

# Design and Implementation of Digital Teaching Platform for Xinjiang Folk Song Sight Singing Based on Mobile Phone

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## **Abstract:**

With the development of science and technology and the progress of society, the achievable functions of mobile phones have penetrated into all fields of people's lives, including music education and teaching. Music sight singing teaching on mobile terminals, such as the development and design of online learning programs for Xinjiang folk song sight singing teaching, has become possible. The author takes the design and implementation of the digital teaching platform for Xinjiang folk song sight singing as an example, expounds from the design and operation to the final implementation, aiming to provide theoretical reference and practical basis for related research.

**Keywords:** Folk song research, Digital platform, Teaching.

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## **I. RESEARCH FOUNDATION**

According to statistics, the number of smart phone users worldwide will exceed 2 billion in 2016, which is more than a quarter of the global population. The British "Daily Telegraph" reported on December 12, 2016 that the number of global smart phone users is expected to reach 2.56 billion in 2018, which is one third of the world's population. In addition, the vast majority of the growth in smart phones will come from China. There are already more than 500 million smart phone users in China. It is estimated that the number will grow to 700 million by 2018. According to "Economic Operation of Telecommunication Industry in May 2018" released by the Ministry of Industry and Information Technology, the domestic total number of mobile phone users of three major operators is 1.43 billion, and the number of 3G and 4G users has reached 1.201 billion. With the advent of the 5G and 6G era, we have reason to believe that China will definitely become the country with the most mobile phone users in the world (as shown in Figure 1).

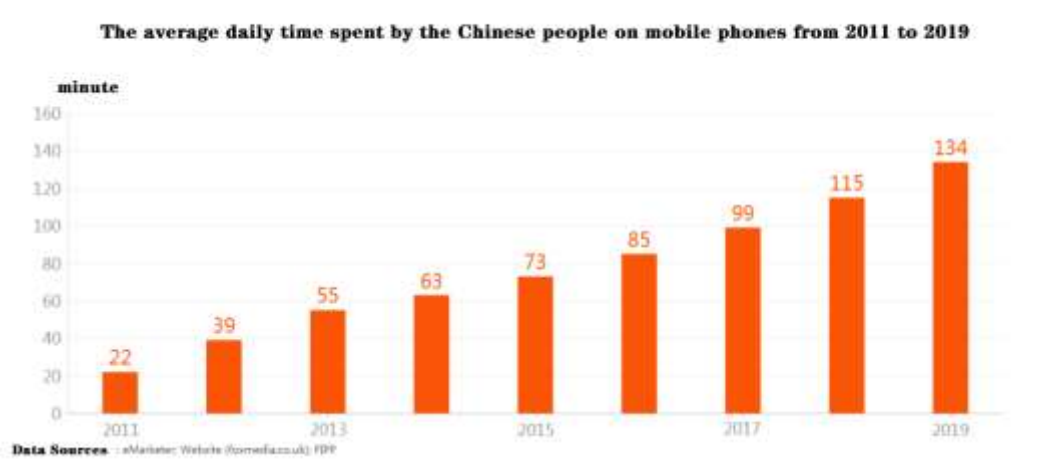


Figure 1: Average daily usage time of smart phones by Chinese people in 2011-2019 (unit: minute)

Nowadays, science and technology are changing with each passing day. As an important network terminal, smart phones are becoming more and more powerful, penetrating into all aspects of people's social life. Where, in education and teaching, it has become possible to use mobile phones as learning terminals. We can use mobile terminals in folk song sight singing learning and develop related APP applets to spread folk song music culture <sup>[1]</sup>.

How to use modern technology to inherit and disseminate the colorful folk songs of various ethnic groups in Xinjiang is not a problem solvable by a certain discipline, but cross-discipline is required. This paper studies the construction of digital teaching platform for folk song sight singing based on mobile terminals, which is a research on comprehensive application of music technology, computer technology, network technology, APP development technology, etc.

