www.cadanda.com
Computer-Aided Design AND APPLICATIONS

Application of Deep Learning in Computer Aided Vocal Tasks Learning

Tianming Xu[1] and Tianzhuo Gong[2,*]

[1]College of Music, Wenzhou University, Wenzhou 325035, China,
luotuo32620746@163.com
[2]Academy of Music, Capital Normal University, Beijing 100040, China,
gongtz@hrbnu.edu.cn

Corresponding author: Tianzhuo Gong, gongtz@hrbnu.edu.cn

Abstract. At present, the vocal music task in institution of higher learning is gradually separated from the old teaching mode, showing a new look, and its computer technology is indispensable. Through the use of computer assisted vocal music tasks in institution of higher learning, some experiments and research have been carried out in the unit, and preliminary application experience and expected teaching results have been achieved. This paper further explores the application of deep learning in computer assisted vocal tasks in institution of higher learning. Experimental research shows that the desire to create songs is the lowest among the three results, with an average of 24.3%. The second is that when you enjoy a song, you will be shocked by your heart, with an average proportion of 33.9%. Among them, the highest proportion is that when singing, people can basically feel the beauty of song rhythm and melody, with an average proportion of 53.97%. Vocal music learning is a systematic, complicated and gradual work. Whether as a vocal music teacher or a student, it requires great efforts to have a good vocal music lesson and learn it well, so as to develop in this field.

Keywords: Deep Learning; Computer; College Vocal Music Tasks.
DOI: https://doi.org/10.14733/cadaps.2023.S7.25-35

1 INTRODUCTION

Computer - assisted instruction plays an important role in the current instrument - assisted instruction in colleges and universities. Which is reflected in the auxiliary music theory, composition technology theory and other courses, has shown many advantages. However, the application of computer technology in technical courses of performing arts needs further study and discussion. Vocal music is a kind of expressive art that expresses music, thoughts and feelings and reflects social reality by means of human voice. Singing instruments grow in everyone's body, normal people have the nature of singing, and singing is more accurately understood by people than other music forms because of its rich lyrics, thus easily forming a wide range of sociality [1].

At present, the vocal music task of institution of higher learning is gradually separated from the old teaching mode, showing a brand-new look, and its application of computer technology has contributed a lot. By using the computer-aided vocal music task in institution of higher learning, some experiments and research have been carried out in the unit where they work, and preliminary application experience and expected teaching effect have been obtained. At present, there is still a lack of national teaching guidelines and corresponding teaching materials, and all institution of higher learning basically carry out teaching according to their existing teachers. Moreover, at present, the teachers who undertake music teaching in ordinary institution of higher learning mainly graduate from professional music colleges, and inevitably bring the teaching methods of professional colleges to teaching posts in their work [2]. These present situations are more or less unfavorable to the development of music education in institution of higher learning. Therefore, the teaching environment is much wider and the degree of freedom is also increased. The teaching mode has become diversified, the interaction between students and teachers has increased obviously, and teachers have a deeper understanding of students, so teachers can carry out their own teaching work more purposefully [3].

With the rapid development of computer music and the maturity of related music software, it is worth our thinking and exploration to introduce computer music system into vocal music teaching system as an auxiliary teaching method. The barriers of traditional vocal music task teaching mode in institution of higher learning have been broken down layer by layer, bringing a brand-new, free and cheerful teaching environment [4]. Therefore, the teaching has the characteristics of randomness to a certain extent, and systematic combing and in-depth studies on the teaching ideas, objectives, teaching contents and teaching methods of this course. It is an indisputable fact that music in the whole education. From the traditional to the current reform of public music curriculum in institution of higher learning, vocal music courses in institution of higher learning always occupy a very important position. Students' creative passion also increases, which brings a pleasant and relaxed learning state. Students' learning effect is gradually improved, and their understanding of vocal music works is gradually improved. Their learning style is changed from passive learning to independent learning [5].

