

Research on the Development of Piano Teaching in Universities Empowered by Artificial Intelligence

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ABSTRACT

Artificial intelligence was born in the 1950s, and it is a new discipline based on computer science, which is composed of computer science and technology, psychology and cognitive science, statistics and applied mathematics, nerve and brain science, etc., to study the formation and evolution mechanism of natural intelligence. The research fields of this discipline include robotics, psychology, speech recognition, thinking science, natural language processing and so on. In recent years, with the popularization and application of big data and computational intelligence, artificial intelligence technology has shown great development potential in many fields. This paper summarizes the concept of artificial intelligence, explores the current situation of the intelligent development of piano teaching assisted by artificial intelligence in colleges and universities, and deeply analyzes the practical research of artificial intelligence empowering piano teaching in colleges and universities.

Keywords: *Artificial intelligence, Piano teacher, Colleges and universities.*

1. INTRODUCTION

In recent years, artificial intelligence technology is constantly innovating, and as a new technical discipline, it is also continuously developing and improving. Artificial intelligence first developed in Europe, America, Japan and other regions. Recently, artificial intelligence has made great progress and breakthroughs in various fields in China. Artificial intelligence is gradually infiltrating into many industries such as medical treatment, agriculture, entertainment, communication, service industry and financial industry, and human's work and life are gradually developing towards intelligence.

With the exponential growth of computer calculating ability and data, academic research around artificial intelligence from different disciplines has also achieved fruitful results. In the late 20th century, with the rapid development of artificial technology, advanced artificial intelligence technology was gradually adopted in the traditional piano teaching in colleges and universities. It will be one of the cutting-edge topics to emphasize the implementation of "intelligence +", the integration of mathematics and intelligence, and the creation and empowerment of intelligent

industry in college teaching research. Artificial intelligence is also widely used in the field of piano teaching in colleges and universities. For example, piano teaching can be assisted by intelligent systems. The intelligent composition system completes the arrangement by artificial intelligence calculation. Zero-based students can play a simple piece of music easily on intelligent musical instruments. Intelligent music system monitors and feeds back students' exercises. These intelligent creative technologies have brought new vitality to music creators, educators and learners. Restricted by the level of economic development, the regional differences, urban-rural differences and inter-school differences, especially the differences in teaching resources and high-level teachers, are unbalanced. To solve these problems, we must rely on the support of artificial intelligence information technology, integrate information technology such as artificial intelligence into the whole process of education and teaching, break the time and space restrictions, and effectively support students' autonomous learning and professional development. The latest research by Adia Shah, Dash and others shows that artificial intelligence faces some challenges and limitations in the emotion

generation system. For example, when it comes to the emotion of music performance, it can't identify and express the emotion needed to play the music, and it can't naturally deal with the elastic speed in some romantic works and the speed of scattered paragraphs in China's works. Artificial intelligence can generate coherent music paragraphs, which have different emotional characteristics, but it needs to improve the recognition in dealing with emotional transition between paragraphs. Artificial intelligence is completely different from human beings in dealing with emotional expression of music. In addition, in the aspect of data protection, especially in the process of transmission and storage, it is necessary to speed up the improvement of technical innovation to ensure the safety of intelligent teaching, such as the defects of algorithm and design, the out-of-bounds access of teaching resources and the stability of development framework.

2. THE CONCEPT OF ARTIFICIAL INTELLIGENCE

The concept of Artificial Intelligence (AI) was formally put forward by McCarthy at the Dartmouth Conference in 1956. It belongs to one of the important branches of computer science and is called one of the top three technologies in the world [1]. At present, through artificial intelligence technology, computers can have human thinking ability, judgment ability, decision-making ability and task execution ability. The application scope of artificial intelligence involves many aspects, including image analysis, machine learning, autonomous learning, language cognition and professional technology.

The innovation and development of emerging information technologies based on digital technology, such as computer technology, network technology, Virtual Reality (VR for short), Augmented Reality (AR for short), artificial intelligence, and fifth-generation mobile communication technology (5G for short), and the empowerment of superposition effect are accelerating the penetration into all fields of society, triggering the innovative development of digital integration in many fields of society. Music artificial intelligence, based on computer technology, uses artificial intelligence to analyze big data, simulating human vision, hearing, touch, feeling, thinking and logic, so as to realize the perception, cognition, research and creation of music and the new exploration of "man-machine

interaction" piano teaching, which promotes piano teaching in colleges and universities to a new form. Intelligent musical instruments have more and more powerful functions, more convenient control and more intelligent new features. Artificial intelligence participates in piano teaching. Students can not only create harmony and polyphony music through programming, but also store a variety of musical instrument timbres in the intelligent system, which can imitate the sounds made by animals and other objects. Students and teachers can choose different timbres to create as needed. In particular, the humanized and powerful phonetic sequence function of the intelligent system can replace the traditional musical instruments for phonetic sequence editing. What's more, artificial intelligence can be used for the bearing and production of video in musical instrument classroom teaching, and the research and development of music accompaniment programs and other relatively simple applications similar to interactive music software (such as scoring software, automatic page turning software, classroom teaching evaluation software, etc.) [2]. How to integrate artificial intelligence into piano teaching and how to organically combine traditional piano teaching with artificial intelligence is an important topic worthy of in-depth discussion and research.