## II. . DESIGN AND IMPLEMENTATION OF DIGITAL TEACHING PLATFORM FOR FOLK SONG SIGHT SINGING

### 2.1 The significance of constructing a digital teaching platform for sight singing

China is a multi-ethnic country, especially with many ethnic minorities. Take folk songs in Xinjiang, China as an example. Folk songs of all ethnic groups are extremely diversified. Thanks to the development of science and technology today, it is an effective way to use mobile phone terminals to spread and inherit the music culture carried by folk songs through learning of folk song sight singing. Xinjiang, as a unique minority area in China, also boasts extremely rich folk song resources that make up an important part of Chinese folk songs. It is also the inescapable responsibility of every music educator to promote ethnic minority music culture, build a digital teaching platform for sight singing, inherit and develop excellent Chinese music culture in the development era characterized by waning and waxing of music culture.

## 2.2 Design of digital teaching platform

The digital teaching platform design for Xinjiang folk songs includes platform database, page, login system, functional modules, song classification method and so on.

In terms of functional design, it is necessary to consider the characteristics of the traditional sight singing learning mode in light of the necessary conditions of traditional sight singing, combine the learning scenes, etc., and give consideration to the actual use process in functional design. For example, in traditional sight singing learning, we should first simplify reading music, and then sing the standard pitch. According to the standard pitch, it is possible to find a suitable key by combining the music score. If the standard pitch in the mind is inaccurate, then the overall sight singing will be out of tune. Hence, a reference to the standard tone is needed. Sight singing exercises can be carried out based on the standard tone, and control test and continuous modification can be performed by referring to model singing or repertoire demonstration, so the re-listening of the standard tone and the standard model singing is also very important.<sup>[2]</sup>

Regarding the scoring system, the most important link is feedback. Students use feedback to understand whether the content of learning and understanding is correct, while the most important part in the learning of sight singing is feedback. Only through feedback can users understand which parts of the singing are problematic. In digital teaching, feedback function is to evaluate the content completed by sight singing. This function is a key point in the functional module design of the teaching platform. After the sight singing is over, the system gives a corresponding score. If the user is satisfied, he can proceed to the next song. If the user is not satisfied with the resulting score, the user needs to listen to the content of his own recording, compares his music singing with the standard model singing, and then practices until reaching the standard. Therefore, functional module design also includes the standard model singing and the comparison recording replay.

In the song classification part, in the Xinjiang folk song sight singing training system, all the collected Xinjiang folk songs are classified, and the ethnic groups are classified according to the ethnic group they belong to. Then, the second classification is carried out according to the mode, and the third classification is implemented according to the key signature. The user can thereby conduct classification search and make choice according to these three categories.

In terms of page design, first, it should be practical, aesthetic, concise and appropriate. Digital teaching platform for Xinjiang folk song sight singing takes various ethnic folk songs in Xinjiang as the main body. The characteristics of the page need to be considered in the page design, and each page contains some function demonstrations, such as music instance demonstration, recording playback, standard tone audition, rhythm speed audition, etc.<sup>[3]</sup>. Secondly, there is relevant information including the user's personal information, browsing history, favorites, likes, class joining, operation records, etc. which will be all presented in the navigation bar.

Digital teaching platform for Xinjiang folk song sight singing mainly contains seven aspects. Before entering the program, it is a page representing the digital teaching concept of Xinjiang folk song sight singing. The elements in this page include: characters of various ethnic groups in Xinjiang, costumes, digital age, music and digital integration, etc. Meanwhile, name of the sight singing track is displayed.

When the user clicks on the song to be learned, it will enter the song learning page, as shown in Figure 2. The song learning page contains the name of the music score, the author, the ethnic property, the folk music score audition, and the sight singing music score. The operation area at the bottom of the song learning page also includes standard tone playback, recording button, and re-listening and recording buttons. These functions are all necessary functions for learning sight singing.



Figure 2: Learning interface

Regarding the login system, the login system is crucial for an application or software. First, it can collect visitor information through background data, which is useful for testing application, collecting user feedback information, grasping the number of application users, adjusting background data, updating vulnerabilities and so on. To use this digital platform, first we need to log in through the user's WeChat account. After the background accesses the user's information, it will be linked to the next page, i.e. the home page of folk song learning. Only users who have logged in with the account can use the functions of song learning, feedback, questionnaire filling, and personal information modification on the digital teaching platform for Xinjiang folk song sight singing.

