

Research Article

Application of Multimedia Technology in Online Piano Teaching

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Multimedia teaching has the characteristics of flexibility, nonlinear structure, and the combination of multiple senses, which can fully mobilize the enthusiasm and initiative of students. Because the traditional piano teaching method is too old-fashioned and single, which is not conducive to stimulating students' interest in learning, the piano teaching is studied according to the methods of information technology, online education, and mixed teaching. This paper controls the rhythm of teaching through multimedia teaching technology, stimulates students' thirst for knowledge, and uses multimedia technology to enrich piano teaching resources to meet teaching needs. Then, by means of a questionnaire, the attitude of most of the high-efficiency students towards online piano teaching with multimedia technology is understood. At the same time, the cluster analysis system is used to analyze the online public opinion evaluation of the three teaching methods by collecting the network behavior of users in various distribution platforms on the Internet and analyzing the feature vector according to the function space formed by the relevant evaluation indicators. The accuracy of the system is above 82%, so the teaching evaluation is effective. Through the value evaluation model of the system, user dynamics can be accurately understood and applied to other fields.

1. Introduction

With the advent of the information age, the application of computer technology has penetrated into many fields of social life, changing people's work, life, and learning methods, and it is showing an accelerating trend. Few schools offer this module teaching content in actual teaching. Since the expressive and rendering power of multimedia works involves multimedia technologies such as images, sounds, animations, and videos, students are highly motivated to learn.

Through cluster analysis and questionnaires, the feasibility of application in piano teaching in colleges and universities is understood, and the traditional teaching is reformed based on multimedia technology, online teaching, and mixed teaching. Through the online teaching of multimedia technology as the starting point, the process of applying multimedia and the Internet to piano teaching and the existing problems and solutions are discussed. This teaching method has certain reference value for other related courses or teaching practice in other industries. The online

teaching of multimedia technology is based on the theory of constructivism, which is mainly reflected in the concept of learning, knowledge, and teaching, and fully demonstrates the activity design between teachers and students.

Traditional piano teaching is more inclined to the cultivation of skills for school music education, lacking basic music theory knowledge, music appreciation classes, etc. [1]. In order to break the teaching idea of traditional teaching, this paper used multimedia technology, video, software, etc. as carriers and used digital resources, classroom feedback, after-school exercises, etc. to provide targeted explanations on a certain knowledge point or teaching link to track learning dynamics and keep abreast of students' learning status, which was conducive to supervising students' learning.

2. Related Work

With the growth of social economy, people's lives are becoming more and more intelligent and data-based and teaching is no exception. Aiming at the development trend

of the choreography structure of competitive aerobics, Li studied the online choreography method of difficult movements of competitive aerobics based on multimedia technology to improve the choreography effect. In the competitive aerobics video based on top-down feature fusion, RGB image, optical flow image, and corrected optical flow image were used as the input mode of difficult action recognition network [2]. Yan proved the inevitability of applying multimedia technology in college basketball teaching and the feasibility of implementing multimedia physical education from three universities and colleges and analyzed the factors that affected the impact of multimedia-assisted teaching from various aspects of the multimedia teaching environment and teachers' teaching ability [3]. Yuan and Wu identified and reviewed twenty design thinking related courses to be taught by coaches from many Chinese universities as MOOC (massively open online courses) between February 2020 and June 2020. There were a lack of well-represented learning outcomes and a lack of diversity in the cultural context and design domain of all the design cases covered by the MOOC. The future was designed with DT-related MOOC in a Chinese context for instructional design thinking within a broader curriculum structure that integrated more active and peer-to-peer learning components to create a better flipped learning experience and increase design diversity [4]. These studies are instructive to a certain extent, but in some cases, the demonstrations are insufficient or inaccurate and can be further improved.

With the development of the Internet, everyone's speech is too complicated, it is becoming more and more difficult to quickly obtain accurate and effective information from network resources, and the confidence level of the information is also difficult to guarantee. Neunhoeffler and Teubner differentiated prototype consumers through cluster analysis based on the discovery of fundamental consumer motivations shared by peer-to-peer [5]. Pang combined traditional cluster analysis algorithms and random forest algorithms to improve traditional algorithms and incorporated human skeleton models to identify students' classroom behaviors in real time. Through experiments, this study verified the effectiveness of the extracted spatial angle features based on the human skeleton model. The results of the algorithm performance test showed that the network structure of the proposed algorithm outperformed the network structure of a single feature extraction algorithm [6]. Muthahharah and Juhari used 2 hierarchy methods, the full contact and Ward's method. It was designed to minimize differences between objects in a cluster. There were four types of medical services, namely, hospitals, health centers, home care, and telemedicine, with 15 divisions [7]. These studies can analyze the relevant conditions, but the research on the accuracy rate needs to be improved.

