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Retraction

Retracted: Application of Artificial Intelligence Technology in Music Education Supported by Wireless Network

Mathematical Problems in Engineering

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Q. Jiang, "Application of Artificial Intelligence Technology in Music Education Supported by Wireless Network," *Mathematical Problems in Engineering*, vol. 2022, Article ID 2138059, 11 pages, 2022.

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Research Article

Application of Artificial Intelligence Technology in Music Education Supported by Wireless Network

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With the increasing application and use of information technology in college music classrooms getting deeper and deeper, the role of music informatization teaching classrooms becomes more and more prominent. In this context, it will be an important research topic to strengthen information technology education, promote the innovation and development of music education in colleges and universities, and build a rich information technology music classroom. Artificial intelligence technology's implementation in the area of music education is developing and becoming more common, and to some extent, it has become a stimulant of music teaching, although there are certain negatives. The arrival of wireless networks, especially 5G, has drawn strong attention from all walks of life, and its characteristics of "large bandwidth, ultralow latency, and connectivity of everything" have been applied and explored in the field of music education, making the teaching mode, teaching methods, and interactive experience develop in a better direction. At the same time, VR, AR, AI, big data, and other technologies based on a wireless network have also been optimized and applied to the field of music education, which will further promote the development of intelligent music education. This study examines the impact of informatization on music education creativity in academic institutions and then goes on to address informatization tactics in music education innovation practice in order to develop a new model of music education digitization that is current. Focusing on music education, the applications of artificial intelligence in music education are listed, and a music education framework based on artificial intelligence algorithms and wireless networks is proposed. Finally, the proposed framework's usefulness is demonstrated in relevant tests, and the prospects for artificial intelligence technology in the realm of music are examined.

1. Introduction

Music is important in art education in colleges and universities, and the learning of music theory knowledge and the mastery of basic skills are important. Only by stimulating students' interest in music learning and allowing them to feel the artistic beauty of music from melody, rhythm, and context can students be truly engaged in music learning and develop rich associations with art in the process of learning knowledge and skills, which can lead them to the path of active learning. Traditional music education in higher education emphasizes "oral instruction" and is mainly guided by teacher demonstrations, with most practical training taking place after class. Because of the lack of timely guidance from teachers, students' musical ability is not very effective, which is not conducive to stimulating students' enthusiasm and initiative in music learning [1–5].

Artificial intelligence technology originated in the 1950s. Artificial intelligence (AI) is a concept, methodology, tool, and implementation system that uses digital computers or computers driven machines to replicate, extend, and enhance human intelligence, observe the environment, gain knowledge, and apply new learning to get the great outcome. Artificial intelligence technology has completely moved from concept to reality, achieving audio recognition, image recognition, language recognition, natural language processing, and other functions over time, and is now widely used in a variety of fields, including education, healthcare, security, finance, and autonomous driving, thanks to advances in computer hardware and computation iteration.

The era of artificial intelligence has arrived and will further assist human analysis and decision-making, reform human work patterns, and even replace some human work in the future. Music classrooms adopted and applied more effective, intelligent, and humanized synthetic percussion instruments in the late twentieth century, including the rapid advancement of science and technology, and the regeneration of these types of equipment showed more convenient, intelligent, and ideal characteristics.

In the field of music, the application of scientific and technological means has led the way for the creation of new works as well as new paths and instructional concepts for music educators. Nowadays, in the field of artificial intelligence and big data, there has been a recent concept in music today's schools through the teaching and use of artificial intelligence technology in arts education to foster the growth of music education. The profession of teaching has long been defined as preaching, teaching, and educating. By preaching and teaching, we mean that teachers should not only teach professional knowledge but also teach by example with their own moral behavior and personal charisma [6–8], guiding students to find the meaning of their own lives and realize their own life values and pursuits. In the artificial intelligence environment, algorithms can continuously iterate and provide personalized learning to students based on their feedback and provide reliable teaching suggestions to teachers, greatly improving the efficiency of students' mastery of professional knowledge. Of course, the booming development of the Internet also gives students richer learning resources, so the teacher's function of teaching will gradually weaken, and the value of nurturing people will become more prominent. Although machines can instruct, sort out, and describe knowledge more quickly and effectively and create students' rational cognition, perceptual cognition cannot be achieved by machines. Whether it is ethical education or psychological guidance, all require face-to-face communication between people, which artificial intelligence cannot provide. Because of the unique nature of music education, it is one of the most significant forms of aesthetic instruction. Music classes are more significant in strengthening students' aesthetic sensibility than in helping them to appreciate excellent musical works and master basic knowledge and skills [9–11].

The rapid development trend of the Internet and big data has triggered changes and innovations in music education. We should focus on the research of new online music education, comprehensively analyze the characteristics of music education under big data and the Internet, explore the informationization mode of music education, realize the innovation and integration of music education and big data information means, truly achieve the seamless connection of online and offline music education resources, better enhance the internal drive, and promote the innovation and development of music education under big data. The meaning of music education in the context of big data is a new education model derived from information technology and network technology [12]. Under the influence of big data, the music education teaching platform is continually evolving. Using the new music education teaching platform and equipment, performing arts teaching is converted from imagination to PowerPoint presentation, and teachers can use MIDI for music making or classroom teaching, which best solves the bottleneck of discovering audio materials, converting tonalities, and background music in music education classrooms, becoming a powerful data technology assistance for music education teaching.

