Evaluation analysis of music education in China based on fuzzy AHP method

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Abstract

Music is not only an art, but also an education practice. Currently, education field in China has paid more attention on music education by means of improving the capability of musical teachers, performing music education reform, and cultivating students' learning interest. By carrying out data mining and exploration, a teaching model for music education in China was established; and the optimal evaluation of the model quantitatively investigated the teaching modes from the aspect of data. To begin with, based on ordinary education mode, relaxed education mode and multimedia assisted education mode, the specific definitions of their secondary modes were explained, and a researching model for music teaching mode was constructed based on optimal evaluation model. Then, the construction of teaching mode evaluation model for music education based on hierarchical structure revealed that the relaxed teaching mode presented a highest weight, and its secondary modes, teamwork and competition teaching modes had a largest response in music education. Therefore, to promote music education, the paper suggested to combining theory and practice, improving classroom efficiency, motivating learning enthusiasm, and building a new situation where teachers and students progress together, and the education situation and teaching mode reform are perfected by technological means.

Keywords: music education, data mining and exploration, optimal evaluation model, hierarchical structure

1 Introduction

Music education has always been an important course since ancient times. As it develops, Chinese music education has integrated the characteristics of multiple countries and areas. The current music education includes educations for western instruments such as piano and violin and Chinese traditional instruments including guzheng, xun and tonso.

Hu Zhongli's paper *Research on city community music education-investigation of music education activities in some communities in Shanghai* that published in 2012 indicated that community music education had been supported by the country and public [1-4]. However, the paper lacked of research pertinence. The paper explained the definitions of community music education and community education, stated the necessity of developing community music education, and described the development of community culture and art education in Shanghai. It intensively studied the community music education activities of Shanghai citizens. Meanwhile, as an object of the investigation, Hu analyzed the demand of Shanghai citizens for community music education. Afterwards, Hu explored the community music education situation in Shanghai in terms of operation mechanism, funds budget and teaching staff. Finally, based on the community music education situation, Hu suggested that the education had to clear out its orientation, adjust the operation mode, plan funds management, and intensify the guidance of professionals.

In 2006, Yao Xiaoxia published a paper entitled *Speculation on the music education in Higher School-the investigation and study of situation on music education in 8 higher schools in 4 provinces of Jin, Ji, Lu and Yu*. It explained that the teaching object of college music education was college students who are not majored in music, and the college music education was conducted by means of classroom teaching in the form of cultural activities in colleges with the basic teaching contents of basic musical knowledge and music appreciation [5-9]. In 21 century, with the increasingly intensively competition of talents, apart from basic professional knowledge, students have to present comprehensive quality. Based on this, music education becomes necessary in colleges. Besides, music education promotes the inheritance of Chinese culture and improves students' artistic culture. By using multiple methods, Yao investigated several colleges in Shanxi, Hebei, Shandong, and Henan provinces to analyze the general problems of Chinese colleges in music education and provided reasonable suggestions. Yao concluded the cultural characteristics of music, analyzed the practical meaning of music education and provided the overall structure of music education theoretically by combining her music education experience and the social functions of music. Additionally, by referring the documents of central government, Yao explained the necessity of perfecting the quality of college music education and improving students' artistic accomplishment.

In 2012, Xu Kerui presented the development of Chinese modern music, to which several generations of musicians contribute a lot, in the paper *He Lvting and modern music education in China* [10]. Among which, He Lvting is the most outstanding one. He clearly realized the influences of Chinese social changes on the development of Chinese music education as he experienced much during key historical changes. Just because of this, He Lvting's music education thought is marked by historical overtones.

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Considering the education and creation of music, He Lvting made a significant contribution for the development of Chinese modern music. By analyzing his music education, we find the essence and basic means of music education.

Dong Yun explained in *Music education from ecological view* in 2012 that music education had to develop synchronously with the society [11,12]. Based on ecological holism, Dong discussed the development of music education from current situation. Firstly, the paper introduced the development history and problems of music education; then stated its ecological characteristics, and proved that the ecological civilization is its final objective; finally, Dong formulated teaching scheme for music course based on ecological holism.