3. Application Methods of Multimedia Technology and Online Piano Teaching

3.1. Application of Information Technology in Traditional Piano Teaching. Taking the work "Stand by Me" as an example, it is divided into four parts. At the same time, b-box

parts can also be added to enhance the sense of rhythm. During the practice process, the electronic sound of mobile phones can also be added to reflect the superiority of digital music [8]. In terms of teaching content, the main tasks of teachers are to make course ppts, use Internet resources to integrate materials, record teaching videos, reflect the major and difficult points of this work in the teaching videos, urge students to practice, and give feedback in class; in teaching methods, observation method, experience summarization method, and comparison method are mainly used; in the assessment process, since the study time for a piece of work is generally four weeks, in the midterm, students will record a flash video and the score of the recorded video will be recorded in the official test. The fourth week is the formal assessment of the students. The practice results of each group are tested, and videos are recorded. By comparing the completion effects of each group, teachers find out the deficiencies, put forward suggestions for improvement to the students, and complete the teaching goals. The specific teaching links are as follows.

3.1.1. Making Course PPT. In the PPT, the background of the repertoire, the introduction of the repertoire, the analysis of the important and difficult points, etc. should be clearly reflected, so as to facilitate the students' understanding of the work [9]: key points: "Stand by Me" is an English work. The cooperation of the lead vocal part and the three parts below shows a perfect harmony effect. At the same time, b-box parts can be added to realize the perfect coordination of each part [10]. This work begins with the bass part, which requires a stable rhythm to reflect the rhythm stress. After the accompaniment part enters, it is requested to pay attention to the balance of the part and the grasp of the breath of the cross-bar tuplet notes when singing. After the lead vocal part enters, the accompaniment parts should pay attention to volume control and the fusion of the voices of each part should be practiced as a key point.

3.1.2. Making Teaching Videos. In the video production process, you can first find the videos of representative singers through the Internet and choose the 1986 movie "Walk with Me" to use this old work as the theme song version of the same name; the instructor led the four students to explain the difficult points. The four students played the four singing parts of the work, respectively, to demonstrate the difficult points. After the recording was completed, the video was sent to each group, so that the group members could complete the work of the work.

3.1.3. Classroom Feedback. Through video learning, each group should report on the staged results in the classroom. The purpose of this link is for teachers to grasp the students' learning situation in time and adjust the teaching capacity in time [11]. Through the report, when the learning results basically meet the standard, the learning can be further deepened and the cooperation of electronic audio can be added to the four parts, such as percussion instruments like

drum kits. At this time, appropriate music software can be chosen for cooperation. Taking the piano timbre as an example, the piano timbre in reality will have overtone characteristics, while the piano timbre in music software is not obvious, so learning software development should make the electronic timbre more realistic. The mobile phone software can use the drum kit from GarageBand and choose the group that has completed the work better to practice. Students compare the differences between four-part singing and four-part singing with percussion accompaniment to increase their awareness of participation.

3.1.4. Results' Report. The achievement report is mainly divided into two parts. The first part is the achievement report of this work, which is usually completed in the fourth week of study; the other part is the achievement report of the final concert. The teacher designates each group to report the results of different repertoires according to the completion effect of each group on all the repertoires, and the final assessment is completed. To sum up, in the flipped classroom teaching process of solfeggio and ear training, every link fully reflects the application of digital technology. Whether in preclass preparation or in the reporting of results, digital technology is needed to assist in order to complete the final teaching goal. Cooperating with multimedia teaching methods, students' learning interest and learning efficiency can be improved [12]. After class, advanced technology can also be used to allow students to interact with teachers in real time while practicing piano at home.

3.2. Online Piano Teaching. Because of the epidemic in 2020, in the field of education, major colleges and universities have begun to adopt online teaching methods to complete teaching goals, take advantage of the Internet, and stop classes without stopping teaching. The application of computer technology in teaching, through games, pictures, videos, etc., easily solves the common problems in the understanding of concepts when students are first learning the basic theory of music. This online teaching method proposes new challenges for both teacher teaching and student learning [13].

Solfeggio is a subject that combines theoretical learning and practical ability training. Some researchers believe that online teaching is feasible in real teaching, and some hold opposing views, believing that online teaching is not conducive to students' mastery of knowledge. Internet tools are a special network medium, which can provide reliable tools for piano education reform, build an online piano teaching experience platform, create a characteristic piano teaching classroom setting mode, build an Internet piano resource library, and establish a diversified piano Internet learning thinking, in order to solve the problems of teaching mode, classroom setting, and teaching resources and learning thinking problems in traditional piano teaching methods [14]. Because of the impact of the current epidemic, it is very necessary to use solfeggio online teaching. Although there will be many obstacles in this process, teachers and students

should also try their best to overcome and find solutions to the problem. Specific steps are as follows.

