The discrimination of college music teaching level based on wave equation

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Abstract

In order to improve the teaching level of college music teachers, in this essay the discrimination of college music teaching level based on the wave equation is put forward. In this study, the advantages of pattern recognition are utilized to establish a college music teaching level evaluation model based on wave equation. The wave equation is adopted to replace the complex function representation in the traditional statistical method, so as to reduce the influence of subjective factors on teaching level evaluation and explore the potential factor correlation in the evaluation process. The linear fuzzy indivisible samples are mapped to high dimensional space to make them linearly divisible, which avoids the traditional process from induction to deduction in essence and simplifies the classification process of nonlinear problems. Structural risk minimization theory ensures global optimization of segmentation and reduces expected risk. The results of this study can be combined with existing research methods to enhance the objectivity of evaluation methods and the accuracy of evaluation results, which has certain reference significance for improving teachers' teaching level and promoting the improvement of teaching quality.

Keywords: Wave equation; College music; Teaching level; Multiple classification method

AMS 2020 codes: 35L05
1 Introduction

Teaching quality is the core of higher education. Classroom teaching evaluation is closely related to specialty orientation, talent training program, teaching syllabus and learning situation. The assessment standards of classroom teaching quality in different types of colleges and universities are different. Even in the classroom teaching of the same major, the differences of students' starting points will affect the assessment elements. On the one hand, college music classroom teaching evaluation embodies the commonness of classroom evaluation. On the other hand, due to the characteristics of music major, it maintains its unique characteristics in teaching concepts, contents, methods, teachers, students and other aspects. The evaluation of music classroom teaching can include the evaluation of students' starting point of music, the evaluation of music course structure, the evaluation of teaching plan improvement and the evaluation of classroom teaching effect [1]. Figure 1 shows the multidimensional thinking of the emotional attitude and aesthetic value of music appreciation in colleges and universities. With the advent of the popularization of higher education in the international society, China's higher education has shown a trend of rapid development, and the essence of education is gradually highlighted, which promotes people's in-depth examination and attention to the quality of education, and educational evaluation has therefore emerged at the historic moment and developed rapidly in the global scope. In recent years, the reform of the education system has been further deepened, and the scale of education has been continuously expanded, which makes the necessity and implementation difficulty of educational evaluation more difficult. Therefore, it has become imperative to carry out scientific, objective and quantitative educational evaluation in colleges and universities, especially the evaluation of teaching level [2].

![Figure 1. Multi-dimensional thinking of the emotional attitude and aesthetic value of music appreciation in colleges and universities](image)

2 Nonlinear phenomena in music sound field

When human vocal cords make sound, the air flow changes from linear advection to nonlinear turbulence, which can stimulate the obvious vibration of vocal cords. The first principle of wind instrument sound is turbulence. Generally speaking, one end is equivalent to an equivalent piston energy, and its vibration is generally nonlinear. The simplest clarinet, for example, has a nonlinear spring, and the player controls the airflow. Varying degrees of turbulence occur in the narrow space passing through the glottis, changing timbre and pitch. The whistle piece of suona is more nonlinear element and its nonlinear vibration characteristics are more obvious. Moreover, different wind instruments have different boundary conditions for sound waves, and strictly speaking, these boundaries themselves must produce nonlinear vibration. Refracted or reflected waves on these boundary surfaces are also necessarily nonlinear waves. In string instruments, the forces on strings are generally nonlinear [3]. For the piano, for example, the player's keystroke force usually exceeds the linear forcing range. The forces on Musical Instruments (such as sanxian, ruan, pipa, guitar, etc.) are generally nonlinear. The bow of a string instrument is also nonlinear. For example, the violin,
Erhu, and especially the Chinese Jinghu, their rosin particles greatly increase the bow-string friction far beyond the linear damping range, giving them a very special timbre. As for percussion instruments, their nonlinear vibration characteristics are obvious, such as large drums, gongs, cymbals, cymbals and so on. String is the original vibrating body of string instrument. The purpose of using string in instrument is to obtain vibration through string. The acoustic characteristics of string instruments mainly come from strings, and strings play a controlling role in the acoustic characteristics of string instruments [4].

3 Waves on a string

The definition of wave in acoustics is: wave is the change of pressure, stress, particle displacement, particle velocity and so on propagating in elastic media or the combination of several changes. The definition of wave must be understood and deepened from the following meanings: wave is a change that is "propagated"; This change is called vibration; What is transmitted is the vibrating state, not the vibrating matter; Propagation is an expansion of the area where the vibration occurs "rather than a" relocation "of the vibration site; Although vibration is the only "connotation" of a wave, it is different from a wave. Although propagation is the only "mode of existence" of a wave, propagation is not a wave, and the vibration being propagated is a wave, that is, vibration + propagation = wave [5].

