According to the purpose of classroom teaching and the basic requirements of teaching, combined with the situation of mixed teaching of Applied Mathematics in higher vocational colleges, the evaluation index system of mixed teaching of Applied Mathematics Course in higher vocational colleges is preliminarily established.

In this study, the importance of each index in the evaluation index system is divided into 1–5 levels. Calculate the score of each first-level indicator, the calculation formula of the indicator score is as follows:

$$Q = \frac{1}{n} \sum_{i=1}^n c_i d_i \tag{1}$$

Among them: Q is the index score; c is the score of the evaluation grade; d_i is the number of people scored at the i level; n is the total number of participants. In this paper, the 9-scale method [6–8] proposed by Sardi is used to construct pairwise judgment matrix. Through the judgment and decision-making of experts in related fields according to their work and practical experience, the judgment matrix of all levels of indicators is obtained, and it is verified by the consistency operation of hierarchical single ranking.

Level single sorting is to calculate the maximum value of the eigenvalues of each judgment matrix and the corresponding eigenvectors to obtain the level single sorting, and obtain the importance data sequence of the index layer to the target layer. In order to obtain the optimal decision. The specific steps are first to solve the maximum eigenvalue α_{\max} of the judgment matrix W , and then use the formula $Q\beta = \alpha_{\max}\beta$ to solve the corresponding eigenvector β of α_{\max} . After standardization, β is the ranking weight of the relative importance of corresponding elements in the same level to a factor in the previous level. To test the consistency of the matrix. Although it is impossible to require all judgments to be completely consistent, the judgments should be made roughly consistent. Therefore, it is necessary to check the consistency of the judgment matrix. First calculate the consistency index P of matrix W , the specific formula is shown below.

$$P = \frac{\alpha_{\max} - n}{n - 1} \tag{2}$$

In the formula, n is the order of the judgment matrix. When W has complete consistency, $P = 0$. The larger P , the worse the consistency of matrix W . In order to evaluate the consistency test of hierarchical total ranking, we need to calculate its consistency test index. P is the consistency index; H is the average random consistency index; G is the random consistency proportion.

$$P = \sum_{i=1}^n c_i P_i \tag{3}$$

In the formula, P_i is the consistency index of the evaluation layer corresponding to c_i .

$$H = \sum_{i=1}^n c_i H_i \tag{4}$$

In the formula, H_i represents the average random consistency test index of the evaluation layer corresponding to c_i . Thus, the consistency verification evaluation of the overall evaluation index system can be completed, and the specific formula is as follows.

$$G = P/H \tag{5}$$

When the calculation result of this formula is $G \leq 0.1$, it is considered that the calculation result of the total ranking has satisfactory consistency, then the index construction result conforms to the teaching quality evaluation standard.

2.2 Constructing a Mixed Teaching Quality Evaluation Model

In view of the multi-objective, multi-level and complex non-linear problem of the quality evaluation of the mixed teaching of Applied Mathematics in higher vocational colleges, and the existing evaluation methods and models of the mixed teaching quality of the applied mathematics course in higher vocational colleges have difficulties in determining the standard weight, too strong subjectivity and randomness, easy to appear over fitting, slow speed of optimization and slow convergence speed of standard BP neural network. In this study, artificial intelligence neural network is used to put forward the fuzzy evaluation model of hybrid teaching quality. The main idea of the model is to introduce artificial intelligence technology to improve the gradient descent method of BP neural network to improve the convergence rate, and optimize the network structure to ensure the stability of the model. In addition, new evaluation indexes are added to the traditional evaluation indexes to construct the teaching quality evaluation index system used in this study, so as to ensure that the model comprehensively evaluates teaching activities. The normalized data set of evaluation index samples is used as the input feature vector of the model to improve the calculation efficiency of the model. The neural network structure used in this design is as follows (Fig. 2).

