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THE TEACHING EFFECT EVALUATION OF BIG DATA ANALYSIS IN MUSIC EDUCATION REFORM

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Abstract. At present, the evaluation of the implementation effect of the music teaching reform project is a hot topic. This project establishes a teaching reform implementation effect evaluation model based on improving the accuracy of teaching reform plan effectiveness evaluation. This project first analyzes the current research status of the impact evaluation of the implementation of music education reform projects and builds a set of evaluation systems. The evaluation method of teaching reform plan implementation effect based on a "big data-driven - support vector machine" was constructed. The simulation experiment verifies that this method can evaluate the implementation of the teaching reform plan well. The relative error of the evaluation results is small. It is practical in improving the effectiveness evaluation of the teaching reform plan. After verification, it is found that the research results of this project are feasible.

Key words: Big data; Music teaching reform plan; Support vector machine; Effectiveness evaluation; Weight; Contrast matrix

1. Introduction. Music education is a significant subject in colleges and universities. Its teaching quality has a significant effect on students' comprehensive ability, so it is essential to improve the implementation of the education reform plan. The implementation of the music education reform plan plays a vital role in the implementation of the school's education reform plan [1]. At present, there have been many studies on the effectiveness evaluation of music education reform programs. For example, some scholars have discussed how to evaluate the effectiveness of curriculum reform according to users' satisfaction [2]. Some scholars have studied the effectiveness evaluation of the implementation of music education reform projects in the environment of big data. The above research results can be used to evaluate the educational effectiveness, but the effectiveness of the evaluation is not high. At present, China's college music education reform project implementation effectiveness evaluation model is facing a significant challenge [3]. Support vector machine (SVM) algorithm is an extensive data-driven evaluation method, which has unique advantages in solving nonlinear high dimensional evaluation problems [4]. Therefore, this project intends to build an evaluation method for music education reform projects based on big data. This paper hopes to solve the problems of "local extreme value" and "over-learning," which are easy to appear in the existing evaluation methods.

2. Research on evaluation model of implementation effectiveness of music education reform plan driven by big data. AHP and expert evaluation are used to construct a set of evaluation systems for the implementation of the teaching reform plan. The specific implementation model is shown in Figure 2.1.

The AHP method is used to compare the leading indicators, and the good and bad relations among the leading indicators are obtained. Finally, the relative weights of each index are obtained (Table 2.1).

The importance of each index in Table 2.1 is expressed by 1,2 and 3. These three factors are equally important, relatively essential and significant. Set the maximum eigen root of the matrix to 5.9865 and the order of the matrix to 6 . Formula $CR = CI/RI$ is the consistency ratio of the contrast matrix; RI represents the random coincidence index of the mean, and CI represents the inconsistency of the paired contrast matrix. The weights of each evaluation index are calculated according to the characteristic vector of the contrast matrix [5]. At the same time, the weighted coefficients of each evaluation index were obtained (Table 2.2).

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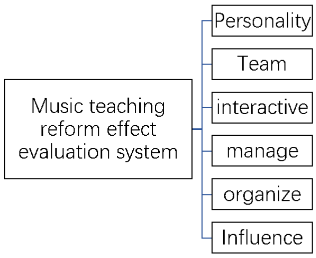

Fig. 2.1: *Index system of system model.*

Table 2.1: *Comparison matrix of principal factors.*

Evaluation index	Personality	Team	Interaction	Manage	Tissue	Influence
Personality	1	2	2	3	3	1
Team	2	2	3	2	1	2
Interaction	1	2	1	3	1	3
Manage	2	3	2	2	1	1
Tissue	2	2	1	2	2	2
Influence	3	2	3	3	2	2

Table 2.2: *Weights of evaluation indicators.*

Primary index	Weighted value	Secondary index	Weighted value
Personality	0.115	Self-confidence	0.385
		Self-control	0.302
		Sense of responsibility	0.313
Interaction	0.292	Listening ability	0.167
		Expression | eloquence	0.24
		Degree of communication	0.406
		Affinity	0.187
Team	0.198	Creativity	0.354
		Scientific research level	0.281
		Music teaching thought	0.188
		Special ontological level	0.177
Manage	0.135	Organization and coordination skills	0.385
		Spirit of solidarity and cooperation	0.615
ASSETS	0.115	Reason	0.427
		Availability	0.375
		Content richness	0.198
Content	0.145	Source of data	0.198
		Content design	0.292
		Content structure	0.354
		Teaching content	0.156