3.2.1. Preparation before Class. The software used in piano online courses mainly includes the Superstar Learning app and the Dingding app [15]. The first step is to find a lot of audio and video as learning materials, upload the audio materials and video materials to the Superstar Learning app, and at the same time, upload the introduction of the work and after-school assignments to the Superstar Learning app, so as to save time when explaining the work in class. By uploading materials, it is mainly to facilitate students to preview in advance, discover their own shortcomings, communicate in class, and strengthen their learning impressions.

3.2.2. Online Teaching. Online teaching adopts the method of PPT projection screen, which is more conducive to the interaction and communication between teachers and students. Through the Superstar Learning app, students can sign in 10 minutes before class and record in time; during the teaching process in class, teachers can let the students discuss in the discussion area to understand the students' learning situation; live teaching can be conducted through the Dingding app, so as to understand the students' learning situation more intuitively in the way of talking online, so as to arrange after-class homework when summarizing after class [16]. It can stimulate students' interest in learning, highlight the key points of teaching, make teaching content specific and visualized, reduce learning difficulty, and improve teaching efficiency.

3.2.3. After-School Homework. Because of the characteristics of the piano subject, piano practice is affected by some factors. The homework after class is to first check the completion of the single part of the work. The group leader sends the completion of the single part of each group to the teacher every Sunday. After the single-part practice, the group leader synthesizes the audio of each part through the Music Editing app and sends it to the group members to fully experience the integration of the work [17]. At the same time, considering that some students do not have a piano as an auxiliary tool, teachers use the Overture software to create the basic ability training content of solfeggio and send it to the students in the form of audio, which plays a certain role in sparring and improves the students' comprehensive quality of music.

Through the five-week solfeggio online teaching course, the teaching situation is summarized. This process is a process of constantly discovering and solving problems. The specific summary is as follows: the first week class form was using Superstar Learning app [5]. Learning situation: because the students of the 2019 and 2020 vocal classes and piano version took the piano course through the completely online teaching method for the first time, there were many problems in the learning process, such as the sign-in was not timely, the questions in the discussion area could not be

answered timely, and the completion of watching the video was not enough. After-school homework was based on groups and was sent to the teacher every Sunday evening, and the teacher then commented on it in turn. The completion of the piano course was considered generally good. The second week class form was using Superstar Learning app. Learning situation: compared with the first week, students could basically sign in and answer questions on time. Because of the subject characteristics of solfeggio, through online learning, there was less interaction between students, although the single-voice singing task was completed, but the joint practice between the various parts could not be completed. After class, students were allowed to practice together through WeChat video and voice. Because of the network delay, the completion was not ideal. Through the communication between each group leader and the teacher, it was finally decided that each group leader would edit the audio of each part together through the music editing software, so that the group members could feel the fusion between the various parts of the music work.

The third week class form was Dingding live teaching. Learning situation: after the first two weeks of study, it was found that there was less interaction between teachers and students, so Dingding was used to teach in the third week. The teacher communicated with the students to learn more about the completion of the students' music works, to answer the questions one by one, and solve the problem of less interaction between teachers and students before [18]. The fourth week class form was Superstar Learning and Dingding live teaching. Learning situation: after learning the video uploaded by the teacher on Superstar Learning, the students had a basic understanding of the content of this lesson, and then the teacher taught through Dingding live. The fifth week class form was Dingding live teaching. Learning situation: the fifth week was the last class of the first work of this semester. Before class, teachers uploaded the homework in time through Dingding, so that students could summarize the learning feelings of this work in text form, and students reported online through Dingding live. Through practice, it was understood that the subject of solfeggio had both theoretical and practical characteristics. It was unrealistic to adopt a completely online teaching method. The most ideal teaching method was to combine offline teaching of solfeggio with online teaching. The combination of teaching and learning could achieve the best teaching effect. Practical links and activity classes can be added in the classroom to improve students' creativity and participation and increase students' comprehensive understanding of music, so that music teaching can be used to improve aesthetic sentiment and cultivate creativity and artistic aesthetics.

3.3. Teaching Platform of Blended Learning Mode. Through the analysis of the disadvantages of traditional teaching in the above colleges and universities, several key aspects of college learning are summarized, including curriculum setting, student learning, and learning assessment [19]. Only by reforming the content of these key links, using

information technology and information ideas to improve teaching concepts, allowing students to give full play to the spirit of "ownership" in learning, and mobilizing students' learning consciousness, creativity, and high efficiency can college students in the age of information be cultivated well. With the help of modern educational technology, this paper tries to design and develop an effective teaching model that meets the requirements of piano teaching in colleges and universities and meets the learning needs of piano students in colleges and universities, in order to promote the development of piano teaching in colleges and universities. With reference to the mixed teaching model, it is divided into four stages, including course content setting, classroom knowledge teaching, after-school activity organization, and teaching evaluation, in order to achieve the goal of improving learning efficiency and cultivating students' comprehensive quality. The teaching resources are set as the core component, which is in line with the current characteristics of information sharing. The frame design is shown in Figure 1.