Deep learning in computer-assisted vocal music tasks in institution of higher learning. Similarly, the application of deep learning mode in college teaching is a very worthy idea to improve teaching efficiency. This technology has gradually gone deep into classroom teaching, and established a good audition effect and stereo sound, enabling students to fully feel the expressive effect and penetrating power brought by music songs in a stereo surrounding atmosphere, laying a good foundation for students to carefully ponder all kinds of songs, thus enhancing students' enthusiasm in music class. Deep learning through computer-assisted vocal music as a carrier enables students to experience the pursuit and realm of life through vocal music and improve their aesthetic appreciation ability. Its aesthetic characteristics should run through the whole teaching process. The teaching content should start with the works that students are familiar with and easy to accept, and choose the works that best represent the excellent human culture. During the whole study period, students' main task is learning, so teaching is always the main task of institution of higher learning. How to teach better, learn better and improve classroom efficiency are all questions that institution of higher learning have been exploring, researching and improving all the time. We should advocate deep learning vocal music teaching ideas and modes with obvious specialization tendency in computer-assisted vocal music tasks in institution of higher learning, advocate comprehensive courses, strengthen the infiltration of humanistic spirit, pay attention to the combination of vocal music teaching and practice, meet the requirements of educational development and talent cultivation in institution of higher learning in the new era, and implement effective vocal music teaching for college students.

Innovation content:

(1) This paper discusses the teaching mode of vocal music task in institution of higher learning for deep learning. Spectrum analysis with deep learning multimedia computer not only provides a means to identify and analyze sounds for vocal music teaching and training, but also the sound

spectrum tested can be saved and printed as computer files. Students and teachers can find the advantages and disadvantages of individual students, strengthen their shortcomings, and make their advantages even better.

(2) The "Style Library" and "Computer assisted vocal music teaching system. The use of static pictures combined with dynamic animation demonstration can enable students to visually observe the physiological structure of vocal organs, understand the basic principles of sound production, understand the use of breath in the singing process and the movement state and change law of each vocal organ, so as to correctly understand and master scientific and flexible sound production methods and singing skills.

2 RELATED WORK

The reasonable in the vocal music task of institution of higher learning can package and integrate information, make students become the real masters of the classroom, make students change the situation of passive acceptance of knowledge, and thus improve the ability of independent learning. Therefore, in view of this situation, many scholars have carried out research on vocal music teaching in college vocal music tasks.

Through computer assisted music creation, we can arrange notes well. The ability to perform structural constraint analysis with minimal effort. The ideal results can be obtained through different clips. Stoller et al. [6] evaluated the improved its limitations, especially ignoring the loudness change during shearing and the non-intuitive control of the output music structure. Wang and Zheng [7] identified the problems of the current dance teaching needs a lot of music teaching analysis. With the help of computers, the college music strategy analysis needs to be adjusted theoretically. In view of the characteristics of the computer-assisted autonomous learning vocal singing system, and in combination with the development of voice mobile streaming media autonomous learning vocal singing technology, Xu and Zhao [8] Teachers should use multimedia to visualize abstract music theory and visualize illusory music according to students' music literacy. Students' acceptance of music is a process from abstract hearing to image feeling. The application of multimedia courseware can increase the capacity of the classroom, but its premise is to follow the cognitive laws of students. When teaching, teachers only need to move the mouse, do not write or say more, and completely let courseware replace teachers. In this kind of teaching without communication between teachers and students, the appeal of music to students will be greatly reduced. Therefore, it is not suitable to make courseware from beginning to end in the computer aided process, but to allow teachers and students to communicate with each other during teaching. In particular, it allows students to listen to the teacher's demonstration and explanation on the spot, so that students can understand the more difficult mode at a glance, so that the teaching difficulties become simple and easy to understand. Zhang et al. [9] In the creativity of computer assisted music, we should try our best to dig out the knowledge points of multimedia available in the teaching materials and make use of all media forms available. At present, music theory course is a very important course in the teaching of professional courses for music majors. The interactivity of multimedia computers is conducive to stimulating students' interest in learning and playing the role of cognitive subject. At the same time, because of the serious disconnection between theory and practice, many students lost interest in music theory courses. In the view of psychology, people's cognitive development needs the assistance of computers. Zhao [10] proved that the more senses people participate in the perception of things, the better the perception effect and memory effect. The information expressed by multimedia is an organic whole. When simulating the occurrence or reappearance of some phenomena on the computer through multimedia technology, it can provide rich perceptual materials and make people's cognitive process closer to nature and science.