3. Application of most miniature square support vector machines in homology identification.

3.1. Derivation of function fitting method based on most miniature square support vector machines. Support vector machine (SVM) is a kind of machine learning algorithm that emerged in the 1990s. Its core idea is to transform a variable nonlinear [6]. Then, the variables are transformed into high-dimensional H-space, which effectively overcomes the linear inseparability problem of the original space. In addition, the paper will use the optimal classification hyperplane on the H-space to classify the samples. The traditional neural network adopts the gradient iteration method, which is likely to have local extreme values. At the same time, the support vector machine aims to solve the quadratic optimization, and its operational complexity and quality are independent of the sample dimension, so it shows excellent performance in identification and nonlinear function estimation. Least-squares support vector machine (LSVM) is an extension of the traditional support vector machine (SVM), which can deal with the categories and functions of SVM effectively [7]. By using the least square method, the inequality problem in the optimal problem is transformed into an equation problem, which reduces the complexity of the algorithm and improves the efficiency of the algorithm. Data $\{t_i, g_i\}_{i=1}^{M}$ has M training sample. $t_i \in R^n$ is the input. $g_i \in R$ stands for output. The format of the regression model in the initial space is:

$$g(t) = \eta^T \zeta(t) + \sigma$$

The following optimization problem is constructed in the most minor square support vector machine regression estimation problem:

$$\left\{ \begin{array}{l} \min_{\eta,\sigma,\varepsilon} F(\eta, \varepsilon) = \frac{1}{2}\eta^T\eta + \frac{1}{2}\delta \sum_{i=1}^{M} \varepsilon_i^2 \\ \text{s.t } g_i = \eta^T \zeta(t_i) + \sigma + \varepsilon_i, \quad i = 1, \ldots, M \end{array} \right.$$

The optimization problem in (3.1) is transformed into a dual space to solve it. The resulting Lagrange function is as follows:

$$S(\eta, \sigma, \varepsilon, \mu) = \frac{1}{2}\eta^T\eta + \frac{1}{2}\delta \sum_{i=1}^{M} \varepsilon_i^2 - \sum_{i=1}^{M} \mu_i \left\{ \eta^T \zeta(t_i) + \sigma + \varepsilon_i - g_i \right\}$$

Where μ_i is the Lagrange multiplier. Using the first order or sufficient condition of Kuhn-Tucker optimality, it is proved

$$\left\{ \begin{array}{l} \frac{\partial S}{\partial \eta} = 0 \rightarrow \eta = \sum_{i=1}^{M} \mu_i \zeta(t_i) \\ \frac{\partial S}{\partial \sigma} = 0 \rightarrow \sum_{i=1}^{M} \mu_i = 0 \\ \frac{\partial S}{\partial \varepsilon_i} = 0 \rightarrow \mu_i = \delta \varepsilon_i, i = 1, \ldots, M \\ \frac{\partial S}{\partial \mu_i} = 0 \rightarrow \eta^T \zeta(t_i) + \sigma + \varepsilon_i - g_i = 0 \end{array} \right.$$

Remove η, ε_i to get the matrix equation:

$$\left[\begin{array}{cc} 0 & p^T \\ p & \psi + \delta^{-1} W \end{array} \right] \left[\begin{array}{c} \sigma \\ \mu \end{array} \right] = \left[\begin{array}{c} 0 \\ g \end{array} \right]$$

$g = [g_1, g_2, \ldots, g_M]^T; p = [1, \ldots, 1]^T; \mu = [\mu_1, \ldots, \mu_M]^T .\psi$ is a square matrix whose i row s element is $\psi_{is} = I(t_i, t_s) = \zeta(t_i)^T \zeta(t_s)$. The conclusion of formula (3.6) is obtained from the mapping function ζ and the core $I(\cdot, \cdot)$ of the Mercer condition.

$$I(t_i, t_s) = \zeta(t_i)^T \zeta(t_s)$$

Finally, the following least squares support vector machine function estimation model is obtained:

$$g(t) = \sum_{i=1}^{M} \mu_i I(t, t_i) + \sigma$$

μ and σ in the formula are solutions to equation (3.5). The kernel function form has the following forms. Linear kernel function: $I(t, t_i) = t_i^T t$; c order polynomial kernel function: $I(t, t_i) = \left(t_i^T t + 1\right)^c$; Radial basis kernel function: $I(t, t_i) = \exp\left(-\|t - t_i\|_2^2 / \chi^2\right)$; Kernel function of two-layer perceptual neural network: $I(t, t_i) = \tanh\left(t t_i^T t + \beta\right)$. Here χ, t and β are both adjustment constants.