The connotation of the blended learning model is the study of information transfer between learning and teaching and the integration of various information and forms. Based on this, the university blended learning model of Figure 1 integrates teaching resources and course learning, starts with target classification and content analysis, provides teaching resource support, and uses autonomous learning and collaborative learning as the main learning methods to promote students to master and explore new knowledge.

According to the four stages of content setting, classroom knowledge teaching, after-school activity organization, and teaching evaluation in the blended learning model of colleges and universities, each functional module of the system is designed [20]. The blended teaching platform is divided into major functional modules, course learning, online assessment, assignment submission, teaching evaluation, and system management. The main functional modules of the system are shown in Figure 2.

In the course learning function module, students can learn online courses on the platform, download supporting learning resources, and communicate with other learners or teachers online to answer questions; teachers publish course content and teaching resources to answer questions for learning; the administrator is responsible for the configuration of the course and the normal operation of the maintenance module.

The online assessment function is suitable for course study. After studying the chapters of the course, students can test the learning effect online. Students can also check their previous test scores and keep abreast of their own learning dynamics. Teachers are responsible for maintaining test questions, organizing test papers, and publishing exams, and teachers can also check students' test results.

In the assignment submission function module, teachers and students have different functions. Teachers have functions such as assigning homework, viewing homework submitted by students, and correcting homework; students have functions such as downloading homework assigned by teachers and uploading homework.

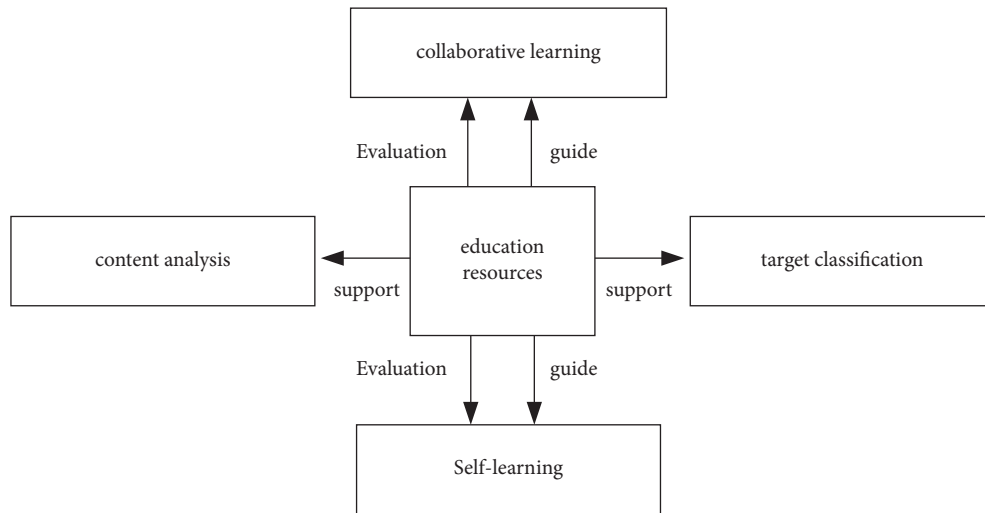


FIGURE 1: University blended learning model.