3 THE ANALYSIS OF DEEP LEARNING IN COMPUTER ASSISTED VOCAL TASKS IN COLLEGES AND UNIVERSITIES

3.1 Auxiliary Participation in Hearing

Through in-depth learning, we can observe the pitch of the song and the sound intensity of various overtones and partials in different frequency bands by using the computer "Lipu Audio Analysis System" to analyze the frequency spectrum of the song. Use high-quality learning resources to carry out various forms of learning activities to emphasize knowledge transformation and transfer application. After class, students' performance in the process of learning activities and homework should be comprehensively evaluated to emphasize the important role of reflection and expansion in realizing in-depth learning. The specific model is shown in Figure 1.

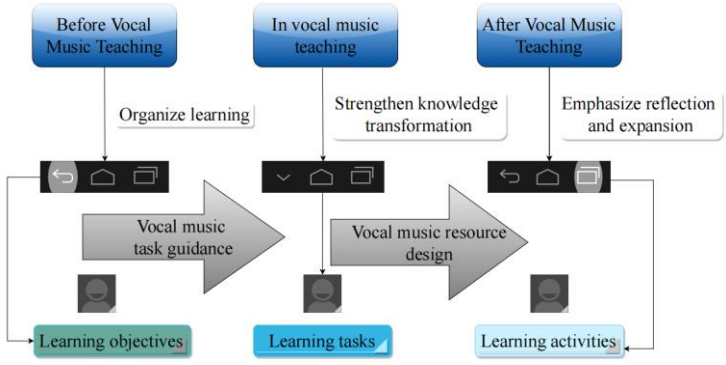

Figure 1: Deep study of vocal music task teaching mode in institution of higher learning.

In order to make deep learning of computer music play an effective role in practical teaching, teachers who play an important role in teaching not only have rich professional knowledge, but also need to master the software and hardware operation skills related to computer music system skillfully. Using deep learning multimedia computer to analyze the frequency spectrum not only provides a means to distinguish and analyze sounds for vocal music teaching and training, but also the tested sound spectrum can be saved and printed as computer files, which provides great convenience for teaching and scientific research to record and sort out data.

Output of hidden nodes

$$o_i = f\sum_j w_{ij}x_j = f\left(net_t\right) \tag{1}$$

In which $net_t = \sum_j w_{ij}x_j$.

Calculated output of output node

$$y_l = f\sum_i T_{li}o_i - \theta_l = f\left(net_l\right) \tag{2}$$

In which $net_l = \sum_i T_{li}o_l - \theta_l$.

Error formula of output node

$$E = \frac{1}{2}\sum_{l}\left(t_l - y_l\right)^2 \tag{3}$$

Formula derivation of output node

$$\frac{\partial E}{\partial T} = \sum_{k=1}^{n}\frac{\partial E}{\partial y_k} \tag{4}$$

E is a function of many, but only one y_l is related to T_{li}, and each y_k is independent of each other. among

$$\frac{\partial E}{\partial y} = \frac{1}{2}\sum_{k} -2\left(t-k\right) \tag{5}$$

Set output node error

$$\delta_l = \left(t_l - y_l\right) \tag{6}$$

With the help of computer technology, students and teachers can discover the advantages and disadvantages of individual students, strengthen their shortcomings and make them by going up one flight of stairs.