### 2.3 Introduction to functional module design

There are four functional modules in the digital teaching platform for Xinjiang folk song sight singing.

The first module is the learning module. The first column of this module displays folk songs classified by different ethnic groups. It also contains folk songs classified by mode, rising and falling signs, etc.



Figure 3: User feedback interface

The second module is the feedback module (Figure 3). In this module, users can give feedback on various problems encountered in the learning process, including opinions and suggestions, and the background data will be prompted in the first time. After the technician confirms the present problem, the error or problem will be corrected in time when the next version is released.

The third module is the questionnaire module, which is a survey of satisfaction with this program after using the digital teaching platform for Xinjiang folk song sight singing. Through the preset questionnaire survey and feedback, it also provides good suggestions for the upgrading and improvement of the digital teaching platform.

The fourth module is the user information module. In the user information module, one can log in or switch login accounts. In addition, it also contains functions such as favorites, mailbox, personal data, and settings.

Next, the author will explain the use of each functional module, background data link, collection and feedback functions.

## 2.4 Song learning function

In the learning function area, click on the category of folk songs you want to learn and enter the list of folk songs under the corresponding category. After entering the song selection interface, the upper part is the illustration of the corresponding folk song with significant representative characteristics. Under the list, there are related folk music scores, audio, video, etc. in periodicals, monographs, teaching materials, books and other materials. Click on the music score to activate the song learning function. After entering the song learning interface, you can see information of the music score you want to learn. The music score consists of two main contents: staff and lyrics. In the upper right corner of the song learning page, there is an instrument demo audio playback button for the song to learn. Click it and audition is possible. Below the song learning is the operating area of the song learning function. The operating area contains five functions. From left to right and top to bottom, there are the male voice recording switch, the female voice recording switch, the playback pause button, the recording start button, and the recording replay button etc.

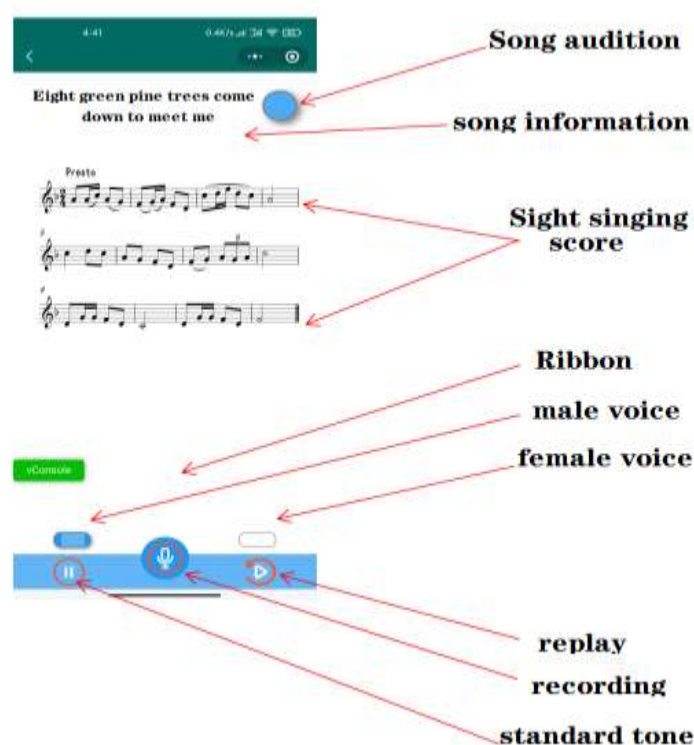


Figure 4: Song Audition Song Information Sight-singing Score Ribbon Male Voice Female Voice Replay Recording Standard Voice Interface

### 2.4.1 Song audition

This function supports the standard audio of the music score. It is implemented by using the audio

export function after installing the tone bank with Sibelius 7.0. The speed is set according to the score requirements. The tone of the music score recording exported by Sibelius 7.0 is Chamber (room) piano tone, close to the tone of upright piano or grand piano used in the learning of sight singing. The liaison, skip, coherent mark and free extension mark in the song can also be completely restored in Sibelius7.0. The audition can meet the users' needs and allow song learning.