3.1 Generation of waves on strings

Waves can be generated on a string because of the propagation of vibrations, and vibrations can propagate because there is a connection within the matter of the string. When a particle produces displacement, it will inevitably pull the neighboring particles to move according to the same property and law, which is propagation. Once the propagation begins, the particles outside the vibration source will gradually enter the same state of vibration. From near to far, one after another, this is the wave. A string is a special wave field. A wave on a string is neither a plane wave nor a spherical wave, but a one-dimensional wave. A one-dimensional wave is a wave that occurs and propagates in a space with only one degree of freedom. In addition to one-dimensional waves, there are also two-dimensional waves and nearly three-dimensional waves in Musical Instruments [6].

3.2 Establishment of wave equation

The meaning of the wave equation is to solve the value of a certain point, a certain time and a certain expression quantity on the wave. However, since the vibration of all places along the wave propagation route is the reproduction of the vibration of the source point, it is only due to the existence of time difference that causes the difference in phase, so only a displacement equation can be established for the wave equation. With the displacement equation, other expressions can be obtained from the displacement equation. The string has a sine wave (or cosine wave) traveling along the string at the speed of C. Suppose that the string is the horizontal axis X representing the propagation distance, and the propagation direction is positive; The direction perpendicular to the string is the vertical axis Y, indicating the displacement of the string. A is a vibration point on the string at a distance X from the source point. According to the principle of fluctuation, the vibration property and process of point A and source point O are exactly the same, and the change law of its displacement is also based on:

$$Y_A = S_o \cos \omega$$

(1)
But after the phase is late, the time after the delay should be \( X/C \), where \( C \) is the wave speed. So while the source \( O \) vibrates for \( t \) time, the source \( A \) vibrates only for \((t-X/C)\) time. So the displacement of \( A \) at time \( t \) should be equal to the displacement of \( O \) at time \( t \) minus \( X \) over \( C \). Then the displacement of point \( A \) at time \( t \) should be:

\[
Y_A = S_0 \cos \omega (t - X/C)
\]  

Equation (2) is the displacement equation of fluctuation. Using these two formulas, we can find the displacement of any given point on the wave string at a given time.

4 Evaluation model of college music teaching level

Based on the evaluation program of undergraduate teaching level of the Ministry of Education and the existing relevant research results, the teaching level evaluation model is established according to the design principle of simplification, comprehensive and simple. The index system of the evaluation model is established from the four aspects of "teaching attitude", "teaching ability", "teaching effect" and "use of teaching materials". As shown in Table 1,2 [7].

<table>
<thead>
<tr>
<th>Category of Project</th>
<th>Item of Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 Attitude towards teaching</td>
<td>f11 Is the classroom teaching according to the lesson plan?</td>
</tr>
<tr>
<td></td>
<td>f12 Whether to be late or leave early</td>
</tr>
<tr>
<td></td>
<td>f13 Is there verbal humiliation, discrimination and corporal punishment?</td>
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<tr>
<td></td>
<td>f14 Are there mobile phone calls in class?</td>
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<td></td>
<td>f15 Is there any unauthorized transfer of classes and hiring a substitute?</td>
</tr>
<tr>
<td>F2 Ability of teaching</td>
<td>f21 Does the teacher's theoretical level meet the requirements of this course?</td>
</tr>
<tr>
<td></td>
<td>f22 Does textbook knowledge relate to practical problems?</td>
</tr>
<tr>
<td></td>
<td>f23 Is the teacher clearly organized?</td>
</tr>
<tr>
<td></td>
<td>f24 Is the teacher's grasp of knowledge up to standard?</td>
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<tr>
<td></td>
<td>f25 Is the teacher's expression of technical terms accurate?</td>
</tr>
<tr>
<td></td>
<td>f26 Is the teacher's schedule reasonable?</td>
</tr>
<tr>
<td></td>
<td>f27 Are you satisfied with the teaching ability of the teacher in this course?</td>
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<thead>
<tr>
<th>Category of Project</th>
<th>Item of Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3 Effect of teaching</td>
<td>f31 Is the difficulty of the mid-term/final exam reasonable?</td>
</tr>
<tr>
<td></td>
<td>f32 Does homework reinforce knowledge?</td>
</tr>
<tr>
<td></td>
<td>f33 Are you satisfied with the teacher's teaching effect?</td>
</tr>
<tr>
<td>F4 Use of teaching materials</td>
<td>f41 Is the selection of textbooks reasonable?</td>
</tr>
<tr>
<td></td>
<td>f42 Is there compulsory purchase of tutoring books?</td>
</tr>
</tbody>
</table>