In November, 2022, OpenAI, headquartered in San Francisco, developed an artificial intelligence chat robot program ChatGPT (Chat Generative Pre-trained Transformer). Chat means "chat"; GPT is the acronym of "Generative Pre-trained Transformer", which means "Generative Pre-trained Converter". [3] In short, ChatGPT has a strong ability to understand and generate natural language. Through the pre-training of massive text data, it can understand the text input by human beings, and output answers and feedback in the form of text according to the questions and instructions of the text, thus realizing multiple rounds of man-machine dialogue with the help of natural language.

College teachers can use the creative writing ability of ChatGPT in artificial intelligence to generate various forms of educational resources, such as improvisational accompaniment music scores and ballads. In order to help students better understand knowledge points, ChatGPT's multi-modal data processing and generating ability will be continuously improved. Especially in the data-driven model of ChatGPT, teaching resources centered on knowledge points of music theory are

added. First of all, mapping the structural diagram of theoretical knowledge in ChatGPT can dig deep into the logical connection between knowledge points. Secondly, the structure diagram formed by theoretical knowledge points not only provides the content information of knowledge points related to music theory, but also shows more accurate playing skills and touch angle diagram. Through the integration of core educational resources and playing knowledge points, more intelligent and personalized playing scene support is provided.

3. ARTIFICIAL INTELLIGENCE ASSISTS THE INTELLIGENT DEVELOPMENT OF PIANO TEACHING IN UNIVERSITIES

Artificial intelligence has brought about a fundamental change in the paradigm of innovative education in colleges and universities. The integration of virtual and reality in the era of artificial intelligence has realized the development of piano intelligence in colleges and universities assisted by artificial intelligence. With the support of intelligent digital controls and virtual technology, the traditional classroom teaching field has made a breakthrough, winning the dominant position for the mixed teaching mode, accurately positioning the learning progress and learning needs, and breaking through the limitations of traditional piano teaching. In the era of digital intelligence, the deep integration of artificial intelligence and piano teaching provides sufficient motivation for piano teaching in colleges and universities. Teachers use digital technology to obtain, process, manage and evaluate digital information and resources, and analyze and solve teaching problems. Artificial intelligence permeates the three fields of piano teaching performance and scientific research service in colleges and universities in an all-round way, which promotes the major reform of teaching mode.

Artificial intelligence has the characteristics of interdisciplinary integration and originality. Thus it is necessary to break down the barriers of piano classroom teaching and build an artificial intelligence teaching circle. It is also of great importance to use artificial intelligence to enhance the activity and innovation of piano classroom, form a systematic intelligent teaching mode combining online and offline, and realize the application value of artificial intelligence in piano teaching.

3.1 Artificial Intelligence Improves the Flexibility of Piano Teaching in Colleges and Universities

Artificial intelligence enables piano teaching to break through the lack of innovation in the introduction of new lessons in traditional piano teaching. The emergence of artificial intelligence has revolutionized the piano teaching mode, which is mainly reflected in the rapid extraction of knowledge data of piano lessons in colleges and universities and the connection of internal logic, making the isolated knowledge points of piano playing techniques more systematic and charted. [4] This fast and flexible intelligent processing system makes piano teaching more in line with the thinking characteristics of students in the new era, thus building a college piano classroom with a logical structure. At the same time, it can also improve students' grasp of the systematic and holistic knowledge of classroom music theory and enhance the framework logic of the background knowledge of piano works. By expanding the new mode of information transportation, artificial intelligence matches the theoretical database of piano teaching by means of data transmission, data sharing and data co-construction, which breaks the information space limit of piano teaching in colleges and universities. In addition, artificial intelligence also promotes the accurate arrangement of teaching content through data sharing and co-construction, and uses intelligent learning to migrate data and intelligent practice. According to students' mastery of theoretical knowledge points and hobbies, artificial intelligence will recommend piano works resources that match students' playing progress, so as to help students firmly grasp knowledge points. For example, when students are particularly interested in piano works in Baroque period, artificial intelligence can recommend music style explanations of relevant Baroque works and play piano playing videos of Bach's piano master Gould and Schiff according to search and query data. Through the intelligent instruction links of major learning platforms, students' understanding of diversified music performance content is satisfied.