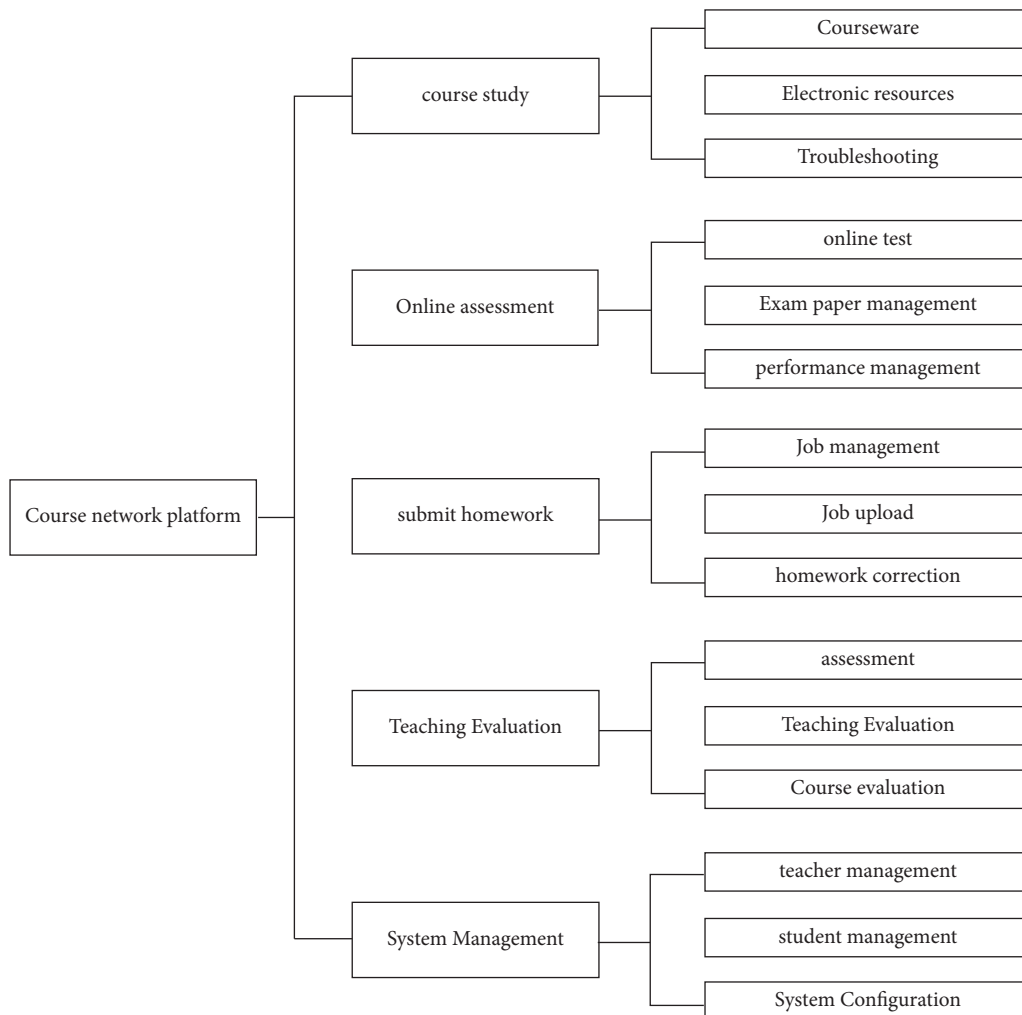


FIGURE 2: The main functional modules of the system.

Teaching evaluation is an important part of the blended learning model. In this functional module, teachers can organize students to evaluate courses and resources, and these evaluations are organized in the form of questionnaires. After students fill in the questionnaire, the system will automatically count the results of the questionnaire and feed it back to the teacher.

The system management is mainly divided into user management, course management, and class management [6]. The management of the system is mainly maintained by the administrator. When the system is initialized, a large amount of user, course, and class information needs to be maintained. In order to reduce the workload of administrators, the system provides two methods of batch import and single input for data entry.

Figure 3 shows all possible relationships that exist between the main entities in the system. This correspondence is inferred from common sense, and now these relationships are analyzed in detail. There is a many-to-many relationship between courses and resources, that is, a course can have many resources and a resource may also correspond to multiple courses. According to this correspondence, a separate course resource relationship table will be mapped when the database table is created. There is a one-to-many relationship between courses and tests, that is, a course can correspond to multiple tests and a test can only belong to one course [21]. There is also a one-to-many relationship between courses and assignments. A course can have many assignments, and an assignment can only belong to one course. There is a one-to-many relationship between courses and evaluations. A course can have multiple evaluations, and each evaluation can only correspond to one course. The above are some of the main relationships in the system, in addition to the one-to-many relationship between resources and evaluation, students and assignments, and many-to-many relationships between teachers and courses.

4. Investigation on Online Teaching of Multimedia Technology Piano

4.1. Questionnaire Investigation. 200 sample students who voluntarily participated in the research were selected from the music majors in three universities in a certain region as the research objects. The gender statistics of a sample of 200 students who volunteered to participate in the study are given in Table 1.

The gender statistics of the sample students are shown in Table 1. Statistics showed that, among the 200 sample students who responded effectively to the questionnaire, the number of girls was slightly more than the number of boys, but the proportion was basically the same, which reflected the opinions of students of different genders in a balanced manner.

The grade distribution of the sample students is shown in Table 2. Statistics showed that the valid sample students had the highest proportion of sophomores, juniors and freshmen were less, and the seniors had the lowest proportion, which might be related to the participation of seniors in off-campus

teaching practice and social activities. Overall, the sample was broadly representative. The following data are also counted according to the sample students who answered the questionnaire effectively.

The sample students' interest in learning piano is shown in Table 3. Statistics showed that 35.5% of the sample students were very interested in learning the piano, 47% of the students were quite interested in learning the piano, accounting for more than 80% in total, and only a few students expressed general or no interest. It could be seen that the sample students were more interested in piano learning and had a higher degree of preference.

The sample students' thoughts of the degree of help of multimedia online piano teaching to piano learning are shown in Table 4. Statistics showed that most students held a positive attitude towards the help of multimedia online teaching in piano course learning and believed that it could facilitate learning and help improve learning effect and efficiency.