3.2 Establishing "Accompaniment Library" and "Computer Assisted Vocal Music Teaching System

To solve the problem of accompaniment in vocal music teaching, the research and development of this work is an important step in the establishment of a "computer-aided vocal music teaching system" which uses computers as teaching media and integrates vocal music teaching materials, accompaniment sound, sound recording and sound spectrum analysis. Under the mode of deep learning, the knowledge of each major forms a net structure. In the student training plan, according to the different needs of each major, a series of curriculum system structures that students can choose are first set up, and the public basic courses are followed. The basic vocal principles and singing methods in vocal music usually involve vocal organs, respiratory organs, resonant cavities and other body parts, as well as the coordination among them. The learning algorithm can be described as initializing the network and learning parameters, and calculating the output of each hidden layer neuron with input data x_p, connection weight coefficient ω_{ij} and threshold value θ_j:

$$y_j = \frac{1}{1+\exp\left[\sum_{i=1}^{n}\omega_{ij}x_i\right]} \tag{7}$$

$$y = \frac{1}{1+\exp\left[\sum_{j=1}^{s}\omega_j y_j\right]} \tag{8}$$

$$\sigma_j = y_j\left(1-y_j\right) \tag{9}$$

The new connection weight between the hidden layer and the output layer and the output neuron threshold can be calculated next time:

$$\omega_j(t+1)=\omega(t)+\eta(t) \tag{10}$$

$$\theta(t+1)=\theta(t)+\mu(t)\sigma \tag{11}$$

$$\eta(t)=\eta_0\left(1-\frac{t}{T+M}\right) \tag{12}$$

Where, $\eta(t)$ is the step size; α is the momentum coefficient, which is between $[0,1]$. η_0 is the initial step size; t is the number of studies; T is the total number of iterations; M is a positive number. Music production and music score printing software, vocal music works and accompaniment library, singing vocal physiological knowledge and physiological anatomy diagram, sound spectrum analysis software, famous singer singing recording and spectrum analysis file library, etc. The following is the "computer-assisted vocal music teaching system" established through in-depth learning, as shown in Figure 2.

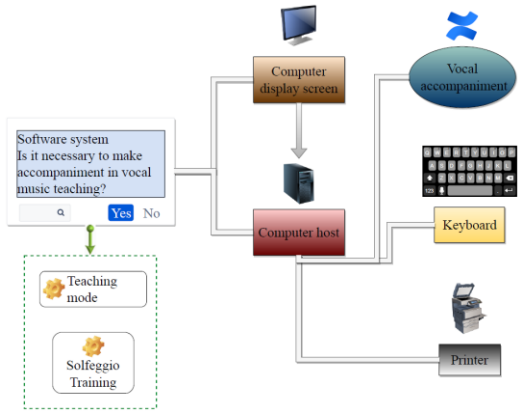

Figure 2: Computer assisted vocal music teaching system.

The emergence of computer music technology can better avoid the occurrence of such problems. It can not only enable students to identify and recognize sounds in a timely manner and perfectly combine them, but also can selectively play a single chord and multiple chords to cultivate students' music perception ability. The application of static pictures combined with dynamic animation demonstration in the computer-assisted vocal music teaching system of in-depth learning can enable students to visually observe the physiological structure of vocal organs, understand the basic principles of vocal production, understand the use of breath in the singing process, the operation state and change rules of each vocal organ, etc., so as to correctly understand and master scientific and flexible vocal methods and singing skills. Output Node of Computer Assisted Vocal Music Teaching System

$$y_t = f\left(net_l\right) \tag{13}$$

$$f\left(net_l\right)=y_l\left(f\left(y_l\right)\right) \tag{14}$$

Opposite hidden node

$$o_i = f\left(net_t\right) \tag{15}$$

At the same time, this way of finding problems is not only through teachers, but not only teachers can help find students' mistakes, but also students themselves and their classmates can learn from

each other to cultivate students' ability to find problems together. Through the deep learning mode, students' enthusiasm for vocal music learning can be improved, and good results and achievements can be achieved. The emergence of computer technology has shortened the teaching time to a certain extent, thus ensuring the accuracy of music teaching, helping teachers to demonstrate and interpret correctly, and ensuring the teaching quality and effect of music classroom in higher vocational colleges.