#### 2.4.2: Song information

The song information includes the nationality of the song, the song's creator, composer, or lyricist information, and some field folk songs are also added with live recording and translator information. Moreover, most songs' expressions, terminology information, performance speed, intensity, etc. are also attached to the music score to provide learners with as much hints and help as possible in the singing.

#### 2.4.3: Sight singing score

The music score is in commonly used treble staff. A few music scores are bass staff and the music score is completed by Sibelius7.0. The export graphic format is portable network graphic (PNG), and the number of points per inch is: 599.4, the pixel density is 2520×3564.

#### 2.4.4: Male and female voices

The design of this function takes into account the physical differences in the voice conditions of boys and girls. In order to improve the experience of different individuals in using the sight singing function and unify the scoring standards of sight singing, users can change the contrast mechanism according to respective gender to improve the sight singing accuracy.

#### 2.4.5: Recording

The quality of feedback during learning is used to judge the learning effect, and the recording function can allow comparison of the user's learning feedback audio with the overtone singing audio of absolute standard sight singing music score in the database. The comparison method adopts FFT (Fast Fourier Transform, a fast algorithm of Discrete Fourier Transform, which is an improved version of Discrete Fourier Transform based on the odd, even, imaginary, and real characteristics of Discrete Fourier Transform).

#### 2.4.6: Standard tone

Each tone level in the musical tone system has a certain standard for its height. The standard height of sound varies depending on generation. The current international standard height (the first international height) is a sound of 440Hz, which takes a group of small letter a as "standard sound". There is a unified pitch standard internationally, which facilitates the study of music theory, musical instrument production and cultural exchanges. The above are all the functions of the song learning operating area.

### 2.5 Problem feedback

As shown in Figure 4, this part is the user feedback interface of the digital teaching platform for



Xinjiang folk song sight singing. The function of feedback is to effectively control and modify this applet. When receiving the user feedback, the background will record the text information fed by the user. At the same time, within a certain period of time, the management personnel will adjust the corresponding problems in time to improve the user experience and program quality. The management effectiveness depends on whether the management information system is complete and whether the information feedback is sensitive and correct. Under this requirement, the digital teaching platform for sight singing requires a large number of users to use, provide feedback, and make adjustment, so that an application with wide effectiveness, high accuracy, strong pertinence, and timely feedback can be finally presented to all learners of this platform.

## 2.6 User Information

This part is the login interface of the digital teaching platform for Xinjiang folk song sight singing. After opening the page, the user only needs to click the login button and then the background data will access personal information such as WeChat nickname, avatar, region and gender. Click the Allow button and login is completed. After successful login, the WeChat avatar and name can be displayed at the top, and below the avatar are favorites, mailbox, likes, browsing history, personal information, class joining, and setting functions.

For setting function, in the setting, users can check account security, cache status, privacy policy, about us, upgrade, current version and logout. For class joining function, when the class is used as the auxiliary software for learning, joining class helps teachers to assign homework, check the completion degree, and check the usage information. The above are all the functions under the user information of the user interface, and inadequate settings of all functions will also be a consideration after users use and provide feedback, which will be improved after continuous use and experiment.

In addition, this part tries to meet the needs of users in many aspects, including the favorite list addition function, mailbox function, personal information, browsing history and other functions, which will not be detailed here.