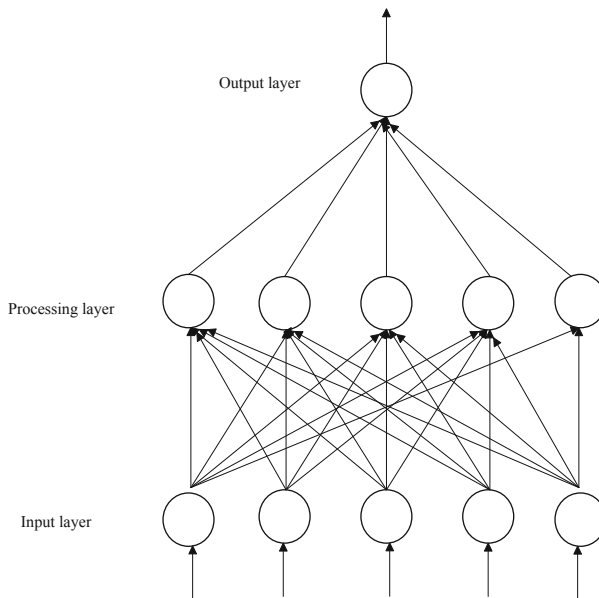


Fig. 2. Neural network structure

According to the above network organization, the mathematical model of fuzzy comprehensive evaluation [9, 10] is composed of four factors (R, T, V, X) . R is the evaluation factor set $R = \{R_1, R_2, \dots, R_n\}$; T is the comment set $T = \{T_1, T_2, \dots, T_n\}$; X is the weight distribution vector of each index in the R index set; $X = \{X_1, X_2, \dots, X_n\}$, $\sum_{i=1}^n X_i = 1$; V is the evaluation matrix $V = \{V_1, V_2, \dots, V_n\}$, V_i is the single factor evaluation result $V_i = \{V_{i1}, V_{i2}, \dots, V_{in}\}$ of the evaluation factor R_i , where V_{in} is the membership degree of the i th evaluation factor r_i to the n comment Grade t_i , and the evaluation matrix is formed by each factor evaluation vector as the row, and the fuzzy evaluation matrix is constructed through the above process.

Suppose there are n evaluation grades T and m low-level evaluation indicators R . There is a fuzzy relationship Z . between the two, expressed as a matrix:

$$Z = \begin{matrix} & m_1 & m_2 & \dots & m_n \\ \begin{matrix} R_1 \\ R_2 \\ \dots \\ R_a \end{matrix} & \begin{bmatrix} z_{11} & z_{12} & z_{1n} \\ z_{21} & z_{22} & z_{2n} \\ \dots & \dots & \dots \\ z_{a1} & z_{a2} & z_{an} \end{bmatrix} & = & (z_{ij})_{m \times n} \end{matrix} \tag{6}$$

In the formula, z_{ij} represents the membership degree of the i evaluation index to the j grade. Assuming that the weight of the evaluation index is $R = \{R_1, R_2, \dots, R_n\}$, the comprehensive evaluation result K is:

$$K = Z \times R \tag{7}$$

In practical evaluation work, the personnel involved in teaching evaluation are often composed of many different types of personnel, and the importance of the evaluation results of various evaluators is different. At this time, hierarchical clustering can be used to aggregate the evaluation data of the same degree of importance. At the same time, in the evaluation, the more important data set is directly selected as the evaluation data to obtain the comprehensive higher vocational applied mathematics curriculum mixed teaching evaluation result, and finally the weighted average is used to obtain the general higher vocational applied mathematics curriculum mixed teaching evaluation result.

2.3 Grading of Assessment

According to the evaluation model constructed above, complete the evaluation process of mixed teaching quality evaluation of applied mathematics courses in higher vocational education. In this part, the evaluation results are graded. In order to ensure the effectiveness of the classification of the evaluation results, some indicators are selected for scoring and combined with the evaluation results to obtain comprehensive and highly accurate evaluation results. The specific indicators and scoring results are as follows (Table 1).