By studying mass of data, the authors investigated the current music education modes in China and evaluated these modes.

2. Model construction

With the development of information technology, the music teaching modes change continuously. At present, the teaching modes of music education include ordinary one, relaxed one and the multimedia assisted one (as displayed in Figure 1).

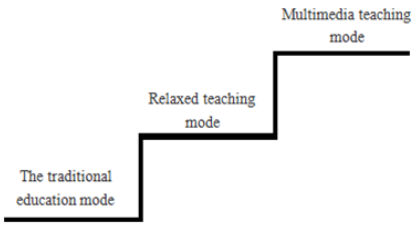

FIGURE 1 Music education teaching pattern classification

Though the music teaching mode updates continuously, there is still disputes on the most efficient teaching mode. The construction of the model is to explore the most efficient musical teaching mode, so that music education can develop better.

2.1 OPTIMAL EVALUATION MODEL BASED TEACHING MODE

Currently, music education is a weak link in education field. Generally, the teaching modes of music education include teaching in different foundational groups, ordinary theoretical teaching, teamwork teaching, competition teaching, situational teaching and practical teaching, as listed in Table 1.

TABLE 1 Classification of teaching modes of music education

Type	Ordinary teaching mode		Relaxed teaching mode		Multimedia assisted teaching mode	
	teaching in different foundational groups	Ordinary theoretical teaching	teamwork teaching	competition teaching	situational teaching	practical teaching
Ratio	18.8%	19.2%	16.3%	16.5%	14.1%	15.1%

The analysis of the above teaching modes reveals that:

(1) Teaching in different foundational groups divides students in different groups according to their learning foundations and formulates different teaching contents for each group. Ordinary theoretical one teaches students theoretical knowledge first and then conducts practical teaching.
(2) Teamwork one assigns tasks for students and requires students to finishing the tasks in teamwork. Competition one motivates students' learning enthusiasm and then improves the competitiveness among students by organizing competitions.
(3) Situational one sets the teaching tasks in certain situations and makes students learn in actual situations.
(4) Practical one teaches students theoretical knowledge by carrying out practical activities.

The aforementioned teaching modes are comprehensively evaluated and analyzed, and the procedures are as follows.

2.1.1 Determining evaluation index set

According to:

$$U=\{u_1,u_2,\cdots,u_m\},m=1,2,3,\cdots,6$$

The evaluation index set is ={teaching in different foundational groups, ordinary theoretical teaching, teamwork teaching, competition teaching, situational teaching, practical teaching}.

2.1.2 Determining evaluation degree set

In the research of teaching modes of music education, expert evaluation is adopted to determine the evaluation degree set. According to:

$$V=\{v_1,v_2,\cdots,v_n\},n=1,2,3,4$$

The evaluation degree set of musical teaching mode is ={quite satisfied, basically satisfied, satisfied, dissatisfied}.

2.1.3 Determining the weights of each evaluation index

Weights are mainly expressed by:

$$w=\{\mu_1,\mu_2,\cdots,\mu_m\},m=1,2,\cdots,6,$$

where $\sum_{m=1}^{6}\mu_m=1$

The methods for determining the weights of evaluation indexes mainly are analytic hierarchy process (AHP) and normalization methods. In which, the normalization formula is:

$$w_i=\frac{C_i/S_i}{\sum_{i=1}^{n}C_i/S_i},(i=1,2,\cdots,m)$$

Where w_i is the monitoring value of evaluation

parameter, and S_i is the arithmetic mean of m^{th} standard of evaluation parameter i, then the weight set is:

$$w = \{w_1, w_2, \cdots, w_m\}$$

Afterwards, by using normalization method, the weights of the evaluation indexes of musical teaching modes are calculated as:

$$w = \{0.03,\ 0.06,\ 0.35,\ 0.25,\ 0.15,\ 0.15\}$$

2.2 HIERARCHICAL STRUCTURE BASED TEACHING MODES EVALUATION

The evaluation methods of comprehensive evaluation matrix R include expert evaluation, AHP, and membership function method.