We should use the Internet and big data to build a platform to share high-quality music education resources, continue to develop new teaching methods, capture regional and unique music education resources, cultivate students' musical art preferences and temperament, and meet students' individualized and diverse music academic goals. The music curriculum model under big data is also pushing the boundaries [12–15]. Through the effective connection of big data, the Internet, and music education, resources can be better integrated and optimized. Teachers can let students independently preview music teaching content before class and conduct independent learning according to their own time and interests, enhancing students' autonomy in music learning. Specifically, the music education teaching mode under big data is manifested in the following ways: microlessons. Professional teachers can compile music education teaching content into short small PPP videos, making them teaching resources for formal classroom learning, or as nonindependent learning resources, designing them as music teaching microvideos of less than ten minutes, and matching them with modules such as teaching design, forum, courseware, practice, test, evaluation, reflection, and puzzle-solving for music classroom teaching, integrating and linking different music through microlessons. Through microlessons, different music topics, knowledge points, and knowledge structures are integrated and linked to help students build a complete and systematic music knowledge system structure and music digital teaching materials [16].

We can develop and use rich music intelligent education resources, embed resourceful music digital teaching materials into music teaching classroom, make music teaching content into graphic teaching materials contents, and record microlesson videos to stimulate and mobilize students' music learning enthusiasm, guide students to self-orientation, motivation, and adaptation, transform the monotonous and boring music learning state, and improve music learning efficiency and quality. Students can watch and prestudy the microvideo before class, reflect on its content, write down any points that they are unclear about, and bring them to the classroom to seek advice from the teacher, while the teacher should provide timely guidance and answers and unify students' common problems. The teacher should give timely guidance and answers, unify and explain the common problems of students, and design targeted music training to enhance students' music independent learning ability and help them deepen their understanding and comprehension of music knowledge [17]. Characteristics of music education under big data music education under the background of the rise of big data and the Internet are reflected in the following aspects: cross-border connection to optimize relationships. Due to the phenomenon of the lack of music education teachers, it is necessary to share and share music education resources by means of big data and the Internet, to form a cross-regional connection of music education under the premise of the application of big data technology, to provide online music education for students, so that students can share the results of excellent teachers' lessons through the Internet, to strengthen the interaction and dialogue of music teaching online, and to provide music education in microlessons, music learners can obtain music knowledge resources from the Internet, and teachers can also strengthen music teaching management through big data and better learn and grasp students' data-based music learning status by integrating, mining, sorting, and predicting students' music learning activity data. At the same time, it is also possible to build a self-help music learning platform based on cloud technology and methods, which can use big data to learn the basic information of music learners, such as age, gender, and family background, so that music learners can realize real free learning and idealized learning [8, 18].

Artificial intelligence can assist in teaching music knowledge and concepts in music teaching, but the sensual contents of music teaching, such as musical beauty and musical interest, still need teachers' guidance and infection. Teachers can inspire and guide students to feel and experience different musical beauty through a variety of teaching methods. If music teachers just let students listen to music and learn to sing, ignoring the experience of emotion and aesthetics, such music teachers will face the crisis of being replaced by artificial intelligence. Therefore, the value of music teachers is not only to teach music knowledge but also to educate aesthetics and to educate life through music with emotion and meaning and temperature.

The continued use of AI technology in the field of music education will encourage music educators to improve their expertise, acquire unique understanding, focus on humanistic concerns, and explore the ultimate significance of music instruction from a developmental standpoint. It is also important to learn and understand emerging technologies such as artificial intelligence with an open mind [19], to master scientific methods of use, and to recognize the value and limitations of technology as an auxiliary tool in order to sublimate the educational meaning and role of music teachers in this era of artificial intelligence and human-computer interaction. At the present stage, quality education is gradually receiving widespread attention from society, and the education majors in colleges and universities, as the source of supply for primary and secondary school teachers, play the role of the mainstay. Universities have gradually upgraded the teaching component of music education degrees in order to create physically and intellectually fit and well-rounded abilities. The wireless network period and artificial intelligence technology have increasingly penetrated education as a new means of teaching innovation, providing a new way of thinking for the teaching reform of music education majors in colleges and universities. This study proposes a music teaching framework based on the wireless network and artificial intelligence, which is conducive to the improvement of students' musical ability and stimulating their enthusiasm and initiative in music learning. The relevant experiments prove the effectiveness of the proposed method.