Table 1. Scoring results of key indicators

Index	Bottom indicators	Evaluation criteria	Score
Teaching team	Applied mathematics teacher	Curriculum teachers have strong teaching ability	10 branch
		Distinctive teaching characteristics	
	Overall quality of teaching team	Strong sense of responsibility, team spirit	10 branch
	Research on teaching reform	Active teaching thinking and innovation in reform	20 branch
Content of courses	Course content	The contents are novel and informative	10 branch
	Reform in education	Combine inside and outside class	10 branch
Teaching effectiveness	Peer review	Excellent evaluation and good reputation	20 branch
	Student evaluation	The content of the course is authentic and the evaluation is good	20 branch

According to the contents of the above table and the evaluation results, the teaching quality evaluation is completed. Because the calculation results of the evaluation model designed in this paper are more complex, therefore, in the process of grading evaluation, the formula of grading is set as follows:

$$e_i = \frac{y_i - y_{\min}}{y_{\max} - y_{\min}} \quad (8)$$

$$e_i = \frac{y_i - y_{\text{mid}}}{\frac{1}{2}(y_{\max} - y_{\min})} \quad (9)$$

$$y_{\text{mid}} = \frac{y_{\max} + y_{\min}}{2} \quad (10)$$

In the above formula, y_{\max} represents the maximum value in the scoring result, y_{\min} represents the minimum value in the evaluation result, and e_i and y_i represent the pre-processing scoring result and the post-processing scoring result. The y_{mid} in the formula represents the intermediate value of the change in the score result. The above-mentioned formula controls the results of the evaluation results to complete the overall process of teaching evaluation. At this point, the design of the mixed teaching quality evaluation model for higher vocational applied mathematics courses based on artificial intelligence is completed.

3 Analysis of Experimental Demonstration

3.1 Experimental Environment Setting

In order to verify the effectiveness of the artificial intelligence-based hybrid teaching quality evaluation model for higher vocational applied mathematics courses designed above, an experimental link is constructed and the design model in the article is compared with the traditional model.

The small-scale evaluation data used in this experiment is the data set collected before the experiment, while the large-scale data set uses the short-term traffic flow data set. Because the large-scale evaluation of education data involves a lot of privacy, it is difficult to collect, so large-scale short-term traffic flow data is used instead of verification, and the structure and dimension of teaching quality evaluation data are similar to those of short-term traffic flow data. Set the activation function of the deep noise reduction encoder as the Sigmoid function, the learning rate is generally set to 0.02, the unsupervised training target accuracy is 0.005, the maximum number of training times is 3000, the weight is randomly assigned, and the threshold is set to 0. The deep noise reduction autoencoder introduces the Adam algorithm, and optimizes the number of hidden layers and the number of neurons to minimize the error between the output data and the original data to obtain the essential characteristics of the original data. The important parameters of support vector regression are adjusted in the supervised output layer to improve the prediction accuracy of the model. Using average absolute percentage error, mean square error, etc. as performance comparison indicators to compare with other teaching quality evaluation models to verify the effectiveness of the design evaluation model in this article.

3.2 Experimental Comparison Index Setting

In order to verify that the evaluation model designed in the article has more advantages than other models in the teaching quality evaluation of applied mathematics courses in higher vocational education, this section introduces the average absolute percentage error, the mean square error, the symmetric average absolute percentage error, and the root mean square error as the models. The performance comparison index for evaluating prediction accuracy, the specific formula is as follows.