## 2.7 Design and Implementation of Scoring System

### 2.7.1 Design of the scoring system for digital sight singing

Another important part of the song learning function of the digital teaching platform for Xinjiang folk song sight singing is the scoring system. Accurate evaluation refuses artificial judgment. The purpose of digital teaching is to save human resources and avoid repeated, mechanical work, allow more audiences to enjoy the convenience and efficiency brought by digital teaching. However, the emergence and popularization of digital teaching cannot completely negate the mature traditional teaching mode. This digital teaching platform for sight singing uses code writing programs of wxml and wxjs, which are both developed and released exclusively by WeChat. The program is designed and developed based on this, and the scoring system is implemented by FFT, the most common tool in spectrum analysis. (FFT, or Fast



Fourier Transform, is a fast algorithm for Discrete Fourier Transform. It is an improved version of the Discrete Fourier Transform algorithm based on the odd, even, imaginary, and real characteristics of the Discrete Fourier Transform. It adds no new discovery to the theory of Fourier transform, but can be said to be a big step forward for the application of discrete Fourier transform in computer systems or digital systems<sup>[4]</sup>).

Based on the overall scoring system with FFT as the core, the logic of the background data after the user clicks on the recording is divided into the following five steps.<sup>[5]</sup>

First, read samples from the input file, divide them into blocks by time and convert the samples in each block into frequency samples. The block size depends on the file sampling rate, and it is important that each block represents the same time regardless of the file sampling rate. Second, read the samples from the file and pass the FFT test to find the loudest frequencies, convert them into a hash table and feed back a 2 "tuple" (a data feedback unit in calculation program compilation), which contains file length and hash table in unit of seconds. Third, find the index of the loudest frequencies in each frequency "bucket" (for each block). These loud frequencies will be used as fingerprints to match standard audio. Each data block will be reduced to a tuple of 4 figures. These numbers are the 4 loudest frequencies in the data block. Convert each correct tuple to form a separate figure, which is unique for every possible tuple. Fourth, check the operation results of audio sample blocks through FFT. For each block, examine the loudest frequency in each "bucket". "A bucket is a series of frequencies. For each block, return the index of the loudest frequency in each bucket. These indexes will be encoded as a single figure for each block." Fifth, if you want to match the fingerprint, you have to check the number of times the fingerprint appears in each file (the number of blocks). Use the offset to store the time difference. The purpose of this is to see whether there are many matching fingerprints with time differences relative to other fingerprints at the same time. If so, it means that the two files contain similar audio. Through statistics, the matching degree is calculated, and the corresponding score is given according to the matching degree.

Current shortcomings: Since only the comparison function is implemented, when the user uses the mobile phone microphone for voice input, the human voice is not extracted and the noise is not removed, and the comparison audio does not separate the instrument from the human voice, so there will be high scoring error rate.<sup>[6]</sup>

#### 2.7.2: Implementation of the scoring system for digital sight singing

Human-computer interaction and timely feedback are the salient features of computers. Interactivity helps to stimulate students' learning interest and give play to the role of cognitive subjects<sup>[7]</sup>. The final function of the digital sight singing scoring system is the comparison between recording and demonstration. When the user uses the recording function and releases the recording button, recording is completed, and in less than one second, the background data will process and feed back the collected sound signals through the preset operating mechanism. Similarly, the feedback results can take several different forms.

First, when the user uses the recording function to complete the pitch and rhythm sight singing in the

score, the system will give score according to the comparison method. At this time, the user's page will prompt completion of the scoring, and give a score value. The score value is from 0- 10 in ten different levels. Similarly, the ten different levels are given based on the comparison of sound signals. If the sound frequency is similar to the standard audio, a score can be given. The higher the degree of similarity, the higher the score. Conversely, the lower the degree of similarity, the lower the score.

Second, when the sound signal read by the comparison program has no similarity with the standard audio signal, completion of scoring will be prompted, which means that the program has compared the collected sound signals but there is no similarity, and "NO MATCH" will be displayed. In use, users don't need to pay too much attention to the scores given( Figure 5). If one doesn't get a satisfactory score, it is possible to click the recording button again and sing again.

