Study on Vocal Music Teaching Innovation Mode Based on Computer Simulation and Voice Spectrogram Analysis

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Abstract
In this paper, the user’s vocal music teaching mode based on computer platform is researched. As a modern means of teaching, computer multimedia technology has the characteristics of visualization, intuition and high information. The application of multimedia technology in the teaching of vocal music has changed the traditional teaching mode of vocal music and fully mobilized the enthusiasm of the students. Give full play to the advantages of multimedia teaching can constantly improve the quality of vocal music teaching and help students to master the vocal skills. It can also help students to cultivate good intonation, rhythm and singing, and then the experiment result shows the proposed method can improve the overall performance of the system.

Keywords: Vocal music teaching, Mobile network, Computer platform

1. Introduction

Vocal music is a musical form that is sung by the voice of people. Vocal music is a sound of human vocal cords, with the mouth, tongue, and nasal cavity acting on the breath, making a pleasant, continuous and rhythmic sound. According to the difference of pitch and tone, it can be divided into soprano, mezzo, bass and tenor, baritone and bass. The sound field of every human voice is about two eight degrees. Vocal music includes bel canto, folk singing and popular singing. In 2006, the original singing method appeared in China. Usually vocal music refers to the bel canto.

The so-called "singing", in fact, is a unique mode of singing, which directly affects the external performance of the singing style. In terms of the three kinds of singing, such as bel canto, national singing, and pop singing, the style of the singing will be different because the mode of singing is different. To be specific, there are great differences between the three kinds of singing methods in the style performance; the main reason is that three kinds of singing methods are caused by the different principles of singing and singing. Bel canto focuses on the skill and standardization of voicing, emphasizes the resonance and concealment of voice, requires larynx to fully open its throat and pursues strong penetration point of "masks", so as to achieve high quality sound effect. National singing singing naturally focus on sound, combine with the basic point of articulation cavity, advocate the "word" is to "cavity" round, the pursuit of "Qing" and "Rhyme" in the traditional format. Popular singing is more emphasis on the "feeling", emphasizing the importance of musicality and imitation in singing, personality and characteristics of the pursuit of sound, and colloquial style of singing. Thus, the difference between the three styles of singing from the singing mode to the style is obvious.

Bel canto produced in early seventeenth Century in Italy, with sound mellow and smooth tone is gorgeous. During the centuries long development, bel canto has been studied carefully by a large number of experts and scholars. Its singing theory and training method are the most complete and systematic in three kinds of singing methods. As the singing method accords with the natural law of human physiological function, relying on scientific breathing method and scientific singing method can reduce the overload and abrasion of vocal cord caused by long term singing, thus prolonging the effective time of vocal cord.

Chinese folk singing is a general term of our traditional folk singing. It is a singing mode with strong national characteristics, mainly for singing folk songs. China is a multi-ethnic country. For Han nationality, because of the differences in expression of local customs, habits and feelings and thoughts and feelings, the way to express the inner meaning of folk songs is also different. The main cause of this difference should be attributed to the influence of different ethnic types and different folk songs. For this reason, it is also necessary to introduce the characteristics of the folk songs while studying and exploring the style and style of the folk singing.

There are many kinds of folk songs in our country and have a long history. In the thousands of years of development and change, gradually formed a variety of folk forms belong to their own, which in the folk songs of Han north and South in the most influential and have the ability to cross the boundaries of time and space, and as the main form of China folk songs and continue to move forward.

Pop singing is the abbreviation of "pop song method", also known as popular singing. The concept of "pop song" is inaccurate, and the exact concept should be a song of commodity songs, that is, to make a profit as the main purpose. Its marketability is the main one, and the artistry is secondary. As a result, the exact concept of pop singing should be “the singing of commodity songs”. The biggest characteristic of pop singing is simple and
easy to sing, popular and convenient. Although it started late in China, it has developed rapidly. In a way, its influence has surpassed the canto and national singing.

For hundreds of years, through the unremitting efforts of numerous artists and vocal music teachers, vocal music has formed a scientific and complete teaching system. As one of the humanities, vocal music is one of the main ways to carry out aesthetic education, and is a compulsory course in normal universities. The teaching of vocal music and instrumental music theory course as the class that is intuitive, it is very abstract, in addition to stage concert performances, such as singing organs of state, breath direction, fulcrum, resonance and the sound position and so on are not intuitive and clear, only by the singer's feeling to bring some vocal exercises it is difficult for students to learn. The visualization, visualization and highly informationalized characteristics of multimedia technology provide a new teaching way for traditional vocal music teaching, provide great convenience for vocal music teaching, and promote the reform of vocal music teaching (Czajkowski, 2015; Yeh, 2016).