4 ANALYSIS AND DISCUSSION OF RESULTS

At present, the interaction between people and computers is further strengthened, which provides an opportunity for the innovation individualized teaching for students according to their different qualities, such as voice characteristics and voice conditions, and adopt targeted teaching plans and models according to the actual situation of students. The vocal music classroom observation scale designed based on deep learning observes nine randomly selected vocal music classroom teaching videos, and analyzes them around five dimensions: knowledge system, focus, degree of engagement, migration ability and thinking level. In the first class, teachers and students were selected from the education department, and the teachers and students sat face to face. The survey results are shown in Table 1.

Observation dimension	Student behavior	Teacher behavior
Focus	3.2	4.9
Migration capability	2.4	2.8
Knowledge system	3.8	4.2
Degree of investment	3.7	4.1

Table 1: Specific scores of each observation dimension in the first vocal music class.

Through Table 1, it can be found that in vocal music class, students scored relatively high in three dimensions: focus, degree of involvement and knowledge system. By observing the actual classroom teaching situation, experts think that students are full of energy, and they can know and understand new knowledge by connecting with their original knowledge and experience. When teachers design problems in real life situations, students can use new knowledge for analysis and interpretation. The second class was selected from the Marxist Department, with more than 32 students in the class. The survey results are shown in Table 2.

Observation dimension	Student behavior	Teacher behavior
Focus	3	3.4
Migration capability	3.2	2.8
Knowledge system	2.7	2.2
Degree of investment	3.1	2.7

Table 2: Specific scores of each observation dimension in the second vocal music class.

Table 2 shows that students do not perform well in vocal music classroom learning, and their scores in four dimensions such as knowledge system are basically consistent with the four grades, indicating that students' learning is still a shallow learning. By observing the actual classroom teaching situation, experts found that students' learning interest was not high and they were in a

mechanical passive learning state. The third class is selected from the School of Media Science, with a total length of 97 minutes. The survey results are shown in Table 3.

Observation dimension	Student behavior	Teacher behavior
Focus	3.5	3.1
Migration capability	3.2	3.8
Knowledge system	2.5	3.7
Degree of investment	3.4	3.8

Table 3: Specific scores of each observation dimension in the third vocal music class.

Table 3 shows that the students' scores in focus, involvement and transfer ability are basically consistent. It can also be found from the evaluation of experts that the students' involvement in this class is high. They actively think about the teacher's questions, and timely interact with their peers and share their views in the discussion.

According to the existing vocal music ability, we can predict the possibility of its development, and give students with various learning levels a fixed degree of appropriate encouragement, so that they can better play their enthusiasm and initiative in learning. Through in-depth learning, we investigated the students' attitude towards vocal music lessons in the computer assisted vocal music task in institution of higher learning, and got three results: like, general and dislike. On this basis, we conducted further investigation and got the experimental results as shown in Figure 3.

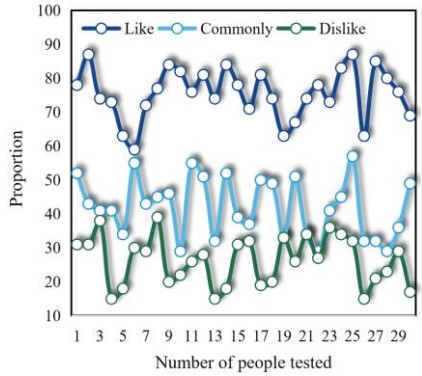

Figure 3: Students' attitude towards vocal music class.

As can be seen from Figure 3, on the question of students' attitude towards vocal music lessons, the average percentage of students who like to take vocal music lessons is 75.53%, and the average percentage of students who hold a general attitude towards vocal music lessons is 42.07%. The average percentage of students who don't like vocal music lessons is 26.3%. The experimental results show that it is of great significance to offer vocal music lessons in institution of higher learning. Then, the students' understanding of vocal music skills was investigated, and four results were obtained through the investigation, namely, they liked learning skills (A), knew some theoretical knowledge of skills (B), knew some breathing methods (C), and were bored with vocal connection (D). The experimental results obtained through detailed investigation of the above four results are shown in Figure 4.