2. Related Work

2.1. Wireless Networks and Mobile Learning. Mobile learning (M-Learning) is the most recent development of digital learning, a new learning mode following E-Learning that is built on mobile communication technology and wireless network technology to enable students with personalized and independent learning anytime and anywhere. With the advancement of wireless network technologies, particularly the widespread coverage of campus wireless networks, a new learning mode known as mobile learning has sprung up in colleges and institutions [20]. Through the campus wireless network, students can access the campus network and the Internet anytime and anywhere using mobile terminals such as smartphones so that learning resources and teaching information can be shared conveniently and quickly. The effective integration of campus wireless networks and mobile learning systems has enriched students' learning mode and cultural life and promoted the further development of teaching, research, and management level of colleges and universities. With the further development of digital campus construction and the gradual expansion of informationization, all universities have built perfect campus networks, and the campus network has become one of the main ways for university students to get learning resources and teaching information. At present, the main body of campus network of a large part of colleges and universities is wired Local Area Network (LAN); however, with the continuous expansion of school scale and geometric growth of students, the shortcomings of campus wired network such as difficult to expand nodes, high construction cost, and small coverage area gradually appear. The wireless network is the key work of digital campus construction of colleges and universities at this stage, which makes up for the shortage of wired campus networks. It is the supplement and extension of a wired network and can achieve maximum compatibility with the main network of colleges and universities and build a ubiquitous campus network of colleges and universities together [21]. The construction of campus wireless network mainly adopts Wireless Local Area Network (WLAN) technology. Compared with wired LAN, WLAN has the advantages of low cost, short construction period, large coverage, fast transmission speed, flexible networking, easy expansion, easy management, and so on, which can solve the problems of wired LAN well. The topology of campus wireless network is based on the existing wired LAN of colleges and universities and utilizes the wireless LAN standard IEEE802.11 to extend and expand the wired network, extending the campus network to all corners of the campus, realizing that all directions on the campus can quickly access the campus network and Internet, and solving the problem of insufficient network information points commonly existing in colleges and universities. It really realizes the efficient use of campus network and the Internet anytime and anywhere and meets the needs of students' independent learning and communication. It adopts the network architecture centering on the wireless access point (AP) to build the wireless network of colleges and universities, realizes the communication of all base stations through AP transfer, and finally realizes the seamless link with the existing wired network of colleges and universities; it flexibly sets wireless access points according to the actual situation and network demand of schools and uses various coverage methods to maximize the signal range so as to achieve the comprehensive coverage of the whole campus. Comprehensive coverage of wireless networks is achieved. The topology of the campus wireless network can refer to the wireless LAN structure scheme shown in Figure 1.

Mobile learning is a new type of learning that makes use of wireless mobile communication network technology and wireless smartphones (such as cell phones, personal digital assistants (PDAs), Pocket PCs, and other similar devices) to access educational information, resources, and services. Mobile learning is a result of the use of mobile computer technology in digital learning, and it has distinct qualities such as flexibility, convenience, personalization, engagement and timeliness, and contextual relevance, allowing students to learn "anytime, anywhere, at will." There are three learning modes of mobile learning: SMS-based learning, connection-based learning, and campus wireless network-based learning. SMS-based mobile learning mode refers to the use of SMS to transmit text and image information among students and between students and the webserver. Through cell phones and other related devices, students first send messages to the web server, which analyzes the messages, transforms them into data requests, completes data processing, and finally returns the processing results to the students. This learning mode, because of the difficulty of real-time connected data communication, cannot browse learning websites and much less transmit and display multimedia learning resources and is often used for the timely release of teaching information, course schedules, and announcements [22]. The mobile learning mode based on connection and browsing mode is that students use mobile devices such as cell phones to connect to the Internet through gateways and access the learning resource servers to retrieve, learn, and interact with learning resources; this mode is suitable for students to carry out independent and collaborative learning. The mobile learning mode-based on-campus wireless network is based on campus wired LAN as the core and connects various wireless learning areas together to realize mobile learning covering the whole campus. Since it is limited to the campus and uses very mature wireless LAN technology, the campus wireless network-based mobile learning mode has a high transmission rate and can transmit not only static learning resources such as text and images but also dynamic learning resources such as multimedia audio and video, which can provide students with more flexible and convenient learning methods and improve learning efficiency.

2.2. Artificial Intelligence and Music Education. Teachers should be good at using AI technology for teaching, using AI technology to enrich classroom content, improve classroom quality, and promote the scientific generation of classroom assessment. The development of music at this stage is facing two dilemmas. Firstly, the professionalism of music creation is too high, and secondly, the personalized consumption level of music is getting lower and lower. In such a context, artificial intelligence technology brings a new solution for music creation. The essence of artificial intelligence lies in the fact that algorithms are trained on a large amount of existing data to master internal logic among the data so as to achieve classification, identification, and prediction of new data, while some advanced algorithms led by adversarial generative networks can even achieve integration, complementation, refinement, or recreation of data. All musical works can be quantified into specific data forms, such as sound maps, so once AI algorithms are trained through learning many musical works, they will have a better understanding of how to write music and certain precipitation of the underlying logic of music creation, and subsequently, this ability can be given to more people, so that everyone can become a music creator. At the same time, AI can learn the characteristics of different song styles based on the training content, thus assisting people in personalized music creation and greatly enriching the genres and styles of music. In view of this, it is also worth thinking about how to make good use of AI technology to improve the quality of music teachers' classroom teaching. The 2017 edition of the High School Music Curriculum Standards divides the compulsory courses into six modules: music appreciation, singing, performance, music composition, music and dance, and music and drama. The six components each have their own focus and comprehensive insurance; however, teaching all six modules at the same time is extremely difficult and a significant challenge for high school music teachers; as a result, only a few schools are prepared to offer all six modules; however, artificial intelligence can greatly reduce the teaching burden of music teachers and reduce the troubles of teaching. For example, in music composition courses, artificial intelligence systems can effectively integrate students' music composition materials and provide more convenient conditions for students to create music. For example, Magenta Studio, an AI composition tool from Google, can automatically integrate and expand new melodies and drums based on user input to create a complete musical composition. Similar AI music composition software is becoming more sophisticated and user-friendly and could be an important tool for students to compose original music in the future music composition classroom. And teachers can go on this basis to guide and inspire, suggesting requirements for creative content and methods for students to complete their compositions. However, because the AI music composition system is based on the harmony and structure of music in the inherent database, it is prone to the phenomenon of similar melodic works, which makes the individual student's personal expression and the emotional expression of student-created works lacking, so it requires timely guidance from the teacher and independent thinking of students to give full play to the students' imagination and achieve the goal of aesthetic education. For example, in performance lessons, AI systems can select the most appropriate content to be taught to learners according to their learning needs and individual learning abilities, and at the same time, they can continuously analyze students'