3.2. Multi-layer dynamic adaptive optimization algorithm. It can be seen from the least square support vector machine algorithm that the key parameters of this method are super parameters and kernel parameters. In engineering practice, the radial basis function is usually used as the core of nonlinear mapping, which can quickly carry out nonlinear transformation and has significant statistical properties and overall convergence, so it has important practical value in dealing with complex, nonlinear and inseparable class problems [8]. At the same time, the kernel function of the radial basis function is selected as the core. The regularization parameter δ and radial base kernel parameter χ are selected. These two parameters directly affect the learning performance and prediction performance of the least-square support vector machine algorithm [9]. The specific implementation steps of the multi-level dynamic optimization method of the least square support vector machine algorithm are as follows:

1. The numerical intervals of δ and χ are given. According to the basic principle of least squares support vector machine algorithm, the maximum value is determined to be $\delta \in [0.1, 10000], \chi \in [0.1, 100]$.
2. Select the maximum value of the parameter. Construct A set of 2-dimensional mesh parameters with pairs $(\delta_i, \chi_j), i = 1, \ldots, m, j = 1, \ldots, n$. For example, if 10 values are selected for both parameters, (δ_i, χ_j) 10x10 grid surface and 100 A parameter pairs are formed. Two different selection methods are adopted: 1) the interval of the two-parameter values is given first, and then they are taken as the same value according to the expected logarithm. 2) Parameter values are determined based on data characteristics and the experience of training samples.
3. A set of parameters (δ_i, χ_j) of each node is used as the training sample of the least squares support vector machine. The corresponding node $(\delta_i, \chi_j)_{E_{\min}}$ is selected as the best parameter combination.
4. If the required learning accuracy cannot be satisfied, $(\delta_i, \chi_j)_{E_{\min}}$ new twodimensional grid plane is established at A. Select parameters with similar values for training to improve the training effect [10]. The new selection method is automated. The practice has proved that 0.01-5 times of $(\delta_i, \chi_j)_{E_{\min}}$ is usually used as an extended mesh width. Construct A new set of 2-dimensional mesh parameters for $(\delta_i, \chi_j)_{E_{\min}}, i = 1, \ldots, i, j = 1, \ldots, s$.

Figure 3.1 shows the optimal network topology for level 2 parameters. The optimal mesh of multiple levels of parameters is constructed successively, and the parameters of the most miniature square support vector machine are continuously optimized until the required learning accuracy is satisfied. The two-dimensional plane optimization design is carried out by using a twolevel grid, and MATLAB carries out the numerical simulation. According to the characteristics of the model, the first parameter is optimized $\delta = [0.1, 1, 10, 50, 100, 500, 1000, 2500, 5000, 10000]$ and $\chi = [0.1, 0.2, 0.5, 1.5, 10, 15, 25, 50, 100]$ are selected simultaneously. The system uses a $10x10$ grid. In the parameter pairs of each node, the least square support vector machine algorithm is used to identify the system and nonlinear components [11]. Next, at the level of the second parameter optimization, the $(\delta_i, \chi_j)_{E_{\min}}$ square is the center. The width of the grid is expanded in the δ direction so that it has a $(\delta_i)_{E_{\min}}$ value of $+0.1$. The width of the expanded grid in the χ direction is $(\chi_j)_{E_{\min}} + 0.05$ and builds a $10x10$ grid. Then, the optimal parameter pair is obtained by using the least squares support vector machine algorithm [12]. Finally, the optimal parameters are used to train and learn the least-square support vector machine algorithm for (δ_i, χ_j).

