Empirical Study of Computer Application and Piano Teaching

ShaoFeng Wang*
Northwest Normal University, China, 730070
*Corresponding author e-mail: 635579255@qq.com

Abstract. Computer technology has been extensively applied to various fields, and piano courses in colleges and universities are no exception. The application of computer technology has revolutionized and driven the development of the traditional model for piano teaching. This paper focuses on the application and specific practice of computer technology in piano teaching, such as the application and analysis of MIDI music technology in piano teaching, application of acoustic sequencer software for visual piano performance analysis, application of plotting software for polyphonic piano works analysis and teaching, analysis of polyphonic works by using acoustic sequencer and plotting software, application of specialized computer piano teaching software to promoting self-directed learning in students. The use of computer technology in piano education and teaching allows more people to acquire piano knowledge, skills, and techniques, expand the talents in piano education and teaching, and cultivate more popular talents who understand piano and can play piano.

Keywords: Computer Technology, Piano Education and Teaching, Digital Piano, Multimedia, MIDI

1. Introduction
As is known to all, traditional piano teaching adopts a “one-on-one” teaching model. This teaching can take into account the development of personalization, has its advantages, but has its shortcomings; computer technology has been integrated into various disciplines in teaching activities, many disciplines have computer series of teaching software and computer network systems, especially the Internet constitutes a huge information interaction and storage system, and it is also a huge teaching resource warehouse, where teachers and students can find very rich educational and learning resources suitable for oneself [1-2]. Similarly, the computer system is also perfect for piano teaching. It not only has rich piano teaching software but also combines computer technology and music technology to
produce a MIDI music system and a network teaching system dedicated to music. Enriched piano teaching will be a game-changer to the learning of students.

2. Application and analysis of midi music technology in piano teaching

Acoustic sequencer hardware is the core control device in MIDI technology and music production systems. It has evolved into acoustic sequencer software. It has become the favored “Digital Audio Workstation” software. Workstation (DAW for short) [3-4]. In computer music systems, the most commonly used is acoustic sequencer software, as shown in Figure 1. Nowadays, the common music workstation software, notation software Cakewalk Sonar, Steinberg Cubase/Nuendo, Pro Tools, Sibelius, Finale, etc. have integrated audio. Aided by such software, it is easy to implement visual and quantifiable intuitive piano performance analysis and teaching.

![Figure 1. Music computer software](image-url)

In education, the metronome in the acoustic sequencer is first initiated to start recording, and let students play on the digital piano. After the students have finished recording, open the piano roll in the software, from which you can see the specific situation of the students' performance. While replaying, they can carry out accurate intuitive and quantified analysis according to the patterns presented on the screen. You can intuitively see that the pedals that were pressed incorrectly during the performance, a few wrong touches, and the beat are slightly misplaced.

In ordinary piano teaching, dynamic expressions such as pp and p, f, and mf are often difficult to express through language. Sometimes, it is not easy for students to feel these differences, especially when performing elaborate polyphonic and multi-level dynamic music performances. Some students with weak foundations can't even compare the basic left- and right-hand melody with the intensity of the accompaniment. With the support of computer technology, after recording, the computer has converted the notes played by the students into quantized MIDI data from 0 to 127. The teacher uses the pencil tool to intuitively modify the student's The magnitude of the note strength allows students to compare the different feelings before and after the modification, or allows the students to modify the strength data on the computer to obtain better hearing effects, and then achieve consistent results through playing exercises as much as possible [5].

As shown in the track window and staff notation of the acoustic sequencer software, different parts are input into different tracks, and the “Mute M” and “Solo S” buttons can be used to listen to the performance of different parts respectively. This is very helpful for training students' ability to
distinguish, separate, master, and express different voices by playing. It has dramatically saved teaching time, and intuitively improves the teaching effect.

3. Analysis and teaching of polyphonic piano works with plotting software

Plotting software is a type of computer music software that is used to present on computer screens or print out sheet music on paper. Cakewalk Sonar, Steinberg Cubase/Nuendo, Pro Tools, Logic Pro, etc. have staff notation display and printing functions, and Overture, Encore, especially Sibelius, Finale are professional publishing-level score plotting software.

In the teaching of a polyphonic repertoire, if the teacher can make full use of the music plotting software technology, enter different parts of the music into different tracks in the acoustic sequencer software, and use “Score” in the lecture. The form is presented in front of the students, and the solo, mute and other functions in the software are used to split the track and synthesize the playback. Hence, the visual sensation of the students will gradually become increasingly clearer. The performance of the theme will be more evident at a glance. With the aid of acoustic sequencer and plotting software technology to assist teaching, the effect is far better than using pencils to make various annotations on the score [6].

Teaching students with real-time spectrum examples through computer screens can enable students to have a comprehensive understanding and understanding of polyphonic music in the shortest time and to arrange chorus arrangements, impromptu accompaniment, and electronic music for future students. Knowledge of the orchestra's orchestration will make significant progress and promote well. For this reason, students can also understand and understand the charm of polyphonic works more accurately, thereby increasing students' interest in learning to play polyphonic piano works, which can have a good effect.

With the support of acoustic sequencer and notation software, each part of the paper score can be separated into different MIDI tracks, and their scores and score examples can be shown or hidden separately. For Solo, Mute, or different parts ensembled, the software intuitively displays the currently playing position and notes so that students can feel the performance and processing method of each piece properly. Hence, the introduction of computer technology can solve this difficult point in traditional piano teaching quickly.