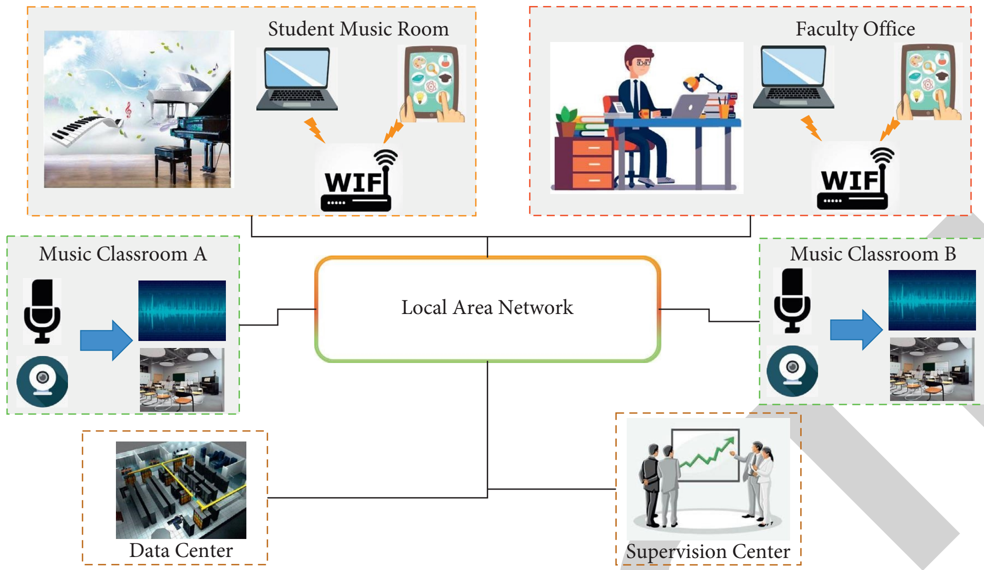

Figure 1: Music teaching wireless network topology.

classroom performance and provide evaluation and feedback, which is the most mature and widely adopted application of AI algorithms in the overall education industry. In addition, it is well known that there are so many kinds of musical instruments that it is impossible for teachers to play every instrument, but AI technology can empower relevant software to effectively master the principles of using different instruments and evaluation systems. With the use of AI systems, students will have a more diverse choice of instruments and a more efficient learning experience, thus enabling the effective implementation of the curriculum concept of "enriching curriculum choices to meet developmental needs." Artificial intelligence technology can be used to deepen music classroom evaluation. Artificial intelligence technology can play an important role not only in the music curriculum as a teaching aid and enrichment but also in teaching evaluation. Teaching evaluation is the activity of collecting, analyzing, and utilizing students' learning information carried out by teachers in order to judge students' learning, understand their own teaching effect, and promote students' efficient learning. In daily music teaching, teaching evaluation is mainly reflected in classroom observation, student performance, and self-evaluation, which need to ensure accuracy, objectivity, and comprehensiveness. However, most of the classes in the past did not really reflect the effect of teaching evaluation but still relied on the subjective consciousness of teachers and students to give grades, and in the classroom observation, the subjective color is too heavy and often causes incomplete teaching evaluation. Based on this, the emergence of artificial intelligence technology has greatly provided reliable support for education teaching evaluation. The functions of face recognition, voice recognition, quantitative data, and analysis of students' classroom behavior can quickly count and generate analytical data on students' learning effectiveness, learning status, and learning ability, thus helping teachers to grasp students' attendance faster and more comprehensively, understand students' learning situation, arrange teaching contents and progress more reasonably, and improve the quality and efficiency of music teaching. At the same time, AI can also measure teachers' teaching process and give reasonable suggestions so that teachers can conduct teaching evaluations more quickly and promote teachers' teaching reflection and summary improvement. With the help of AI technology, students' academic indexes include "score reading ability," "singing ability," and "playing ability." Music teachers will be able to assess students' performance based on objective dimensions such as pitch, speed, rhythm, intensity, and finish. The music teacher will grade the students' musical performance based on objective dimensions such as pitch, speed, rhythm, intensity, completion, and subjective dimensions such as emotion and style.