4. Case analysis. Take a university as the research object. It introduced a music teaching reform plan in 2021. An online questionnaire survey was conducted among the college students at this university. A total of 1200 questionnaires were distributed, and 1122 valid questionnaires were obtained. 561 of them were selected as extensive data-driven training samples, and the remaining questionnaires were selected as test samples [13]. In this paper, SPSS is used to make statistics on the questionnaire and draw conclusions. The value of the reliability coefficient is 0.995, and that of KMO is 0.9421, where both the reliability term and KMO are above 0.9. This proves the validity and reliability of this questionnaire, which can be used to evaluate the effectiveness of music education reform programs [14]. This model is used to evaluate the implementation of a music education reform plan, and ten copies of it are used as the manifestation of teaching effectiveness evaluation. The big data used in this study was processed using the mean deviation as the evaluation criterion. It can be seen from the test results in Figure 4.1 that the mean deviation of the output of the big data-driven model used in this project is the smallest when the penalty value is 100. This means that big data-driven models have better output performance at this time. In the evaluation of music education reform projects, the accuracy of

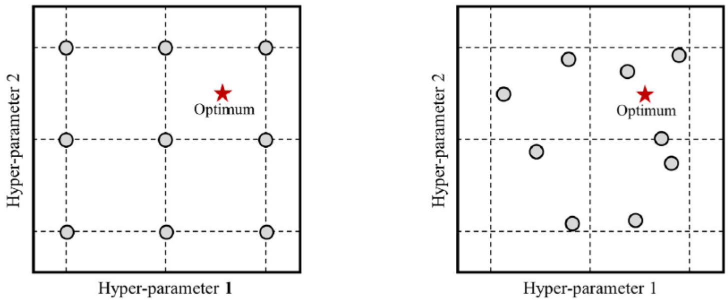

Fig. 3.1: *Schematic diagram of the grid plane for Layer 2 parameter optimization.*

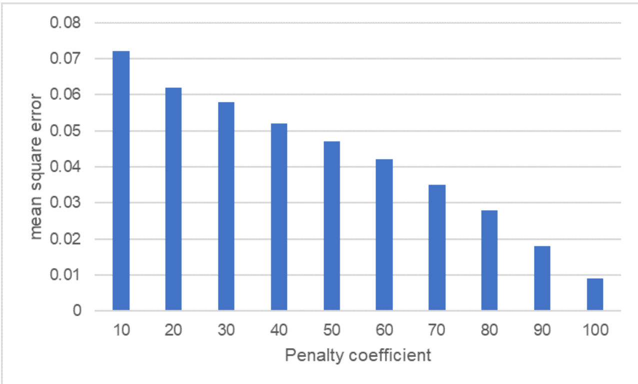

Fig. 4.1: *Output results under different penalty factors.*

the evaluation can be well improved, and the penalty factor of using the big data-driven model to evaluate the impact of music education reform projects is set at 100.

The effect of applying this model to the evaluation of the music education reform plan is shown in Table 4.1. As can be seen from the experimental data in Table 4.1, the evaluation of the implementation of the music education reform plan with this model obtained a score of 6.56. It shows that the effectiveness of the school's education reform program is moderate, and there is much room for improvement [15]. According to the results of the evaluation, schools should find out the corresponding improvement methods from the "affinity" and "creativity" and other poor indicators so as to enhance the effectiveness of the "music education reform plan."

People also need to compare this method with the expert evaluation method to analyze the role of this method in the evaluation of music education reform projects to better test the evaluation performance of this method [16]. The model in this paper is compared with the linear analysis model and the hierarchical analysis model, and the comparison results are shown in Figure 4.2. As can be seen from the experimental results in Figure 4.2, this model uses a big data-driven model to evaluate the effectiveness of teaching reform programs, and the relative deviation of its evaluation is much smaller than that of other models. The relative deviation of the teaching reform programs assessed by this model was within 0.2% at all levels, while the other two models were above 0.3%. Because the implementation of music education reform programs is a very complex issue, the evaluation results of different models vary greatly. Compared with the traditional expert evaluation method, the difference between the proposed algorithm and the traditional expert evaluation method is not significant [17]. Therefore, this method can replace the expert evaluation method to evaluate the effect of music education reform project so as to achieve the purpose of saving manpower and improving the evaluation efficiency.