$$A = \frac{1}{n} \sum_{i=1}^n \left| \frac{a_i - b_i}{a_i} \right| \quad (11)$$

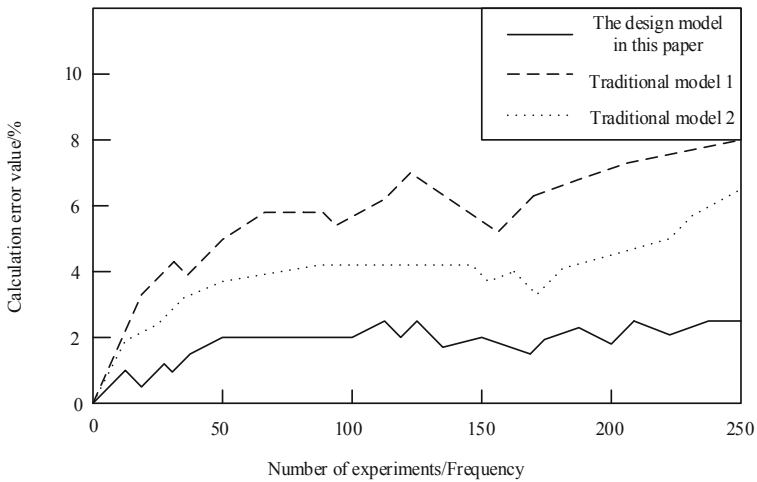
$$B = \frac{1}{n} \sum_{i=1}^n (b_i - a_i)^2 \quad (12)$$

$$C = \frac{100\%}{n} \sum_{i=1}^n \frac{|a_i - b_i|}{(|a_i| + |b_i|)/2} \quad (13)$$

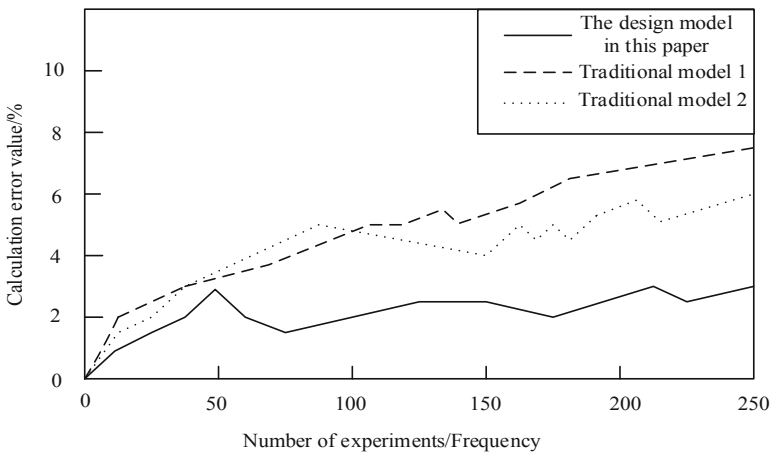
$$D = \sqrt{\frac{\sum_{i=1}^n (a_i - b_i)^2}{n}} \quad (14)$$

In the above formula, A represents the average absolute percentage error of the model, B represents the average absolute percentage error of the model, C represents the symmetric average absolute percentage error of the model, D represents the root mean square error of the model n represents the sample size of the test data, b_i represents the actual truth of the test data Value, a_i represents the predicted value of the model on the test data. Using the above formula, the use process of the design model to the traditional model is calculated, and the comparison between the design model and the traditional model is completed. In order to obtain the experimental data effectively, five experiments were carried out and the corresponding data results were recorded.