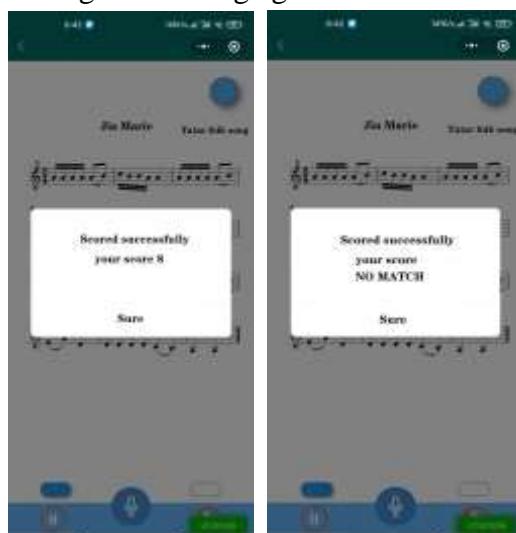


Figure 5: Scoring interface

Third, as shown in Figure 6, when the user uses the recording function, if it prompts "please try again", it means that the user's audio signal and the standard audio signal score are less than 1.

Fourth, as shown in Figure 7, when the user clicks the recording button and quickly releases the recording button, it will prompt "recording time is too short". Since the collected sound signal time is less than one second, the background sound comparison program cannot be started.



Figure 6: Please try again



Figure 7: Recording time is too short

The above four situations often appear when we use the song learning page. In use, the user should

take care not to click the recording button by mistake, but should try to skillfully master the rhythm, pitch, speed and other key points in the music score before sight singing recording. Or, one can first click the audition button to audition and sing the standard audio file of the song, and then start recording if self-recognition of learning is high. When recording, one can hum and sing without singing the note name in the staff, thus completing the song learning, lowering the threshold of sight singing learning. In this way, sight singing learning can attract more audiences.

## 2.8 Making and uploading music score

### 2.8.1: Make music scores

Music score can be the commonly used treble staff or bass staff. The score is made by Sibelius7.0 software, and the exported graphics format is Portable Network Graphics (PNG). The number of dots per inch is 599.4, and the pixel density is 2520×3564. Use the Sibelius export function to export and input PNG format music scores and WAV format audio files that simulate musical instrument performance. Use SIB (Sibelius file format) format to save the file for backup use. The specific use of music-making software will not be repeated in this paper.

### 2.8.2 Upload music score

Digital teaching platform for Xinjiang folk song sight singing uses the Tencent WeChat applet database to save background data files. After paying a certain fee, you can use a database with great capacity. In the same way, folk song learning resources such as music scores, audios, and videos are also stored in the database. Professional staff have also set up an upload interface for the follow-up resource uploading and function expansion of the digital teaching platform for Xinjiang folk song sight singing. The interface is <http://audio.batariya.top/upload>. One only need to use PNG to upload the edited music score. Upload audio file in WAV format at the same time, select the nationality of the song, enter the song name, and click to upload the song. After the review, the song will appear in the corresponding song directory in the applet, as shown in the figure.

### 2.8.3 Questions and reflections

First of all, although digital sight singing and ear training can bring us many advantages and conveniences, it can only be used as a supplement to the traditional teaching mode. For example, the epidemic has inflicted a very serious impact on various countries, especially students in school. However, if the digital teaching system can be introduced into the school and more courses are made into the form of online courseware, so that open learning mode, independent learning management systems will enter the current colleges and universities, then, it will reduce the flow of personnel, reduce people-to-people interactions, and then reduce the spread of the epidemic.<sup>[8]</sup>

Secondly, when learners use mobile phones to learn folk song sight singing, whether they can effectively conduct self-control and focus on learning without being attracted by other entertainment, office, games applications on mobile phones, and whether they can concentrate on using "Xinjiang folk song singing learning assistant" when using mobile phones, effectively complete the learning tasks

assigned by the teacher, is the key to sight singing learning or digital autonomous learning. Therefore, the effectiveness of digital teaching is also related to the user's learning habits. Accordingly, digital teaching cannot completely replace the traditional teaching mode, but can only be used as a supplement to traditional teaching methods.