2. Overview

In the direct impact on the May 4th New Culture Movement, China's modern music culture has been established and the development of the real, but also opened a new page in the history of the development of Chinese music. "May 4th" movement, the emergence of a large number of composed of bourgeois and bourgeois intellectuals engaged in professional music groups, from their works not only reflect the anti-imperialist and anti-feudal spirit of the times, but also on behalf of the people's progressive thought. In the "May 4th" during this period, China's art songs influenced by the European art song creation, flourish (Cuadrado, 2016; Biasutti, 2017).

The rise of Chinese art songs has promoted the prosperity of vocal performance. Since the first half of the twentieth Century, professional vocal music education in China has been developed and developed, and all kinds of music associations have been set up in Beijing and Shanghai. In this new situation, Beijing, Shanghai and established the first Peking University Conservatory of music, Beijing Arts University Music Department, Shanghai Academy of Fine Arts Department of music and the Music Department of Shanghai University. The establishment of professional vocal music education institutions has trained a large number of singers and vocal educationists in China. For example, four famous Chinese Vocal Music: Huang Youkui, Lang Yuxiu, Yu Yi Shou, Zhou Xiaoyan.

After the end of the war of resistance against Japan and the founding of new China, the creation of artistic songs in China has made bold attempts in the aspects of national and folk tones, and has achieved remarkable results. These works have become the teaching materials for the music teaching of the Music Department of our country and the teachers' colleges and universities, and have been used in the teaching of vocal music.

After entering 80s, China's vocal music art with a leap of improvement, with Yu Yirong, Zhou Xiaoyan, Shen Xiang as the representative of the outstanding vocal educator, formed its own unique teaching style, the delivery of many in the international contest prize, with superb singing skills and excellent singer of artistic accomplishment for the domestic foreign music. They have been recognized at home and abroad by the vocal circle.

After the reform and opening up, China's art songs in thought, content, theme, style and artistic creativity, skills of composition, harmony, and the ideological and artistic aspects of folk songs and popular songs, with its own scale and relatively stable pattern, and the prosperity of art songs in China and making unremitting exploration and development. At the same time, it also promotes the continuous development and perfection of Chinese vocal music performance and vocal music teaching in technology and art. In vocal music performance and teaching, we should learn from the successful experience of vocal music teaching abroad, broaden our vision of vocal music teaching, and promote the change of style and style in song creation. These works are not only the crystallization of the ideas, wisdom and labor of the creators, but also the reappearance of the spirit of the times.

With the further deepening of China's vocal music teaching and vocal music teaching of foreign exchanges, promote the development of vocal music teaching in our country, the Chinese musicians in vocal music history, vocal music, vocal music teaching, the basic theory of Panzhihua singing psychology, linguistics, aesthetics of vocal music singing two degrees of creation, works and genres, style and other levels to carry out the active exploration and research. From the stage of sensory and experience teaching, vocal music has gradually moved towards a more scientific and more advanced stage, which has made great contributions to the development of outstanding vocal talents.

In the field of sound training, various technologies are becoming more and more standardized, mainly in the following six aspects (Parkinson, 2016; Schmidt, 2015):

1. Correct breathing. Bel canto emphasizes that breathing is the foundation of singing. It requires "holding the voice with breath". It affirms the thoraco abdominal breathing method, and puts forward the viewpoint of adjusting the state of singing by adjusting the breathing state.
2. Accurate sound. It is believed that only a good sound can be achieved by the sound of a beautiful sound, and a soft, bright and round sound can be obtained. In order to complete sound sound, we must breathe correctly, the throat is stable, the mind is concentrated, the psychology is fully prepared, the vocal cord is actively closed. Garcia, a famous vocal artist, concretely summed up the main points of the sound: the tongue was flat, and the pitch was sung accurately, and it was smooth but unable to slide.

3. The coherence of the sound. Bel emphasize consistent, maintain the quality of the sound position unchanged, sound and sound connection exquisite smooth uniform, crescendo diminuendo.

4. The flexibility of the sound. Compared to eighteenth Century advocate coloratura skills and complex ornamentation in singing, so focus on the training of Bel sound development range, flexibility, open throat, control ability to exercise sound should practice more rapid scale, fast walk sentence, skip, clear and accurate requirements of sound.