3.2 Artificial Intelligence Assists Piano Teaching and Playing Practice

Piano teaching in colleges and universities should actively adapt to the new paradigm of development in the era of digital intelligence. Artificial intelligence can assist college teachers to design classroom interaction related to knowledge

points to form open questions and improve the interest in piano teaching. The intelligent database constructed by artificial intelligence is helpful to the arrangement and collection of piano teaching resources. With the high-quality computing power of artificial intelligence, according to the pre-set data standards, teachers can quickly search for piano works of different styles and select works that are suitable for the teaching content according to keywords. The characteristics of information dissemination environment of artificial intelligence virtualization and digital technology are the links of knowledge transmission, and then the virtual environment simulated by VR technology can make students immersive through sound recognition, face recognition and gesture recognition, and fully feel the atmosphere of the times in the creative background of piano works. [5]

Artificial intelligence can assist the practice of double pianos and piano concertos, which are common in piano teaching in colleges and universities. The performance of double pianos requires high cooperation and coordination ability of two players, and it is very important to choose the right partner, which is one of the important conditions for cultivating the cooperation ability of double pianos. Students who play concerto or double piano, need to upload the video of piano practice in the intelligent system. The system will quantify the data according to the piano sound recognition technology and visual recognition technology, and match the style similarity of students' rhythm, keyboard comprehensive performance level, style characteristics and other dimensions through artificial intelligence calculation to determine the matching speed of piano concerto or the second piano. The intelligent system can help students to record the audio of collaborative etudes, and judge the phrases and segments with poor running-in through the comprehensive analysis technology of intelligent acoustics for each segment, rhythm, tonality between parts, volume ratio and timbre of the tracks, and finally present them in the form of data reports.

3.3 Artificial Intelligence Collects Intelligent Samples in the Piano Classroom

In piano teaching in colleges and universities, the data collection of artificial intelligence is accompanied by no influence function, which can be combined with students' facial expressions and used by intelligent analysis methods. The collection

of data has gradually become unconscious, and the data of teachers and students' physical space position, behavior, expression, language, text and other data are obtained by using integrated devices or sensors such as wearable devices, intelligent terminals, body perception and eye tracking, and the source of the data is more authentic. The data of students' practice includes pitch, rhythm, intensity, practice duration and variables, and teachers can effectively grasp the problems and technical difficulties in students' practice. Using artificial intelligence sampling technology and emotion recognition function, expression emotion and behavior emotion can be recognized and captured in real time. Through the in-depth analysis and processing of data, an intelligent education management system is established, so that teachers can supervise the "blind area" in the management of piano practice after class, find out the problems of practitioners in time, and provide suggestions and guidance to improve students' piano playing skills and professional level.

4. RESEARCH ON THE IMPLEMENTATION PATH OF PIANO TEACHERS' APPLICATION OF ARTIFICIAL INTELLIGENCE TEACHING IN COLLEGES AND UNIVERSITIES

The application of intelligent scenes in piano teaching in colleges and universities needs to face a fragmented and humanized intelligent education environment. College teachers should give full play to the highly integrated education environment of big data simulation, monitoring and management, and realize an intelligent teaching mode integrating online teaching and online testing.

4.1 Piano Teachers in Colleges and Universities Apply Artificial Intelligence to Train Students' Ability to Read Music

With the continuous popularization of artificial intelligence technology, in order to better arouse students' enthusiasm for playing the piano, many intelligent music software begin to add challenging game link design, so that students can master and practice playing skills in "games". For example, in the form of "waterfall flow", students have the opportunity to explore and create freely. Most students can practice according to the guidance of LED lights in "games" and learn a song more easily

and quickly. By connecting various intelligent devices and educational tools, the interaction between human and piano can be realized. For example, Dust Buster software makes many rhythms in music scores into games, thus improving its interest. It is suitable for students to have an entertaining study in their spare time after class. Music score is the most intuitive and accurate form of music expression. The digitalization of staff will be displayed effectively on the screen. The teaching of reading music for intelligent piano has successfully realized the interaction in the classroom, and also made the classroom content more vivid and visualized.