According to Table 1,2, the evaluation attribute set and the evaluation result set are divided:

Evaluation attribute set : \( F = \{F_1(\text{teaching attitude}), F_2(\text{teaching ability}), F_3(\text{teaching effect}), F_4(\text{teaching material use})\} \), where : \( F_1(\text{teaching attitude}) = \{f11(\text{teaching plan preparation}), f12(\text{late arrival and early leaving}), f13(\text{corporal punishment/verbal humiliation}), f14(\text{mobile phone reception in class}), f15(\text{unauthorized course transfer/hiring substitute})\} \), \( F_2(\text{teaching ability}) = \{f21(\text{standard of theoretical level}), f22(\text{combination of teaching and practice}), f23(\text{clear organization}), f24(\text{knowledge knowledge}), f25(\text{expression of professional terms}), f26(\text{teaching schedule}), f27(\text{students' satisfaction})\} \), \( F_3(\text{teaching effect}) = \{f31(\text{exam difficulty arrangement}), f32(\text{homework arrangement}), f33(\text{students' satisfaction})\} \), \( F_4(\text{selection of textbooks}) = \{f41(\text{reasonable selection of textbooks}), f42(\text{compulsory purchase of books})\} \)[8-9]. Evaluation result set : \( V = \{v1(\text{excellent}, \text{reasonable}, \text{average}, \text{poor})\} \).
satisfactory), v2(average, basically reasonable, basically satisfactory), v3(poor, unreasonable, unsatisfactory)}[10].

5 Evaluation of college music teaching level based on wave equation

According to the setting of the evaluation result set, the teaching level evaluation system is divided into three types of classification problems, and the one-to-one method (1vs1), one-to-many method (1vsA), minimum output coding method (MOC) and error-correcting output coding method (ECOC) are selected for multi-categorization [11]. The questionnaire survey was conducted for several music teachers with students as the survey objects. The anonymous method was adopted to ensure the recovery rate and authenticity, and the questionnaire statistics were conducted. The classification data were collected from 200 questionnaires. The methods of 1vs1, 1vsA, ECOC and MOC were respectively applied to conduct a multi-classification study with 10 times of cross-validation. As shown in Figure 2,3 [12].

![Figure 2](image2.png)

**Figure 2.** Fitting result of teaching level assessment method (accuracy)

![Figure 3](image3.png)

**Figure 3.** Fitting result of teaching level assessment method (time)
The four multi-classification methods have obtained good fitting effects, among which 1vs1 method has the highest accuracy, with an accuracy of 93.5% for 10 cross-validation and excellent operating efficiency. Without algorithm optimization, it can basically meet the application of college music teaching level evaluation [13-17]. Compared with traditional classification methods such as artificial fitting and neural network, this method makes full use of the characteristics of efficient learning of small samples to achieve efficient learning effect. At the same time, the high-dimensional mapping mode essentially avoids the traditional process from induction to deduction, greatly simplifying the classification and regression process of nonlinear problems. The multi-classification method is adopted to establish the teaching level evaluation method, which reduces the divergence error and the influence of subjective factors in the traditional evaluation methods and is more consistent with the macro-oriented evaluation conclusions [18-20].

6 Conclusion

In this study, the multi-classification method of wave equation was introduced into the evaluation task of college music teaching level, and the linear fuzzy indivisible samples were mapped to the high-dimensional space to make them linearly divisible. In essence, the traditional process from induction to deduction was avoided, and the classification process of nonlinear problems was simplified. Structural risk minimization theory ensures global optimization of segmentation and reduces expected risk. Compared with the traditional classification methods such as manual fitting and neural network, this method makes full use of the efficiency of small sample learning to achieve excellent learning effect, reduces the divergence error and the influence of subjective factors in the traditional evaluation methods, and is more consistent with the evaluation conclusion of macroscopic orientation. The results of this study can be combined with information entropy, fuzzy mathematics and other research methods to further enhance the accuracy of data fitting. This method has certain reference significance for improving the teaching level of college music teachers and promoting the improvement of teaching quality.

References