5. Sound areas and resonance. The sound area is a complicated technical problem, and many experts have their own theoretical views. But no matter how to divide the voice area, Bel canto always insists on unified sound area in teaching, and thinks that the sound area is the key of teaching, and the sound area and resonance are complementary. To achieve the unity of sound, full of penetration, the position of resonance must be relatively stable and accurate.

6. Words and language, singing to have good language habits. Bel language requirements of each vowel sound is clear and accurate, vowels in singing should be rounded and smooth, only in this way, the principle of Legato can be truly reflected in words and language.

3. Model and algorithm

Multimedia technology (Multimedia Technology) is a technology that uses computers to comprehensively process various information, such as text, graphics, images, sounds, animations, videos, etc., and to establish logical relations and human-machine interaction.

The real object of multimedia technology is the product of computer technology, while other simple things, such as movie, TV, sound, etc., do not belong to the category of multimedia technology.

The media (medium) in the computer industry, the media has two meanings: one is the vector of the dissemination of information, such as language, text, images, video, audio and so on; the second is the storage of information carriers, such as ROM, RAM, magnetic tape, disk, CD, there is the main carrier of CD-ROM, VCD, "etc.. Multimedia is a new thing that has emerged in recent years. It is developing and perfecting at full speed.

In the media of multimedia technology mainly refers to the former, is to use the computer to text, graphics, images, animation, sound and video and other media information is digitized and integrated in the interactive interface, the computer interactive display ability of different media forms has. It has greatly changed the traditional way people get information, in line with the way people read in the information age. The development of multimedia technology has changed the field of computer, the computer is composed of special products, office in the laboratory has become a common tool of in production management, school education, public information consulting, commercial advertising, military command and training field, and even family life and entertainment etc..

The spectrogram analysis vocalists teaching research, teaching achievement belongs to “the Project of Vocal Music Construction” (Fig.1.) characteristic teaching methods and means of teaching. The results of teaching for free and open online sound related audio and video teaching resources link has played a strong supporting role, realizes the high quality teaching resources sharing. Using multimedia spectrogram analysis, on animation technology, will sing the human physiological organ motion process dynamic innovative made into video (Fig. 2), in combination with the practical training of students in vocal music singing in breath, resonance, articulation and other specific issues.

The solution vectors are randomly generated according to the variable range for each variable. Namely (Simones, 2015; Bradt, 2016),

\[
HMV = \begin{bmatrix}
  x^1 & f(x^1) \\
  x^2 & f(x^2) \\
  \vdots & \vdots \\
  x^n & f(x^n)
\end{bmatrix} = \begin{bmatrix}
  x_1^1 & x_1^2 & \cdots & x_1^n & f(x^1) \\
  x_2^1 & x_2^2 & \cdots & x_2^n & f(x^2) \\
  \vdots & \vdots & \cdots & \vdots & \vdots \\
  x_n^1 & x_n^2 & \cdots & x_n^n & f(x^n)
\end{bmatrix}
\]

Hence, we have equation (2):

\[x_i^{new} = \begin{cases} 
  x_i^j, & j \in \{1, 2, \ldots, S_{HM}\}, \text{ if } \text{rand} < HMCR \\
  x_i \in X_i, & \text{otherwise}
\end{cases}
\]

As for \(x_i^{new}\) from harmony memory, we have equation (3):
\[ x^{new} = \begin{cases} 
    x^{new} + \text{rand} \times BW, & \text{if } \text{rand} < \text{PAR (Continuous)} \\
    (k + \lambda) \times x^{new}, \lambda \in [-1,1], & \text{if } \text{rand} < \text{PAR (Discrete)} \\
    x^{new}, & \text{otherwise}
\end{cases} \]  
\hspace{1cm} (3)

The worst harmony is replaced with the new harmony, i.e.,
\[ x^{worst} = x^{new}, \text{ if } f(x^{new}) < f(x^{worst}) \]  
\hspace{1cm} (4)

According to the analysis and description of routing problem in express delivery, the constraints can be expressed as:

Distribution route length does not exceed the maximum value, i.e.,
\[ \sum_{k=1}^{n} d(k-1,k) + d(n,0) \leq MD \]  
\hspace{1cm} (5)

The mathematical model of route programming can be defined as
\[ L = \min \left( \sum_{k=1}^{n} d(k-1,k) + d(n,0) \right) \]  
\hspace{1cm} (6)