In practice, teachers are required to take into account all dimensions, which requires a sustained and high level of concentration during the assessment process, a requirement that can be difficult for teachers with limited experience or energy. In addition, not all teachers can be accurate and objective in judging the objective dimensions in this process, so the introduction of AI technology to assess some of the objective dimensions will greatly reduce teachers' pressure and allow them to focus on the subjective dimensions, while also effectively improving the accuracy of the assessment. The establishment of a mature and accurate AI system requires a large amount of data training, and too little training data will result in the system not being able to master the accurate discriminatory rules, and too rigid assessment criteria will not meet the original purpose of AI "simulating the human brain" on the one hand and stifle students' personality, imagination, and creativity to some extent on the other hand. Therefore, after the establishment of the AI art assessment system, the most important work is the creation of the original dataset. Based on the rigor of art assessment, at least dozens and at most hundreds of different assessment audios should be input for a single track and then repeatedly measured and analyzed to finally form a stable, accurate, and comprehensive database. Such an AI-based art assessment system can be of obvious help to music teachers, and the application of its core concept not only is limited to the art assessment of graduation or final exams for primary and secondary school students but can also be applied to a wider range of singing or instrumental music competitions, allowing music teachers, judges, and audiences to focus more on emotional expression, singing style and other issues related to deep artistic aesthetics and humanistic qualities.

Although artificial intelligence has provided great convenience for human life and work in the present social environment and has optimized the working mode and enriched the working methods in various fields, artificial intelligence is not omnipotent, and there are some problems and drawbacks that are difficult to avoid or have not been solved in the present stage of development, especially in the fields of music and literature that require human perceptual thinking. The essence of artificial intelligence is actually code and data, and cold code and data are very difficult to express the human emotional attitude and thinking. This is because the current AI is not only still in the weak AI stage but also a manifestation of the disadvantages of AI. Music is a sensual art, a figuration of human thinking and consciousness, and machines and data do not present all human thinking in its entirety. Therefore, for the use of artificial intelligence, we need to look at it from a dialectical perspective; on the one hand, we should not regard it as a flood of anxiety, and on the other hand, we should not be overly dependent on it. At this stage, artificial intelligence can only be used as a teaching aid. For example, in music evaluation, or instrument training at the primary level, teachers can use AI to alleviate such simple and repetitive tasks. But for the emotional experience of music, the expression of feelings and other aspects that require the use of perceptual thinking for reflection still need to be taught by the music teacher by example. The influence of an experienced teacher on the emotional development of music beginners and the cultivation of a love of music is completely irreplaceable by artificial intelligence technology.

3. Method

3.1. Wireless Network-Based Music Education Architecture. The architecture of the campus wireless network-based mobile learning system can be divided into three layers: representation layer, business logic layer, and data service layer, as shown in Figure 2.

As the interaction interface between users and the system, the representation layer is located on the client side, mainly responsible for session processing, data communication between users and the business logic layer, and providing corresponding interaction interfaces for various users, mainly including administrator interface, teacher interface, and student interface. The representation layer involves the adaptation of mobile devices and learning content. The mobile learning contents need to have good adaptability so that they can be displayed normally on various models and screen sizes of mobile devices so that students can better start learning. The business logic layer is the system's heart, and it is on the server side. It is in charge of providing the system's business services; it includes accepting application requests from users at the representation layer and making logical judgments and business processing on the requests. The business logic layer is the functional modules of the mobile learning system and the corresponding standard interfaces. The data service layer is the database of the whole system, which is located on the server side and mainly used to provide data sources. The databases in the data service layer mainly include three types of databases: user, teaching, and learning resources. The user database is used to store teachers' basic information, teaching process information, students' basic information, learning process, and performance information; the teaching database is used to store teaching management information, teaching dynamic updates, and course information; the learning resource database is used to store various learning resources, teacher-student interaction, that is, questions and answers, and so on. According to the multiple users, the mobile learning system is organized into three modules: student module, instructor module, and administrator control unit. It can be broken down into teaching management modules, course management discrete components, course learning components, course assessment modules, assignment submission modules, teaching resource management modules, user information management modules, and course information management modules based on business logic. In the process of construction, the characteristics of mobile learning should be fully considered, such as the complex environment of mobile learning, the impossibility for students to concentrate for a long time, and the small screen, small storage capacity, and narrow bandwidth of the terminal devices used; the mobile learning resource library should be able to provide learning resources in various forms and rich contents, such as text, images, animations, and microvideos, so that learners can independently choose the appropriate learning resources according to their interests and needs for knowledge acquisition, stimulate learning interests, and improve learning efficiency. The teaching resources provided by the mobile learning course are mainly divided into three categories: first, the teaching description documents of the course, such as course introduction, course syllabus, experiment syllabus, lesson plan, assessment method, and lesson plan; second, the learning resources related to the course, such as multimedia courseware, text, and microvideo; third, the tutorial materials of the course, such as the key points analysis of each knowledge unit, case study, test analysis, and question and answer analysis.