Finally, one will encounter various difficulties while making music score in the form of audio and video. We know that music culture of various ethnic groups in Xinjiang has unique modal characteristics and unique styles. It is very difficult to record the moving tone and special rhythm patterns with modal tonal characteristics through the staff generated from the Western classical literature. Therefore, its learning cannot be compared with traditional learning. Despite countless difficulties in the design and implementation of the digital teaching platform for Xinjiang folk song sight singing, the practical significance in the development and construction of the digital teaching platform for Xinjiang folk song sight singing far exceeds its problems and shortcomings. It is believed that with the continuous advancement of science and technology, music learning system based on mobile phone terminal will continuously improve, receiving more attention and popularity.<sup>[9]</sup>

### **III. FUTURE PROSPECT**

First, as part of the traditional music culture of the Chinese nation, Xinjiang folk songs also contain its unique regional style. As an excellent traditional music culture, it should be fully explored and spread. Today, with the rapid development of digitalization and the rise of new media, there is no longer any difficulty in cultural preservation. What we lack is the attention to and rescue of the endangered thing. However, the use of digital methods and new media technologies brought about by modern science and technology can help us reserve the culture faced with disappearing crisis. Everyone is contributing to the preservation of the traditional music culture of the Chinese nation. Also, the digital teaching platform for Xinjiang folk song sight singing is doing the same thing.<sup>[10]</sup>

Second, digital teaching is a supplement to the traditional teaching model. Under the trend of datafication, technology, integration and modernization, we have bold ideas for future digital teaching methods. In the future, we can work together with national music culture protectors, collect music scores of fifty-six ethnic groups regardless of whether they are taught or recorded to establish a shared database. The videos, audios, and music scores published in the shared database can be viewed and downloaded for viewers. On the other hand, the folk song sight singing digital platform allows one to independently upload music scores and use all the functions on the folk song sight singing digital platform to learn folk songs, so that it is possible to focus on protecting and developing the Chinese nation's music culture using modern methods to the greatest extent. In this way, people living on this land can enjoy, use, learn, and appreciate the treasures of Chinese national music culture.

Third, the establishment of digital teaching platform means a change in teaching mode. In the future, if the form of teacher lectures is combined with artificial intelligence, artificial intelligence can use the knowledge in the database and automatically generate class introduction, class content, key explanations,

quotations, review after class about a lesson, etc., according to the subject name, the teaching goal of a certain course, the teaching purpose, etc. In this way, use of artificial intelligence can help the teacher complete repetitive and mechanical labor, while the teacher only needs to manage the classroom order, answer student's questions, correct student homework, feed back teaching shortcomings, and check for missing points. This will reduce a lot of burdens on students, teachers, and schools, allowing teachers to have more time to design course content forms, decide various key knowledge proportions and prepare lesson plans.

In short, the design and development of this platform is a useful attempt to use modern technology in teaching, which represents a research that adapts to the development trend of the times. It is believed that with the continuous development of science and technology, more and more related technologies will be used in education and teaching fields, more people will learn and spread all the achievements of human civilization through similar platforms.

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## REFERENCES

- [1] Diao Xiaoqian. Research on the integration and development of solfeggio teaching in the era of digital technology. Harbin Normal University, 2017.
- [2] Zhang Enhao. Feasibility study of flipped classroom for solfeggio training. Hebei Normal University, 2017.
- [3] Wang Luyao. A comparative study of domestic solfeggio training materials for ear test. Qingdao University, 2017.
- [4] Zheng Junli, Ying Qiheng, Yang Weili signals and systems BEIJING: Higher Education Press, 2011,118
- [5] Li Hua. On-line analysis algorithm of CZT harmonics based on DSP. Sichuan University, 2005.
- [6] Zhang Haiyan. On the expansion and extension of the traditional teaching method of Solfeggio and ear training in music education in normal universities. Northeast Normal University, 2007.
- [7] Wang Xiuyu. On the promotion and development of the teaching of solfeggio and ear training in the CCTV Youth Song Competition. Northeast Normal University, 2014.
- [8] Xiang Xiaoying. Design and implementation of music solfeggio teaching system. Central China Normal University, 2012.
- [9] Hu Xinxin. Design and implementation of a solfeggio learning assistance system based on CAT technology. University of Electronic Science and Technology, 2012.
- [10] Chen Xi. A preliminary study on the design, production and application of sight-singing multimedia teaching courseware. Liaoning Normal University, 2013.