4. Learning approaches of computer multimedia technology applied to piano teaching

Computer technology is a multimedia technology that includes audio, video, pictures, and other media. It is an excellent educational technology when it is appropriately applied to teaching. On computers with multimedia teaching software, it will bring great convenience to teachers 'teaching and students' learning.

In the specific teaching practice of teachers, students should be the main body, and modern teaching media and teaching resources that can help stimulate students' initiative, understand and master relevant knowledge, and form professional skills should be selected.

1) Application of Computer Piano Teaching Software to Promote Self-directed Learning in Students

Computer multimedia technology is more important to support students' self-directed learning, which will change the previous model of piano teaching.
Currently, there are many professional computer piano learning software. Teachers can appropriately arrange students to use these teaching software in teaching, so that students can learn and practice by themselves with the help of teaching software. There is also a computer-based “expert system” to assist students at home when the teacher is away.

(2) Promotion of Piano Learning Based on General Music Software and MIDI Library

In addition to professionally developed professional piano teaching software systems, general-purpose digital audio workstation software (DAW) for music arrangement, production, acoustic sequencer software, and plotting software can be used for open piano learning, practice, recording, and analysis by students.

The prepared “Small Dance” demonstration MIDI music file in Cakewalk Sonar is opened to play, listen, analyze, feel, learn the demonstration music at any point in time. Subsequently, the performance can be imitated to synchronize MIDI or audio recording, Sonar software analyzes the MIDI information of his own performance in the piano roll or staff window, compares and analyzes with the original song, finds out the problem and corrects it. After recording the performance (as shown in Figure 2), the recorded audio file, MIDI file, or the proprietary engineering project file of the digital audio workstation software can be saved and sent to the teacher for homework grading.

![Figure 2. Keyboard piano](image)

(3) Establishment of MIDI Demonstration Music Library

The collection of MIDI demonstration songs and the establishment of a MIDI demonstration song library are the resource basis for piano teaching under the support of computer technology. The first step in its establishment is the design of the resource structure of the MIDI demonstration song library.

In the design of the resource structure for the MIDI demonstration music library, we must consider not only the gradual progress of teaching but also the structure of related knowledge and skills. For example, classification can be based on classical pianos, modern pianos or famous performers and composers, or multiple classifications based on the technical difficulty of the performance, designing the data structure or folder structure of the song library to store MIDI demonstration files.

For different types of piano editing, different piano performance data can be processed:

1) Boolean Type

\( U_i \) is the \( i \)-th element in \( U \), that is, \( i = 1, 2, 3, \ldots, n \). \( A_j \) is the \( j \)-th element in \( U \), \( j = 1, 2, 3, \ldots, n \). \( S_{ij} \) is the attribute value of the \( i \)-th element, and the \( j \)-th attribute. \( a_{jk} \) is the \( k \)-th attribute value \( k = 1, 2, 3, \ldots, t \) in the \( j \)-th attribute, where \( t \) is the class number of one
attribute. \( N(a_{jk}) \) is the count of \( a_{jk} \), and the dependency between attribute value pairs can be expressed by the membership function of the attribute value, as shown in equation (1):

\[
\mu_A(S_{ij}) = N(\alpha_{jk}) / n, k = 1, 2, \ldots, n
\]

(1)

Where \( n \) is the data number.

2) Numerical Type

Assuming that \( l \) is the number of classes of attributes, \( C_l \) is the \( l \) class, \( N(C_l) \) is the number of attributes in \( C_l \), \( C_i \) is the \( i \)-th attribute value in class \( l \), and the membership function of the attribute value is shown in equation (2):

\[
\mu_A(C_i^{(l)}) = N(C_i)/n, l = 1, 2, 3, \ldots, i = 1, 2, 3, \ldots
\]

(2)

3) Class Attributes

The membership function of the class attribute is shown in equation (3):

\[
\mu_A(C_i^{(l)}) = N(C_i)/n, l = 1, 2, 3, \ldots, i = 1, 2, 3, \ldots
\]

(3)

The meaning of the variable is the same as the membership function of the above numeric type.

4) Null Membership Function

\[
\mu_A(S_y) = \begin{cases} 
\min(\mu_A(S_y)), r_0 \leq l_0 \\
\mid(A(S_y)), l_0 < r_0 < h_0 \\
\max(\mu_A(S_y)), r_0 \geq h_0 
\end{cases}
\]

(4)

Null membership function is shown in equation (4).

The Classic Music Document Library website (http://www.classicalarchives.com) has collected many classical music files and established a great musician series of classical music MIDI music library, which has collected dozens of people in human history works of far-reaching great musicians and corresponding MIDI music.

Another targeted and effective approach is to make piano MIDI demonstration songs for teaching proactively. For the music required for teaching, it is specially produced in batches. You can also select outstanding works from the assignments produced by students in the past, and then further processing, processing, and accumulation gradually, you can obtain a fairly effective, practical, and independent MIDI demonstration music library.

5. Conclusions

With the rapid development of computer technology, the integration of computer technology with piano teaching for research is a significant breakthrough and innovation in the field of education. The application of computer technology in piano teaching is also an inevitable and right development direction of piano education and teaching reform that injects new vitality into piano teaching. It allows the interests and abilities of students to be fully tapped, their creativity, and subjective consciousness to be further stimulated. Through the application of computer technology in piano education and teaching, many teachers are trained to meet the demand of the whole society for basic piano education, primary and secondary school music teachers, and social music and cultural activists. Hence, more people can acquire piano knowledge, and more popular talents who understand how to play the piano can be cultivated, thereby contributing to the construction of socialist spiritual civilization.
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