3.2. Artificial Intelligence Algorithms. In music education, speech and music are two highly significant types of data for speech signal processing. Voice and music signal classification is useful in a variety of applications, including audio retrieval, beat monitoring, and speech recognition. For example, in speech signal processing, the category is determined first, and if it is a speech category, the subsequent

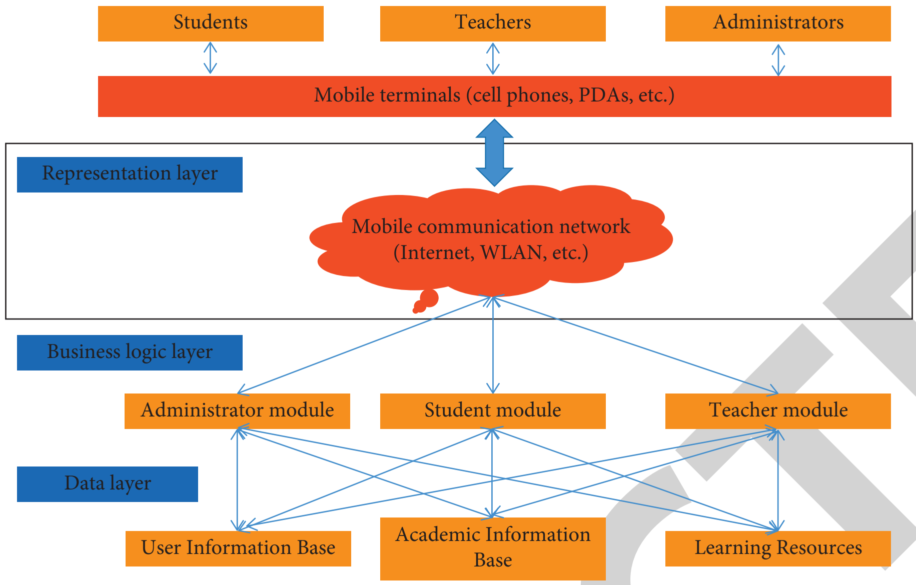

Figure 2: Wireless network music teaching architecture.

steps can analyze the language, gender, and so on. If it is a music category, the subsequent steps can analyze the music category, beat tracking, and so on. It can be seen that speech and music classification affects the subsequent experimental results. Currently, there are various classification methods for speech and music classification problems. Beat refers to the combination pattern of strong and weak beats. Strong and weak beats are repeated cyclically in a certain order to form a beat. In music, beats organize music with strong and weak relations. Therefore, a speech music classification model based on the beat spectrum is proposed; that is, after the audio is preprocessed, it is processed by Meier triangle filtering to get the beat spectrum obtained using MFCC parameters, which are then employed in an autocorrelated similarity matrix to provide the beat spectrum, and the statistical correlation threshold is used to determine the type of audio. In the subsequent non-real-time extraction of music beat time points, this model has less influence on it, and the operation speed is faster.

The beat spectrum calculated from the music has a periodic pattern, while most of the speech is irregular. In this paper, the beat spectrum is chosen as the input feature of the model to determine whether the signal is speech or music. The characteristic parameters of the signal not only affect the accuracy of the model but also affect the computational speed of the model. In the realm of speech recognition systems, Meier's frequency cestrum coefficient, which integrates the auditory perceptual features of the human ear with the mechanics of speech generation, has been frequently used. The height of a sound heard by the human ear is not directly related to its frequency; hence, the Meier frequency scale is more in accordance with the human ear's auditory properties. The logarithmic distribution of the real frequency broadly correlates to the value of the Mel frequency scale, and the specific link with the actual frequency is

$$\mathrm{Mel}\{x\} = 2595 \times \lg\left(1 + \frac{x}{700}\right), \quad (1)$$

where $\mathrm{Mel}\{x\}$ is the perceived frequency in Mel and x is the actual frequency in Hz. The similarity between the two vectors is evaluated by calculating the cosine of the angle between them, which is 1 for 0° and not greater than 1 for any other angle with a minimum value of -1. Music has a rhythmic nature that makes the calculation of its similarity somewhat repetitive, while speech does not. The specific formula is

$$\cos\,\theta = \frac{\mathbf{a}\cdot\mathbf{b}}{\|\mathbf{a}\| \times \|\mathbf{b}\|}, \quad (2)$$

where a and b are the two eigenvectors, respectively, and $\cos\theta$ is the calculated cosine value. The beat spectrum is a function of time lag and is a measure of acoustic self-similarity. Strong peaks in the beat spectrum will appear in highly structured or repeated music, exposing the relative strength of rhythms and specific beats and so identifying distinct types of rhythms with the same beat. The beat spectrum differs from previous methods of rhythmic analysis in that the beat spectrum does not depend on specific properties such as energy or frequency and is therefore applicable to any type of music or audio. In this paper, the beat spectrum is a short-time Fourier transform of the signal, and the amplitude of each frame of the signal is used as a feature vector for similarity calculation. The similarity matrix of the signal is calculated by equation (3) using the angle cosine parameter of the eigenvector. The beat spectrum is obtained by calculating the autocorrelation of the similarity matrix as follows:

$$\mathbf{R}(i, j) = \frac{\mathbf{x}(i) \cdot \mathbf{x}(j)}{\|\mathbf{x}(i)\|\|\mathbf{x}(j)\|},$$
$$\mathbf{C}(k, I) = \sum_{i,j} \mathbf{R}(i, j)\mathbf{R}(i + k, j + l), \quad (3)$$

where $x(i), x(j)$ are the feature vectors of frame i and frame j, respectively; $R(i, j)$ is the similarity matrix; $C(k, l)$ is the symmetric matrix; the beat spectrum $C(l)$ can be obtained by simply summing by row or by column. The model flow of speech music classification based on audio-related features is shown in Figure 3.