Based on the gradient descent method, node center and base width parameter are:
\[ w_j(k) = w_j(k-1) + \eta \left( y(k) - y_m(k) \right) h_j + \alpha \left( w_j(k-1) - w_j(k-2) \right) \]  
\hspace{1cm} (7)

\[ \Delta b_j = \left( y(k) - y_m(k) \right) w_j h_j \left( \frac{X-C_j}{b^j} \right) \]  
\hspace{1cm} (8)

**Figure 1.** An spectrogram analysis sample

**Figure 2.** Video of human physiological organ motion process dynamic innovative
4. Result and discussion

First, the use of multimedia technology is conducive to the reform of the traditional vocal music teaching mode. The first is the student of singing organs, singing skills and use of the voice methods have an intuitive understanding; secondly, the students of voice and stage on their own performance only by subjective feeling to evaluate, and there is no objective evaluation and correct understanding, and after class, and the lack of proper guidance and practice thus the lack of objective evaluation of their own learning and assessment. Because of this, learning vocal music often goes through many failures and some detours. At present, vocal music has a set of scientific, universal, stable and strict training, teaching system, however, the perfect teaching system there are still many uncertain factors, and cannot be taught, this is mainly due to some problems in the teaching of expression, can only use symbolic language, metaphor of the and even some teachers use some vague and it's hard to understand exactly the language. This makes many basic, important questions only on the sense of the students. The application of multimedia technology can make the abstract concept of the vocal music teaching intuitionistic, and the complicated singing skills are visualized and clear. The invisible voice can use Cool Edit pro, Cakewalk90 and other computer music software to record audio, and through the sound wave figure of audio window, achieve the visualization of voice, solve the problem of vocal art teaching. Multimedia is a combination of characters, images, animation and sound, with a large amount of information and flexible conversion, which provides convenient conditions for the teaching of vocal music. Now the use of multimedia technology will be playing the piano vocalizing, made with the orchestra music effect to the students training, not only changed the previous simple piano accompaniment is monotonous, more is to enable students to practice the more high passion of singing in the vocal process between China and Vietnam, to enter the singing part, will receive good an unexpected effect. Using multimedia technology, we can make three dimensional animations for the movement state of the laryngeal body, the direction of breath movement and the process of voicing, and enlarge and slow down the key parts with computer simulation technology. This forms a form of expression that changes imagination into image, changes abstract into concrete, images and texts, sound and image is good, and the movement is good. At the same time, the use of multimedia image and sound processing, the song "position" and "breath" shades "throat height" singing from multimedia demo can enable the students to learn the correct knowledge of comparison.

Second, the using of multimedia technology, it is beneficial to create vocal music teaching situation vocal music is a subject with singing performance and lyric as the main body. The traditional mode of teaching overemphasizes the teacher in the teaching of "right of control" and "authority", too much emphasis on vocal skills, ignoring students' initiative, which will lead to the students' mastery of vocal skills in vocal music teacher or a singer's timbre imitation as standard. In recent years, with the in-depth study of educational theory and the renewal of teaching ideas, it has gradually become the common understanding of the educational circles to pay attention to the students' main position in the classroom. The "situational teaching model" fully embodies the main position of the middle school students. Situational teaching is a teaching method that uses vivid scenes to arouse students' interest in active learning and improve learning efficiency. The characteristics of network and multimedia technology are very conducive to the creation of learning situations. Dewey, an American educator, said, "in order to stimulate the students' thinking, we must have a practical experience situation as the beginning of thinking." Teachers can create practical teaching situations in the teaching process according to the needs of teaching, and guide students of different levels to participate in the teaching process by moving their brains and moving their mouths. But all of the traditional vocal music teaching is a piano, a mirror plus a blackboard. Most of the time is teachers playing the students' singing. Classroom teaching is monotonous and boring, which is not conducive to mobilize the enthusiasm of students. Situational teaching in multimedia network environment can make students familiar with, interested and tangible, visible teaching situations can stimulate creativity, initiative, and students' learning, to develop students' comprehensive knowledge, intelligence, ability, emotion etc.. In the creation of teaching situations can make use of the spectrum analysis technology, X light photography, slow flash frequency observation instrument, rapid test instrument, MIDI camera, electrical technology, audio and video recordings, carries on the design to make the students in the teaching of vocal music, entertaining multimedia means for students to create a specific teaching context, and comprehensive use of words image sound animation and a variety of information, the development of students' music image thinking, cultivating creative inspiration, let the students get knowledge in a relaxed and pleasant school. Figure 3 shows the experiment data of the spectrogram analysis.