The learning needs of sample students in multimedia online teaching are shown in Table 5. Statistics showed that 63.5% of the students were eager to try microlecture teaching, accounting for the majority, some students had a general attitude, accounting for 20.5%, and only a few students said they did not care or were not interested. Combined with the survey results of the abovementioned sample students' piano teaching methods and interest level, the piano teaching in ordinary colleges and universities mainly adopted the collective teaching mode, supplemented by multimedia to create a situation. This method had been difficult to meet the needs of students for piano teaching. It had a high degree of demand, that is, the desire and attempt for a new teaching model.

4.2. User Interests Based on Big Data Cluster. Through a sample survey of current students in three colleges and universities in a certain area, the students' learning attitude towards multimedia online piano teaching was understood. In order to ensure the accuracy of the data, cluster analysis of big data was carried out.

The user interest model is established by collecting the user's network behavior and user interest information in various distribution platforms on the Internet within a certain period of time, including the user's web page access history, browsing content, publishing information, and retrieving content. Based on these web page information, a user interest model is established [22]. The advantage of constructing a user interest model is that the search system can intelligently discover the information that the user is interested in and tap the potential search purpose of the user, so as to provide information services for the user. Building a user interest model includes two basic steps.

First is to collect information related to the user interest model. The methods used include direct user participation or implicit feedback. The direct participation method mainly refers to the interest information or records based on the user's displayed feedback, and the implicit feedback method

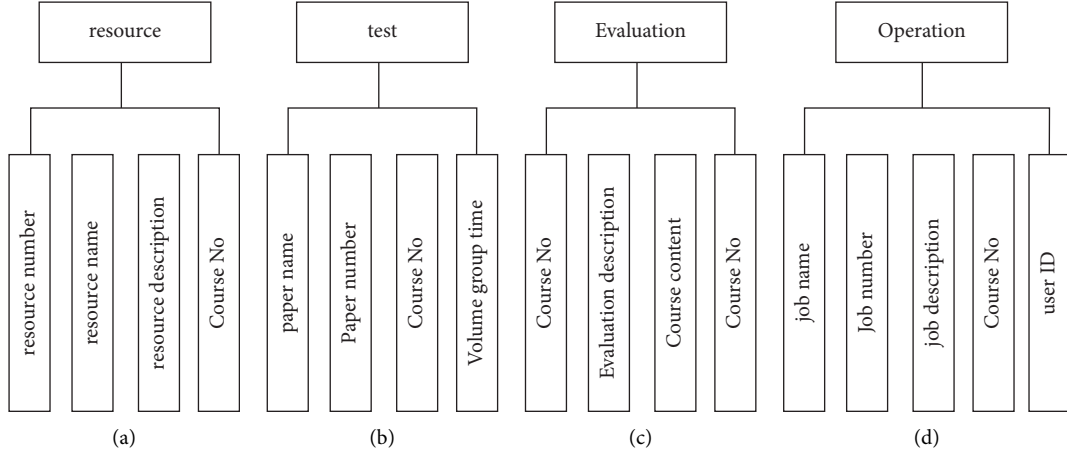


FIGURE 3: Data entity relationship model diagram.

TABLE 1: Sample student gender statistics.

Gender	Male	Female	Total
Number of people (n)	99	101	200
Proportion (%)	49.5	50.5	100
Ranking	2	1	

is to judge the user's interest pattern by mining the user's web page behavior.

Second, according to the information collected in the first step or the basis of user network behavior analysis and combined with the dynamic changes of user interests, a user interest model is constructed through statistical modeling or corresponding mathematical modeling methods. In the process of collecting information related to the user interest model, the precondition is to ensure user privacy. The method of direct user participation is highly transparent, efficient in information collection, and has high reliability and credibility, but requires more user participation, which brings inconvenience to actual work. Implicit feedback requires research and analysis of the user's network behavior and predicts the user's interest or intention through the user's behavior. This method is not transparent, and it is difficult to guarantee whether the obtained information is trustworthy.

In constructing a user interest model, a combination of two methods can be adopted. Through the above analysis, the data sources of web page information collection mainly include the following aspects: (1) user browsing behavior, (2) web page information browsed, (3) user visit times, (4) user residence time on the web page, (5) keywords, (6) server log information, (7) data and pages saved and downloaded by the user, and (8) other information input by the user.

In a word, the establishment of the user interest model will provide a strong guarantee for the intelligent, personalized, and diversified realization of the search system, and more importantly, it can make the search system truly understand the user's search needs and intentions and provide users with fast reliable and accurate information. This will help improve user experience, enhance user

stickiness, promote information consumption, and promote the rapid development of the Internet industry.