The specific model steps are as follows:

Step 1. Extract MFCC parameters. The extraction principle is shown in Figure 4. The preprocessing contains frame splitting plus windows and so on. FFT is a fast Fourier transform.

Step 2. Using cosine similarity, calculate the similarity between MFCC parameters two by two, and you will get a similarity matrix. The speech signal's beat has no regular pattern, while the music signal will produce periodic peaks. The experiment uses MATLAB's cos function to calculate the similarity of the feature vectors. The cosine distance distinguishes differences more in terms of direction and is not sensitive to absolute values. Because of the numerical insensitivity of the cosine similarity, it can only distinguish the difference between individuals in dimensions and cannot measure the difference in each dimensional value, so the obtained similarity matrix better reflects the periodic pattern of the beat.

Step 3. The beat spectrum is calculated using the similarity matrix's autocorrelation. In terms of the beat's properties, it might reflect the rhythm's periodic pattern. The beat spectrum does not depend on specific attributes such as energy or frequency, so it is applicable to any type of music or audio, reflecting the periodic change pattern of beats. The experiments use MATLAB's cord function to calculate its autocorrelation. The proportional amplitudes of the various peaks in the beat spectrum represent the strength of their respective rhythmic components, and the peaks in the beat spectrum correspond to the primary rhythmic elements of the music signal. Some music with a strong rhythmic sense will have a more pronounced peak change in the beat spectrum, while those with a weaker rhythmic sense will have a slightly weaker peak change.

Step 4. Normalize the data. The goal of normalization is to confine the obtained data to a specific interval so that each audio's data may be processed easily later, and it can eliminate the adverse effects caused by odd sample data. The normalization formula is

$$X' = \frac{x - \min(x)}{\max(x) - \min(x)}, \quad (4)$$

where X is the amplitude value after calculating the beat spectrum and X' is the normalized value.

Step 5. Determine the audio category by calculating the threshold value. The threshold is modified when the accuracy of speech or music dips too far.

4. Experimentation and Evaluation

4.1. Data and Experimental Setup. Using a distributed network topology, based on the user levels of teachers, students, and administrators to support different identity rights while corresponding to slightly different services, the music intelligence system closely associates teachers and students, as well as teaching resources. In order to ensure efficient integration and control of multiple subjects (teachers, students, courseware, and aids), teaching methods (organization, management, assessment, evaluation, and strategies), and teaching behaviors and various roles, intelligent aspects such as teaching mode and appraisal of learning skills are applied to teaching leadership. The modules for supplementary training, autonomous learning, and performance training make up the majority of our interactive instructional music intelligence system. Its logic diagram is shown in Figure 5.

The composition of each module requires the support of the background music database, which is supported using the SQL Server database, thus realizing the automated management of the system integration and executing the overall solution of the data solution. The music intelligent system's network topology has already been stated; the intelligent system's operating environment is a combination of software and hardware, the server environment, the database server's configuration, and the system's memory, 500 GB solid-state drive, dual-CPU Xeon processor system, and gigabit network card. The software selected system software and application software, and backup software selected Veritas backup. The operating system of the application server is MS Windows 2007 Enterprise Edition, and the system software is WinCC. The main function of the platform database is the music learning question bank, and the lesson question bank contains performance questions, music score questions, judgment questions, and general music knowledge questions. The information list of the database contains various types of information, such as knowledge point information, music field information, music score information, multimedia file information, answer information, and so on, as shown in Table 1.

Radio stations, Mandarin learning networks, and MIR data were used as sample data sources for the trials to test the classification accuracy of the rhythm spectrum-based speech music classification model. The threshold value is determined using this information. The Mandarin learning network, music obtained from several radio stations and music applications, and other data sources were used in the tests. There are 436 samples in all, with 198 for music and 238 for speech. Each sample has a sampling frequency of 16 kHz, a precision of 16 bits, a monochannel, and a duration of 10 seconds.

Figure 3: Algorithm flow.

Figure 4: MFCC parameter extraction process.