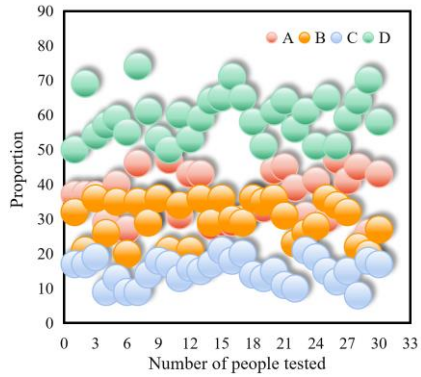

Figure 4: Students' understanding of vocal music skills.

As can be seen from Figure 4, the average proportion of students who like skills and skills knowledge is 36.63%, and the average proportion of students who know skills and skills knowledge is 29.73% and 15% respectively. Students feel that pronunciation practice is boring, and the number is as high as 59.6%. After the above analysis, the students' understanding of vocal emotion was investigated and tested, and the following four results were obtained, namely, they can be deeply touched when listening to a song (a), and they can arouse their feelings about life when singing (b). From the songs, they can see faint morning mist, quiet water (c), and sometimes cry or laugh with the songs (d). Through the analysis of the above four results, the experimental results are shown in Figure 5.

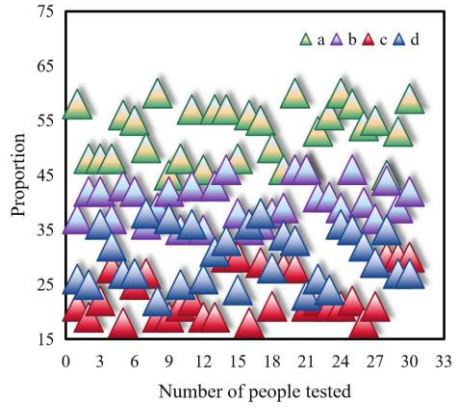

Figure 5: Students' understanding of vocal emotion.

As can be seen from Figure 5, the average percentage of students who can be deeply touched when listening to a song is the highest, accounting for 52.9% on average. Secondly, they can arouse their feelings about life when singing, accounting for 40.3% on average. Then, they can sometimes cry or laugh along with the song, accounting for 30.27% on average. Finally, they can see faint morning fog and quiet water from the song, accounting for 23.3% on average. Finally, the students' understanding of vocal music aesthetics is analyzed, and four results are obtained through investigation, namely, they can get a shock of the soul when enjoying a song (I), they can basically feel the beauty of the rhythm and melody of the song when singing (II), and they have

their own desire to create songs (III). Further analysis is made on the above three results, and the experimental results are shown in Figure 6.

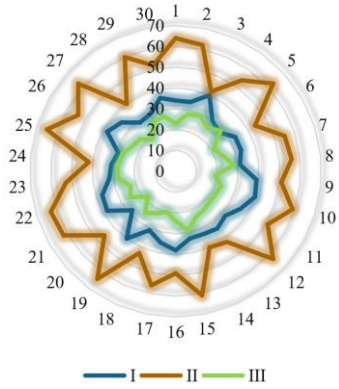

Figure 6: Students' understanding of vocal music aesthetics.

As can be seen from Figure 6, the desire to create songs by oneself is the lowest among the three results, accounting for 24.3% on average. Secondly, when you enjoy a song, you will be shocked by your heart, accounting for 33.9% on average. Among them, the highest proportion is that you can basically feel the beauty of the rhythm and melody of songs when singing, accounting for 53.97% on average. The analysis results have important reference value for adjusting singing state, identifying singers' voices and selecting vocal talents. Through teaching practice, it is proved that the current computer music production software provides a perfect music creation environment, and has great freedom of creation in terms of timbre, speed, intensity, performance and effect. Singers make accompaniment for themselves, taking into account their own characteristics of performance and control when making, so the accompaniment produced is tacit in coordination with singing. This problem can be solved intuitively by means of computer-assisted instruction and the function of audio workstation. The recording, comparison, analysis and playback of audio by using the recording function of music making software can make students objectively evaluate their voices from both visual and auditory aspects, and it is easier to find and solve problems.