According to the relevant evaluation indicators, in the vector space model, the text record is regarded as a function space composed of a set of vectors. The vectors in the space are orthogonal to each other, and each document d in the text record D is represented by a feature vector, that is, $V(d) = (t_1: \omega_1(d); \dots; t_i: \omega_i(d); \dots; t_n: \omega_n(d))$, in which $\omega_i(d)$ represents the weight of the participle t_i in d , where the participle includes title participle and abstract participle, and the description generated by the feature vector in user interest modeling is the same. The eigenvector is a non-degenerate vector through a linear transformation, and its direction does not change under the transformation. The ratio by which the vector is scaled under this transformation is called its eigenvalue, and the eigenspace is a collection of eigenvectors of the same eigenvalue. It will generally express $\omega_i(d)$ as a function of the frequency $f_i(d)$ of the occurrence of the participle t_i in d , which is $\omega_i(d) = \Psi(f_i(d))$. Except for $f_i(d) = \Psi(f_i(d))$, the usual methods include square function, binary function, logarithmic function, and TF-IDF function:

$$\sqrt{f_i(d)} = \Psi(f_i(d)), \quad (1)$$

$$\Psi(f_i(d)) = \begin{cases} 1, & f_i(d) \geq 1 \\ 0, & f_i(d) = 1 \end{cases}, \quad (2)$$

$$\Psi(f_i(d)) = \log(f_i(d)) + 1, \quad (3)$$

$$\Psi(f_i(d)) = f_i(d) \times \log\left(\frac{N}{n_i}\right), \quad (4)$$

where N is the number of documents and n_i is the number of documents containing terms t_i .

TF-IDF is a common weighting technique used in information retrieval and data mining to assess the importance of a word to a document set or one of the documents in a corpus. According to the TF-IDF method, the weight of the participle in this system can be expressed as follows:

TABLE 2: Grade distribution of sample students.

Grade	Freshman	Sophomore	Junior year	Senior year	Total
Number of people (n)	50	69	56	24	200
Proportion (%)	25.5	34.5	28	12	100
Ranking	3	1	2	4	

TABLE 3: Sample students' interest in learning piano.

Options	Very interested	More interested	Generally	Not interested	Total
Number of people (n)	71	94	23	13	200
Proportion (%)	35.5	47	11.5	6.5	100
Ranking	2	1	3	4	

TABLE 4: The sample students' thoughts of the degree of help of multimedia online piano teaching to piano learning.

Options	Very helpful	Generally	Not much help	Uncertain
Number of people (n)	109	54	21	16
Proportion (%)	54.5	27	10.5	8
Ranking	1	2	4	5

TABLE 5: Sample students' perceived learning needs of online piano teaching compared to traditional courses.

Options	Very needed	Generally	It does not matter	Not interested
Number of people (n)	127	41	21	13
Proportion (%)	63.5	20.5	10.5	6.5
Ranking	1	2	3	4

$$w_{TF-IDF} = \frac{f(D_{ij}, D_i)}{D_i} \times \log\left(\frac{N}{df(D_{ij})}\right), \quad (5)$$

where $f(D_{ij}, D_i)$ is the number of times the participle D_{ij} appears in the text record D_i , $|D_i|$ represents the number of participle occurrences in D_i , $df(D_{ij})$ represents the total number of records containing the participle D_{ij} in the text record D , and N represents the number of records contained in D . After the above processing, the title and abstract in the record are converted into weighted title vector and abstract vector, respectively, which are expressed as follows:

$$V_t = (t_1, w_1, t_2, w_2, \dots, t_n, w_n). \quad (6)$$

Among them, V_t represents the feature vector form of the title, w_i represents the weight value of the title participle t_i , and n represents the number of participles contained in the title.

$$V_s = (s_1, w_1, s_2, w_2, \dots, s_m, w_m). \quad (7)$$

Among them, V_s represents the feature vector form of the title, w_i represents the weight value of the title participle s_i , and n represents the number of participles contained in the title.

By adopting the vector space model method, the title records and abstract records in the user information are represented by feature vectors, and the construction of the user interest model will be based on these feature vectors.

When considering the time factor, the feature vector weights of the title and abstract in the document can be uniformly expressed as follows:

$$\bar{w} = \frac{f(D_{ij}, D_i)}{|D_i|} \times \log\left(\frac{N}{df(D_{ij})}\right) \times e^{-t}, \quad (8)$$

where t is the difference (days) between the most recent access time and the current retrieval time of participles (including title participle and abstract participle). When considering the relevant matching degree factors between the user's retrieval history and the current retrieval, the relevant matching degree between the current retrieval q and the historical retrieval $V(V_t, V_s)$ is defined as follows:

$$\text{Sim}(q, V) = \frac{2}{3} \text{Sim}(q, V_t) + \frac{1}{3} \text{Sim}(q, V_s). \quad (9)$$

Among them, $\text{Sim}(q, V_t)$ represents the correlation matching degree between the current retrieval q and the title feature vector of the historical retrieval and $\text{Sim}(q, V_s)$ represents the correlation matching degree between the current retrieval q and the abstract feature vector of the historical retrieval. Their calculations are as follows:

$$\text{Sim}(q, V_s) = \frac{\sum_{i=1}^n t_{cq} \bar{w}}{\sum_{i=1}^n \bar{w}}. \quad (10)$$

In the formula, the numerator represents the sum of the weights after the time factor is introduced into the feature participle included in q and the denominator represents the

sum of the weights after the time factor is introduced into the feature participle of all document summaries.