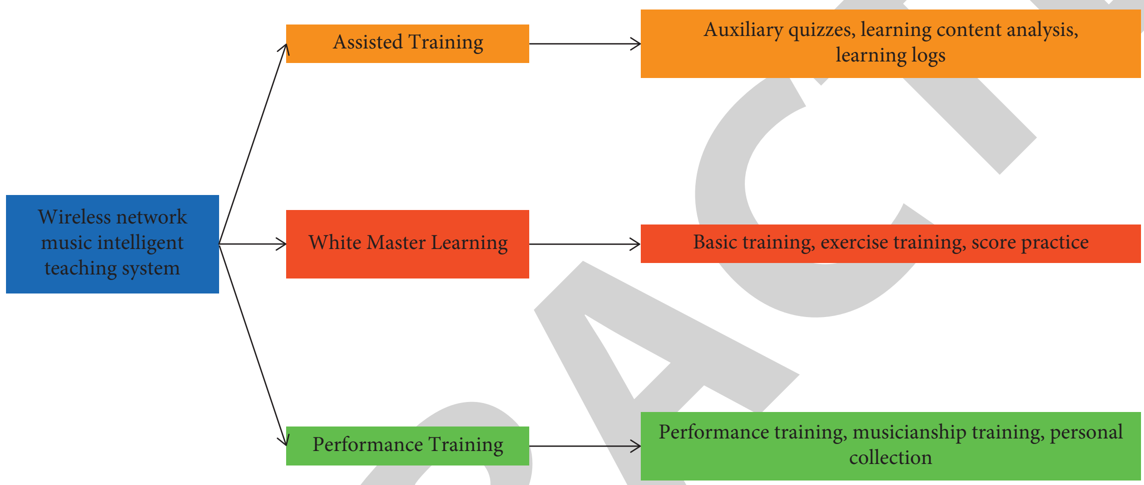

Figure 5: Functional structure diagram.

Table 1: Database information list.

Field name	Field content explanation	Data type	Category restrictions	Remarks
Test type ID	Type number	Number (4)	Not null	Interaction type
Test type name	Type name	Varchar2 (40)		
Test title	Song title	Varchar2 (1 000)	Not null	Topic description
Knowledge ID	Knowledge point number	Number (2)	Not null	
Knowledge name	Knowledge point name	Varchar2 (40)	Not null	Music history knowledge points and so on
Grammar ID	Exercise number	Number (2)	Not null	Main key
Grammar name	Exercise name	Varchar2 (40)	Not null	Chopin etudes and so on
Territory ID	Instrument number	Number (2)	Not null	
Territory name	Instrument name	Varchar2 (40)	Not null	Piano, guitar, and so on
Test text	Body of knowledge point	Varchar2 (4 000)		
Level ID	Level	Number (2)	Not null	
Diff quot	Difficulty factor	Number (2)	Not null	12345
Create name	Submitted by	Varchar2 (20)		
Book no	Source	Number (10)		
Test image	Corresponding pictures	Varchar2 (200)		Image file names
I media text	Multimedia files	Varchar2 (200)	Not null	File name and table of contents
Choice text	Options	Varchar2 (1000)	Not null	
Key text	Performance text	Varchar2 (2000)	Not null	Standard text
Key remark	Music category description	Varchar2 (1000)		Remarks

4.2. Experimental Results. Experiment 1: the 32-dimensional MFCC parametric beat spectrum was tested, and the results are shown in Table 2. Experiment 2: the 13-dimensional MFCC parameter beat spectrum was tested, and the results are shown in Table 3. The results of the model are shown in Table 3. Compared with the existing model, the classification result is about 3% higher, and the music differentiation is about 2% higher, which shows the effectiveness and reasonableness of the model. The reason for the high differentiation of music in this model is that music contains beat

Table 2: Classification results of experiment 1.

Audio datasets	Total number of samples	Number of correct samples	Number of incorrect samples	Correct recognition rate (%)
Speech	238	225	13	94.54
Music	198	163	6	97.47

Table 3: Classification results of experiment 2.

Audio datasets	Total number of samples	Number of correct samples	Number of incorrect samples	Correct recognition rate (%)
Speech	238	219	19	92.02
Music	198	196	2	98.99

Table 4: Classification results of experiment 4.

Audio datasets	Total number of samples	Number of correct samples	Number of incorrect samples	Correct recognition rate (%)
Speech	100	2	98	98
Music	100	2	98	98

characteristics, so the recognition rate will be higher. In order to verify that the model has the same differentiation effect on music with insignificant rhythm as speech, experiments were conducted on it. The experimental dataset consists of 200 samples of classical music and Mandarin speech, including 100 samples of music and 100 samples of speech. The sampling frequency of each sample is 16 kHz, the precision is 16 bits, the monochannel, and the length of each time is 10 s. The experimental results are shown in Table 4.

The recognition rate of speech and music can reach 98%, which proves that this model has the ability to classify music with insignificant rhythm as well.

5. Conclusion

Wireless networks and artificial intelligence development have grown by leaps and bounds in recent years, and the integration of wireless networks and artificial intelligence with music teaching is already a prominent trend. In the future, we may be able to see AI directly in the classroom, giving students an immersive experience and real emotional feedback. In the case of optimizing the use of teachers to completely promote equality and equity, science and innovation, on the other hand, have given us new goals and expectations as music educators. Because there are a limited amount of music educators and funds for music education, investments in artificial intelligence can successfully increase the popularity of high-quality music education, hence increasing the level of universal music education and improvisational music. Second, by enriching the assessment mechanism, optimizing the evaluation structure, and optimizing the algorithm, the current music composition and evaluation system may be made more objective and realistic while preserving the human touch. More random elements should be incorporated into the music composition to fully explore the complexity and diversity of music and to create extra options for music production.

Data Availability

The datasets used during the current study are available from the author upon reasonable request.

Conflicts of Interest

The author declares that he has no conflicts of interest.

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