The music library of the intelligent music software contains a large number of music scores. The music scores provided in the software include *Cherny 599 Etudes*, *Bouguemuller*, *Bach minuets*, etc. These are all music scores suitable for elementary piano students, and players can retrieve them at any time as needed. When it is connected with the intelligent piano, it can automatically turn the page with the performance process, which can facilitate students to watch music without obstacles. The music score will be displayed on a 4k ultra-clear display screen with a film, which not only protects the player's vision, but also helps the player to reduce the number of piano music flipping. There are also some intelligent music score software suitable for students, which also has a rich library of practice music, including pop music, classical music, jazz music, etc., and is suitable for learners of different ages. In the practice mode of PA Player application software, students can choose their own practice methods, such as left and right hand practice, phrase practice and fun practice. The phrase practice part is divided into two parts: "reading music" and "slow practice". "Reading music" ensures that each note pops up accurately at the beginning, while "slow practice" is to match the rhythm and music, so that students are no longer bored during practice. According to the rhythm and intonation problems that students encounter when reading music, audio analysis is carried out, and the mistakes are prompted on the page, providing real-time practice evaluation reports, and dynamically analyzing students' investment in practice, the development of higher-order thinking ability and the quality of reading music, so as to realize the value-added evaluation of students' reading music level in piano class.

4.2 Piano Teachers in Colleges and Universities Apply Artificial Intelligence to Analyze the Student's Learning Situation

According to the standards of piano course evaluation in colleges and universities and the characteristics of artificial intelligence technology, an intelligent teaching assistant system based on this technology is developed, and a network teaching assistant platform is built on the mobile phone and PC side of the system. Through the intelligent teaching assistant platform, teachers can provide students with personalized guidance and targeted evaluation, and students can quickly search the content related to the creative background and music style of piano works, and mark the wrong notes to improve learning efficiency. Intelligent teaching assistant system has great potential in data collection, processing, analysis and prediction. With the technical support of artificial intelligence linking, identification and feedback, a large number of training data can be generated intuitively for students' hand type and the strength of touching keys. The system can not only help students better understand their own performance, but also help students to clearly understand the key points and technical difficulties of practice. It can also guide students to make out their learning goals, self-monitoring and planning, and improve their ability of independent cooperation and inquiry learning. In addition, it can also collect and integrate all students' performance records in class, and make a systematic analysis of the teaching results, so that teachers can clearly understand the teaching effect, and can also find the weak links of students in the practice process, provide targeted counseling for difficult paragraphs, and improve students' sense of efficacy in practicing the piano.

4.3 College Teachers Use Artificial Intelligence Piano Concerto and Double Piano Module to Assist Students in Playing Practice

The design of intelligent piano concerto ensemble module is based on the teaching content of piano concerto and double piano works, and it is divided into intelligent piano concerto ensemble module and double piano concerto module. Teachers can design the intelligent concerto ensemble module in detail. First of all, a large number of piano concertos and double piano repertoires with different periods and styles are

stored in the repertoire library. [6] Players can input music movements and choose the band mode of piano concerto or ensemble, or choose the double piano mode. Then the system will automatically perform intelligent matching and searching in the repertoire library, and output the concerto or double piano repertoire matched with the music, that is, recommend one or more intelligent concerto players for students. What's more, students can carry out personalized playing practice and run-in practice with intelligent companions, so as to improve the piano concerto ability while experiencing the fun of human-computer interaction, so that players can experience the real cooperative acoustic effect with high-level collaborative pianists or professional orchestras in real time when practicing or even performing. This module will provide players with the playing experience as if they were in a concert hall, and the intelligent concerto will interact in real time with the parts of their own performances, thus gaining an unparalleled band rehearsal experience, enabling players to gain a deeper understanding of the music connotation and simulate the situational playing experience. In addition, the module can also automatically record and mix playback, present the practice effect in the form of a report, and the performer can analyze the performance status through playback or report.

5. CONCLUSION

Artificial intelligence is the frontier of scientific and technological innovation and an important starting point of scientific research. College teachers should fully rely on the organizational characteristics of artificial intelligence, condense new strategic driving force, and take the policy of rejuvenating the country through science and education as the guide to promote the intelligent development of piano teaching in colleges and universities. The changes in education brought by the era of artificial intelligence have come. We should make full use of the mining and analysis technology brought by artificial intelligence, provide visual data analysis reports, formulate personalized development plans, and realize the future choice of teachers and students' connotative development. Artificial intelligence not only helps piano education, music creation and voice recognition, but also brings effectiveness and interest to piano teaching. The application of artificial intelligence by college teachers to assist students in their creation and performance to form a man-machine cooperation model will also become

the development trend of artificial intelligence transforming into technological innovation.

ACKNOWLEDGMENTS

Foundation: Zhaoqing University Quality Engineering and Teaching Reform Project 2022(ZLGC202258).

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