Among above three methods, owing to the expert method is based on questionnaire survey and the statistics of expert evaluation results, to obtain more accurate results, APH method is applied to determine fuzzy relation matrix *R*, where:

$$R = (R_1,\ R_2,\ R_3,\ R_4,\ R_5,\ R_6)^T$$

2.2.1 Principles of AHP method

(1) Establishment of hierarchical structure

Objective layer is the satisfaction degree of musical teaching mode.

Criterion layer contains the influencing factors of schemes; C_1 is teaching in different foundational groups, C_2 is ordinary theoretical teaching, C_3 is teamwork teaching, C_4 is competition teaching, C_5 is situational teaching, and C_6 is practical teaching.

In schematic layer, A_1 is quite satisfied, A_2 is basically satisfied, A_3 is satisfied, and A_4 is dissatisfied.

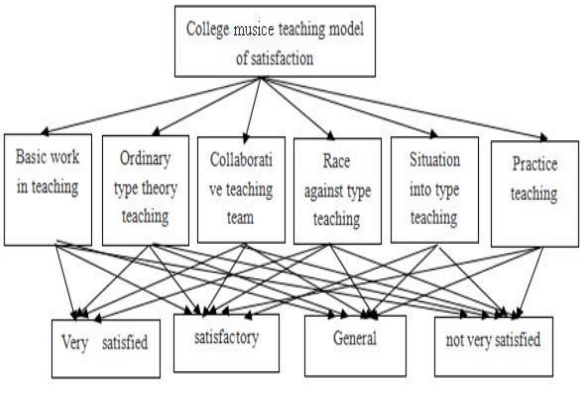

FIGURE 2 Class Hierarchy

(2) Construction of pairwise comparison matrix

The construction of pairwise comparison matrix is to compare elements in pairs and shows the significance of each element in a layer to each element in the upper layer. The scales range from 1 to 9 that proposed by operational research experts are used here.

TABLE 2 Definitions of 1~9 scales

Scale a_{ij}	definition
1	Element i is as significant as j
3	Element i is slightly significant than j
5	Element i is significant than j
7	Element i is very significant than j
9	Element i is absolutely significant than j
2, 4, 6, 8	Scales of the intermediate states of the above judgments

According to the above scale table 2, suppose the judgment matrix *A* is:

$$A = \begin{pmatrix} 1 & 2 & \frac{1}{3} & \frac{1}{5} & \frac{1}{2} & \frac{1}{2} \\ \frac{1}{2} & 1 & \frac{1}{2} & \frac{1}{4} & \frac{1}{3} & \frac{1}{5} \\ 3 & 2 & 1 & 3 & 4 & 5 \\ 5 & 4 & \frac{1}{3} & 1 & 5 & 6 \\ 2 & 3 & \frac{1}{5} & \frac{1}{3} & 1 & \frac{1}{4} \\ 2 & 5 & \frac{1}{5} & \frac{1}{6} & 4 & 1 \end{pmatrix}$$

(3) Weight calculation

For judgment matrix *A*, following processes are performed using MATLAB software:

$$\xrightarrow{Column\ \ vector\ \ normalization}$$

$$\begin{pmatrix} 0.882 & 0.925 & 0.874 & 0.733 & 0.619 & 0.427 \\ 0.736 & 0.811 & 0.821 & 0.722 & 0.509 & 0.653 \\ 0.652 & 0.657 & 0.773 & 0.604 & 0.527 & 0.662 \\ 0.551 & 0.431 & 0.694 & 0.585 & 0.448 & 0.586 \\ 0.288 & 0.305 & 0.548 & 0.454 & 0.339 & 0.496 \\ 0.186 & 0.063 & 0.167 & 0.145 & 0.185 & 0.386 \end{pmatrix}$$

$$\xrightarrow{According\ \ to\ \ the\ \ row\ \ sum}$$

$$\begin{pmatrix} 2.898 \\ 2.196 \\ 1.254 \\ 0.993 \\ 0.874 \\ 0.627 \end{pmatrix} \xrightarrow{The\ \ normalized} \begin{pmatrix} 0.213 \\ 0.176 \\ 0.715 \\ 0.579 \\ 0.451 \\ 0.322 \end{pmatrix} = W^0$$