This model is used to evaluate the time required for indices at each level of a music education reform

Table 4.1: *Results of model evaluation in this paper.*

Primary index	Rating result/score	Secondary index	Rating result/score
Personality	7.7	self-confidence self-control Sense of responsibility	7.0 8.5 7.8
Interaction	5.9	Listening ability Expression | eloquence Degree of communication affinity	9.0 6.7 6.0 2.9
Team	6.3	creativity Scientific research level Musical thought Special ontological level	3.5 6.1 10.0 7.8
Manage	6.7	Organization and coordination skills Spirit of solidarity and cooperation	8.4 5.6
ASSETS	5.9	reason availability Content richness	6.9 4.9 6.0
Content	7.7	Source of data Content design Content structure	6.4 8.4 7.0
Total score	6.8		

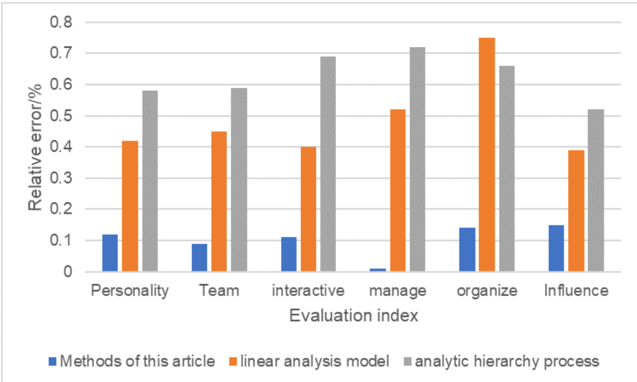

Fig. 4.2: *Comparison of evaluation accuracy of different models.*

program and is compared with linear and hierarchical models. The results of the comparison are shown in Figure 4.3. From the experimental data in Figure 4.3, it is found that both the evaluation efficiency and the time required for the evaluation of the teaching reform plan in this paper are within 200 milliseconds. It can be seen from the test data in Figure 4.2 that the method can guarantee real-time performance on the premise of ensuring the accuracy of the algorithm [18]. The results show that the algorithm is effective. This method has good evaluation ability and can be used to evaluate the reform plan of music teaching.

Among them, this study designed the opinion answer module to remove meaningless content such as ”none” and ”no” and conducted statistics on opinions and strategies through network word frequency statistics to obtain the keywords with the highest frequency (Figure 4.4). From the results of the experiment, it can be seen that interaction and interest are the most essential words and appear most frequently, which indicates that college students pay more attention to lively and exciting music education [19]. When conducting music education, people should pay attention to improving the vividness and interest of life. This can improve the

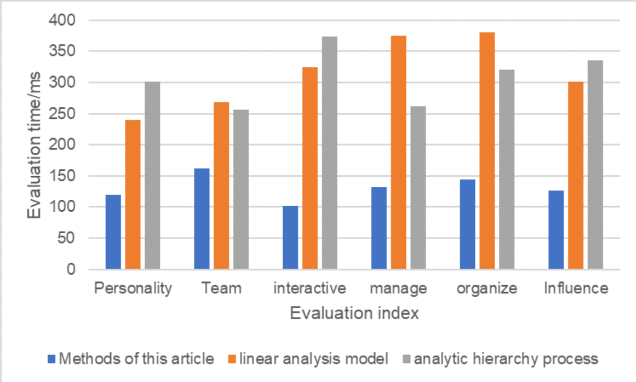

Fig. 4.3: *Comparison of evaluation time of different models.*

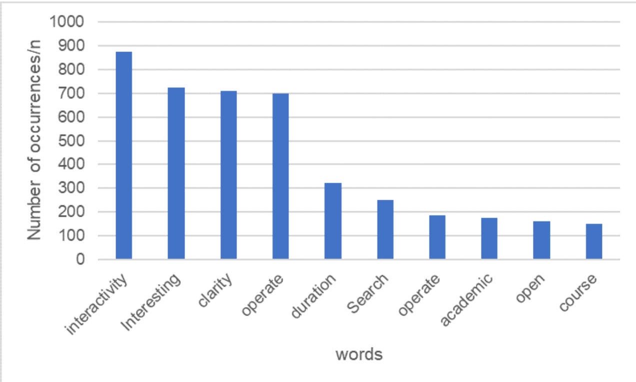

Fig. 4.4: *Keyword frequency results.*

effectiveness of the music reform in terms of educational content and evaluation and make the music reform curriculum livelier. In this way, the self-learning ability of college students has been improved.

5. Conclusion. This paper evaluates and empirically studies the implementation of a music teaching reform plan based on "big data". The evaluation model driven by big data has the characteristics of high accuracy and wide application. It has more potential in evaluating problems. Scholars can improve the evaluation effect by selecting appropriate loss functions and core functions. This model is used to determine some problems in the implementation of the music education reform plan. The teaching department can improve the effect of teaching reform by improving the comprehensive teaching ability, improving the traditional teaching idea and enriching the teaching mode.

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