3.3 Analysis of Results

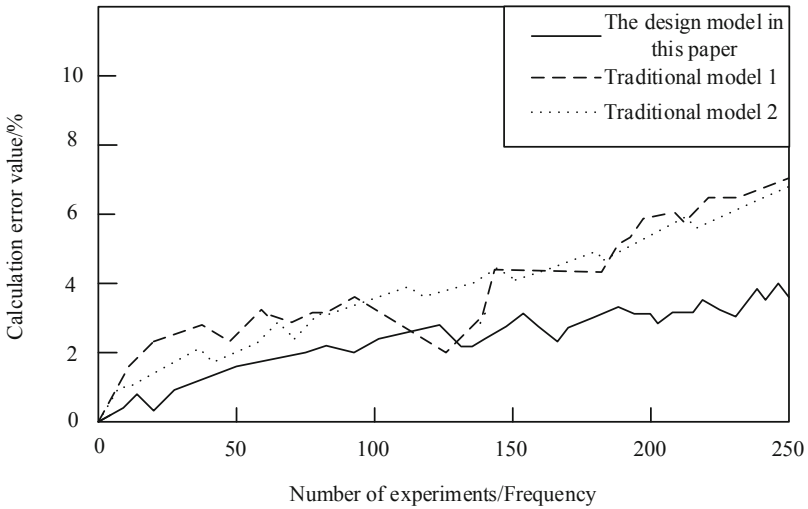


(a) Experimental results of mean absolute percentage error

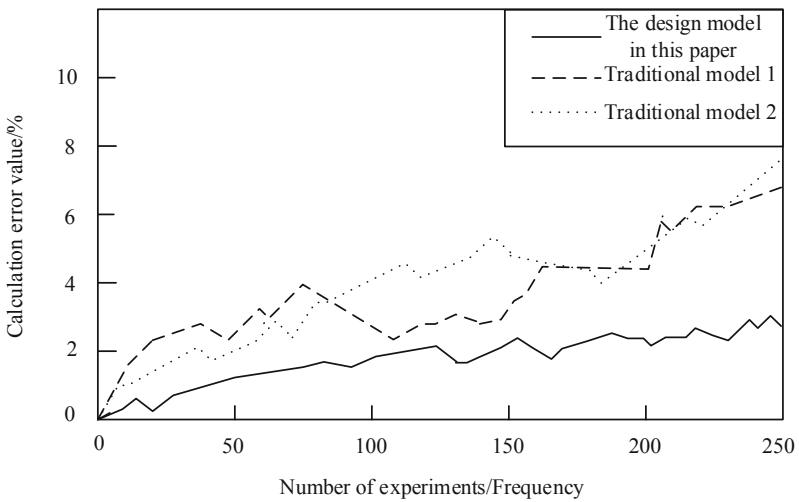


(b) Experimental results of mean square error

Fig. 3. Analysis of experimental results



(c) Experimental results of symmetric mean absolute percentage error



(d) Experimental results of root mean square error

Fig. 3. continued

According to the above experimental results, when the small-scale evaluation sample data set is input to train and verify the model, and the prediction evaluation results are inverse normalized, the experimental results of the design model in various models are the best. At the same time, compared with the traditional model, the training time of the design model is higher than that of the traditional model, but the other four performance indicators are better than the traditional evaluation model. Compared with the traditional model 1, although the design model in the article has no big difference in training time

and average absolute percentage error, it is better than it in other performance indicators, especially the mean square error and symmetric average absolute percentage error. Important indicators to verify the effectiveness of the design model in the article. On the other hand, although the design model variance error and the symmetric mean absolute percentage error in the article are better than the traditional model 2, the difference between them is not very large, and the time performance of the traditional model 2 is much lower than the model in this chapter, thus verifying The design model in the article is more suitable for processing small-scale data sets. From the above comparison, we can see that both the design model and the traditional model can complete the teaching quality evaluation and each has its own advantages, but the effect of the design model in this paper is obviously better than that of the traditional system (Fig. 3).

4 Conclusion

Improving the teaching quality of applied mathematics courses in higher vocational education has become the focus of current higher education. With the continuous deepening of teaching reform in colleges and universities, how to improve teaching quality and train more talents has become the core issue in college teaching reform. The establishment of a teaching quality evaluation system that focuses on improving the teaching quality of applied mathematics courses in higher vocational education also highlights its Significance. Teaching quality evaluation refers to the process of using effective technical means to comprehensively collect, sort out and analyze the teaching situation and make value judgments to improve teaching activities and teaching quality. Some of the classification rules generated in this study have low adaptability to the actual situation. The reason for this phenomenon may be some shortcomings in the selection of data set attributes. Therefore, in future research, it is necessary to increase the capacity of sample data to improve the representativeness of sample data. In this way, the final construction of the mixed teaching quality evaluation model of applied mathematics courses in higher vocational education has more application value and becomes a more practical analysis model.

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