Then, $\lambda^0_{max} = 4.135$ is calculated according to

$$A \times W^0 = \begin{pmatrix} 0.213 \\ 0.176 \\ 0.715 \\ 0.579 \\ 0.451 \\ 0.322 \end{pmatrix}$$

Similarly, the maximum characteristic value and characteristic vector corresponding to judgment matrix in criterion layer are:

$$\lambda^{(1)}_{max} = 2.871, \omega_1^1 = \begin{pmatrix} 0.567 \\ 0.413 \\ 0.902 \\ 0.883 \\ 0.747 \\ 0.624 \end{pmatrix} \lambda^{(2)}_{max} = 2.865, \omega_2^1 = \begin{pmatrix} 0.112 \\ 0.057 \\ 0.872 \\ 0.761 \\ 0.595 \\ 0.385 \end{pmatrix}$$

$$\lambda^{(3)}_{max} = 2.859, \omega_3^1 = \begin{pmatrix} 0.406 \\ 0.146 \\ 0.875 \\ 0.769 \\ 0.654 \\ 0.527 \end{pmatrix} \lambda^{(4)}_{max} = 2.841, \omega_4^1 = \begin{pmatrix} 0.406 \\ 0.251 \\ 0.885 \\ 0.741 \\ 0.621 \\ 0.557 \end{pmatrix}$$

$$\lambda^{(5)}_{max} = 2.865, \omega_5^1 = \begin{pmatrix} 0.369 \\ 0.321 \\ 0.898 \\ 0.751 \\ 0.624 \\ 0.547 \end{pmatrix} \lambda^{(6)}_{max} = 2.852, \omega_6^1 = \begin{pmatrix} 0.441 \\ 0.242 \\ 0.893 \\ 0.731 \\ 0.544 \\ 0.527 \end{pmatrix}$$

2.3 COMPREHENSIVE EVALUATION MATRIX

The above calculation results indicate that:

$$R_1 = \begin{pmatrix} 0.567 \\ 0.413 \\ 0.902 \\ 0.883 \\ 0.747 \\ 0.624 \end{pmatrix} \quad R_2 = \begin{pmatrix} 0.112 \\ 0.057 \\ 0.872 \\ 0.761 \\ 0.595 \\ 0.385 \end{pmatrix} \quad R_3 = \begin{pmatrix} 0.406 \\ 0.146 \\ 0.875 \\ 0.769 \\ 0.654 \\ 0.527 \end{pmatrix}$$

$$R_4 = \begin{pmatrix} 0.406 \\ 0.251 \\ 0.885 \\ 0.741 \\ 0.621 \\ 0.557 \end{pmatrix} \quad R_5 = \begin{pmatrix} 0.369 \\ 0.321 \\ 0.898 \\ 0.751 \\ 0.624 \\ 0.547 \end{pmatrix} \quad R_6 = \begin{pmatrix} 0.441 \\ 0.242 \\ 0.893 \\ 0.731 \\ 0.544 \\ 0.527 \end{pmatrix}$$

Therefore the following comprehensive evaluation matrix is obtained according to

$R = (R_1, R_2, R_3, R_4, R_5, R_6)^T$:

$$R = \begin{pmatrix} 0.567 & 0.112 & 0.406 & 0.406 & 0.369 & 0.441 \\ 0.413 & 0.057 & 0.146 & 0.251 & 0.321 & 0.242 \\ 0.902 & 0.872 & 0.875 & 0.885 & 0.898 & 0.893 \\ 0.883 & 0.761 & 0.769 & 0.741 & 0.751 & 0.731 \\ 0.747 & 0.595 & 0.654 & 0.621 & 0.624 & 0.544 \\ 0.624 & 0.385 & 0.527 & 0.557 & 0.547 & 0.527 \end{pmatrix}$$