Third, the use of multimedia technology, training of vocal art helps students pitch and rhythm is a basic condition for students to learn music art, vocal music is more accurate intonation and rhythm. The pitch and rhythm are the soul of the music works in both the tunic music and the vocal music of the non-tonal music. Can accurately reproduce the music works, shaping its vivid music images, intonation is the key. How to scientifically grasp the rhythm and intonation training, training students? As everyone knows, the intonation rhythm mainly by the teacher in the solfeggio class to complete. At present, the uneven art colleges piano
intonation condition, teachers rhythm accuracy also depends on its level, which makes the students there are
many uncertain factors in the process of learning. It is now possible to avoid the above uncertainty by using the
multimedia aid. First, we can use multimedia into MIDI vocalizing to students in training, its unique sound
effect can enable students to understand the music mood and interest in training, accurate intonation and rhythm
also runs through the vocal music teaching. At the same time, teachers can be liberated from the vocal piano
accompaniment, more comprehensive attention to the voice of the students and the state of music expression,
and effectively improve the training effect, to lay a good foundation of singing. For the beginner students,
because not enough skilled master singing skills, often intonation and rhythm and other aspects of the problem
caused by the atmosphere, the location of the sound and other reasons. This kind of student's heart pitch is
accurate, the main reasons for the differences in intonation is the singing skills are not mature. In the traditional
vocal music teaching, students in the absence of reference, feel the intonation errors unaware, and transient
sound, teachers' voice on the passing judgment, there will be more or less one-sided statement too, is not easy to
let students sincerely convinced. Using Cool Editpro, Cakewalk90 and other computer music software to record
audio, in the audio window, students can see their own acoustic patterns. By analyzing acoustic patterns, we can
improve students' understanding and objective evaluation ability of voice. The teacher can cut down the
inaccurate waveform of the pitch, point out the problem, correct the pitch, establish accurate and correct
hearing, and solve the problem according to the problem. Then tell the students to make meticulous and correct
adjustment of singing state, such as opening of throat, breath support, voice location, etc., which helps students
find out a good voice state and urge students to achieve corresponding accurate pitch in good singing state.

Figure 4 shows the experiment result.

Fourth, the use of multimedia technology is conducive to cultivating students' good performance state.
Vocal music is a branch of performance art in the field of art. It is a performing art on stage to show personal
singing skills and skills. At present, the teaching of vocal skills in normal universities is relatively standardized,
scientific and systematic, but the teaching of singing performance is still a weak link, and the comprehensive
training of vocal performance is very important in the whole vocal music teaching. The traditional vocal music
teaching training students' performance status and the training of students' psychological quality can only be
used in this way. "Art is the emotion," Luo Dan said. In order to improve the students' singing level and
complete the complete singing art, multimedia teaching can be used to stimulate the students' emotion and
develop the thinking of image. The teachers use the video and accompaniment functions of multimedia to create
teaching scenes similar to the stage performance in the vocal music class. In the teaching, to stimulate students to sing with accompaniment by the multimedia function, sound with feeling. At the same time, the camera lens will be used to record the students’ performance. The students in the witness, listening to their voice and singing performance, more aware of their problems, and correct targeted, teaching progress relatively quickly, the students must be to improve the psychological quality, and gradually form a good state performance.

5. Conclusion

The application of multimedia technology in vocal music teaching is not only a renewal of educational concept, but also a reform of teaching means and form. The application of multimedia technology can greatly enrich the content of vocal music teaching, enhance the scientifficity, intuition and interest of teaching, so that students can try a lot of new ways to solve problems, and improve teaching quality and teaching efficiency. At the same time also can promote the teacher role transformation, make the teaching process from the teacher "teaching" as the center into the students to cultivate quality problems through research and knowledge innovation, make students become the subject of study, which not only can solve the problem of vocal music teaching and learning, improve the vocal music teaching efficiency, but also will have a major impact the development of creative thinking. Therefore, multimedia technology not only provides advanced means for the vocal music teaching, the meaning and the way we re make more profound understanding of the vocal music teaching method, teaching model for teachers to adapt, and explore the regularity and characteristics of classroom teaching a variety of teaching methods complementary learning mode, to optimize the teaching process.

References