5 CONCLUSIONS

Students can find out where their problems lie, suit the remedy to the case, and find ways to correct them. In intonation, timbre, sense of rhythm, emotional expression have further correct understanding. The mastery of basic knowledge is further deepened, and the curiosity of music exploration is gradually strengthened when each piece of music can be played well independently. It is the only choice for schools and teachers to cultivate comprehensive talents. This paper further explores the application of deep learning in computer assisted vocal tasks in institution of higher learning. Experimental research shows that the desire to create songs is the lowest among the three results, with an average of 24.3%. The second is that when you enjoy a song, you will be shocked by your heart, with an average proportion of 33.9%. Among them, the highest proportion is that when singing, people can basically feel the beauty of song rhythm and melody, with an average proportion of 53.97%. Vocal music learning is a systematic, complicated and gradual work. Whether as a vocal music teacher or a student, it requires great efforts to have a good vocal music lesson and learn it well, so as to develop in this field. Vocal music teaching is a comprehensive and systematic performing art, which covers all aspects of information. Therefore, the application of computer assisted vocal music task teaching in institution of higher learning for

in-depth learning is an aid rather than a substitute for vocal music teachers. The final judgment of music is people's hearing and psychological feelings, which can never be completely replaced by computers or any kind of technology.

Tianming Xu, https://orcid.org/0000-0002-6514-4262
Tianzhuo Gong, https://orcid.org/0000-0002-8045-0962

REFERENCES

[1] Borodovskaya, I.; Yavgildina, Z.; Dyganova, E.; Maykovskaya, L.; Medvedeva, I.: The possibilities of artificial intelligence in automatic musical transcription of the Tatar folk song, Rast Müzikoloji Dergisi, 10(1), 2022, 147-161. https://doi.org/10.12975/rastmd.20221018
[2] Fang, P.: Optimization of music teaching in colleges and universities based on multimedia technology, Advances in Educational Technology and Psychology, 5(5), 2021, 47-57. https://doi.org/10.23977/aetp.2021.55009
[3] Kaleli, Y.-S.: The Effect of Computer-Assisted Instruction on Piano Education: An Experimental Study with Pre-Service Music Teachers, International Journal of Technology in Education and Science, 4(3), 2020, 235-246. https://doi.org/10.46328/IJTES.V4I3.115.
[4] Kong, F.: Application of artificial intelligence in modern art teaching, International Journal of Emerging Technologies in Learning (iJET), 15(13), 2020, 238-251. https://doi.org/10.3991/ijet.v15i13.15351
[5] Liu, M.; Huang, J.: Piano playing teaching system based on artificial intelligence–design and research, Journal of Intelligent & Fuzzy Systems, 40(2), 2021, 3525-3533. https://doi.org/10.3233/JIFS-189389
[6] Stoller, D.; Vatolkin, I.; Müller, H.: Intuitive and efficient computer-aided music rearrangement with optimised processing of audio transitions, Journal of New Music Research, 47(5), 2018, 416-437. https://doi.org/10.1080/09298215.2018.1473448
[7] Wang, Y.; Zheng, G.: Application of artificial intelligence in college dance teaching and its performance analysis, International Journal of Emerging Technologies in Learning (iJET), 15(16), 2020, 178-190. https://doi.org/10.3991/ijet.v15i16.15939
[8] Xu, C.; Zhai, Y.: Design of a computer aided system for self-learning vocal music singing with the help of mobile streaming media technology, Computer-Aided Design and Applications, 19(S3), 2022, 119-129. https://doi.org/10.14733/cadaps.2022.s3.119-129
[9] Zhang, W.; Shankar, A.; Antonidoss, A.: Modern art education and teaching based on artificial intelligence, Journal of Interconnection Networks, 22(Supp01), 2022, 2141005. https://doi.org/10.1142/S021926592141005X
[10] Zhao, Y.: Research on the music vocal music teaching model based on the computer platform, Basic & clinical pharmacology & toxicology, 65(35), 2019, 124-134. https://doi.org/10.26914/c.cnkihy.2019.037442