2.4 COMPREHENSIVE EVALUATION

Given $W = (\mu_j)_{1\times m}$ and $R = (r_{ji})_{m\times n}$, the fuzzy evaluation set S is obtained by

$$S = w \circ R = (\mu_1, \mu_2, \cdots, \mu_m) \circ \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{pmatrix}$$

$$= (s_1, s_2, \cdots, s_n)$$

Where " $\circ$ " is fuzzy composite operator, which is operator $M(\cdot, \oplus)$ here, that is

$$s_k = \min\left(1, \sum_{j=1}^{m} \mu_j r_{jk}\right), k = 1, 2, \cdots, n$$

By substituting the calculating results in the above formula, we obtain:

$$S = (0.124, \quad 0.123, \quad 0.347, \quad 0.333, \quad 0.280 \quad 0.231)$$

2.5 EVALUATION RESULTS

A comprehensive conclusion is drawn by analyzing the fuzzy evaluation vector S. Generally, maximum subordination principle, weighted average principle and fuzzy vector uniformization can be used; here the first one is adopted.

Regarding maximum subordination principle, given that $S = (S_1, S_2, \cdots, S_n)$ (where S_i is the membership degree of degree v_i for fuzzy evaluation set), then $M = \max(S_1, S_2, \cdots, S_n)$. The elements that correspond to M are comprehensive evaluation results.

According to

$$S = (0.124, \quad 0.123, \quad 0.347, \quad 0.333, \quad 0.280 \quad 0.231)$$

TABLE 3 Weights comparison of teaching modes of music education

Type	Ordinary teaching mode		Relaxed teaching mode		Multimedia assisted teaching mode	
	Teaching in different foundational groups	Ordinary theoretical teaching	Teamwork teaching	Competition teamwork	Situational teaching	Practical teaching
Weight	12.4%	12.3%	34.7%	33.3%	28.0%	23.1%
Sum	24.7%		68%		51.1%	

The three teaching modes are compared and analyzed.

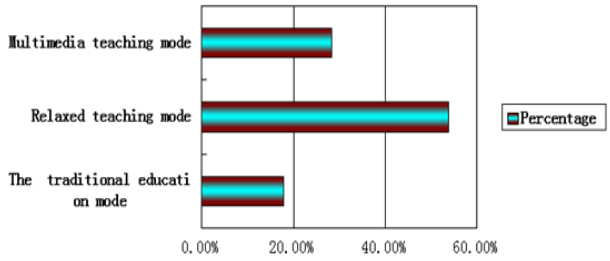

FIGURE 3 Three types of college English teaching mode

Obviously, it is learned that:

The above analysis indicates that the relaxed teaching mode shows a highest satisfaction of the students with a weight of 53.8% in music education. Therefore, relaxed teaching mode has to be the major mode for music education in the future, and more attention has to be paid on teamwork and competition teaching modes to make students learn knowledge and motivates their learning enthusiasm in cooperation and competition.

Besides, multimedia assisted teaching mode presents a large weight as well. This is because situational and practical teachings are effective in innovating classroom teaching, guiding students' learning and motivating learning enthusiasm. Therefore, based on the relaxed teaching mode, the redevelopment of musical teaching mode has to combine high-tech means such as multimedia assisted teaching to improve teaching efficiency and make the classroom teaching content more novel and unique.

3 Conclusion

Based on the analysis of 6 teaching modes of music education and their implementation ratios, the following conclusions are drawn using optimal evaluation method:

(1) The secondary teaching modes of ordinary, relaxed and multimedia assisted teaching modes are introduced firstly. By evaluating students' satisfaction for the teaching modes using fuzzy comprehensive evaluation method, the optimal teaching mode is obtained.

(2) The construction of evaluation matrix using AHP method indicates that relaxed teaching mode, that is, teamwork and competition teaching mode, has a highest weight. It reveals that the optimal teaching mode for improving the musical teaching quality and changing the current situation of low musical quality of college students is the relaxed one. In addition, high-tech means including multimedia has to be combined based on relaxed teaching mode to improve music education efficiency of college students and contribute more innovative teaching content.

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