The selected set of relevant feature vectors of the current search q is also called the user description file. The title and abstract feature vectors of the document are synthesized, the impact factor θ is introduced, and the title and abstract feature vectors in the document are uniformly expressed as follows:

$$V = V_t \times V_s \times \theta (\theta \notin (0, 1)). \quad (11)$$

The reason for introducing the impact factor is to consider that the feature vector in the document title can better represent the center of web page information and has a greater impact on users than the abstract. Furthermore, assuming that users have the same interest in each feature vector in the document, the average vector of all feature vectors in the same retrieval session can be expressed as follows:

$$S = \frac{1}{m} \sum_{i=1}^m w_i \times V. \quad (12)$$

Through the above analysis, the user description file is represented in the form of $U = (S_1, S_2, \dots, S_m)$, in which the representation of the user dictionary in U is $T = (T_1, T_2, \dots, T_n)$; through U and T , the eigenvector matrix can be represented as follows:

$$\begin{pmatrix} w(s_1)(t_1) & w(s_1)(t_2) & \dots & w(s_1)(t_n) \\ w(s_2)(t_1) & w(s_2)(t_2) & \dots & \\ \dots & \dots & \dots & \dots \\ w(s_m)(t_1) & w(s_m)(t_2) & \dots & w(s_m)(t_n) \end{pmatrix}. \quad (13)$$

Among them, w represents the weight value of the participle t_i in s_j ; if t_i is not in s_j , it is 0. It can be seen that the design of the user interest model is based on the eigenvector matrix.

The evaluation indicators of web page information retrieval and text mining generally include recall rate, precision rate, $F1$ value, and accuracy rate. These evaluation indicators are defined below. First, TP is the number of texts that belong to the category corresponding to a certain text and are classified into this category, TN means the number of texts that do not belong to the category corresponding to a certain text but are classified into this category; FP means the number of texts that originally belonged to the category corresponding to the text but were assigned to other categories; FN represents the number of texts that do not belong to the category corresponding to the text and are also classified into other categories.

4.2.1. Recall Rate. The recall rate refers to the ratio between the number of correctly classified documents in a specific text category and the number of all texts belonging to this category in the text collection, which is expressed as follows:

$$\text{Recall} = \frac{TP}{TP + FN}. \quad (14)$$

4.2.2. Precision. It represents the ratio between the number of documents that are correctly classified in a specific text category and the total number of documents corresponding to this category, which can be expressed as follows:

$$\text{Precision} = \frac{TP}{TP + FP}. \quad (15)$$

4.2.3. $F1$ Value. It represents a comprehensive evaluation of recall and precision, which can be expressed as follows:

$$F1 \text{ score} = 2 * \frac{\text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}}. \quad (16)$$

4.2.4. Accuracy Rate. It refers to the ratio of the number of correctly classified texts to the total number of samples in all text categories, which can be expressed as follows:

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN}. \quad (17)$$

Through the analysis of piano teaching methods through big data user interest modeling, the relevant comments on the application of information technology in traditional piano teaching, online piano teaching, and the teaching platform of blended learning mode were collected in the past month. There were mainly likes, innovations, and dislikes, and the process was cumbersome and other public opinion information website sources distribution, from news websites, blogs, or WeChat platforms. The relevant public opinion information of the teaching platform of the blended learning model was relatively large in information on news websites, blogs, and WeChat platforms, followed by the application of information technology in traditional piano teaching. It can be seen from this that the amount of public opinion information in the piano teaching of the blended learning model teaching platform and the application of information technology is relatively large, which requires the high attention of the relevant transportation departments and medical departments.

By searching the test results of the system in terms of public opinion source analysis, emotional color statistics and public opinion distribution, and then based on the recall rate, precision rate, $F1$ value, and accuracy rate and other indicators, the performance of web crawler and public opinion text data clustering algorithms was tested and analyzed.

Figure 4 shows the statistical distribution of sources of various public opinion categories in August 2019, which is mainly the result of statistical analysis of public opinion on the web page information on Tencent's website by applying the search system, and the cycle interval is one week. It can be seen from Figure 4 that the likes and creatives have a larger amount of information, while the dislikes and the cumbersome process are less than the former two. Therefore, like and innovative public opinion information should be highly concerned, and its potential factors and knowledge need to be further analyzed to provide valuable decision-making basis

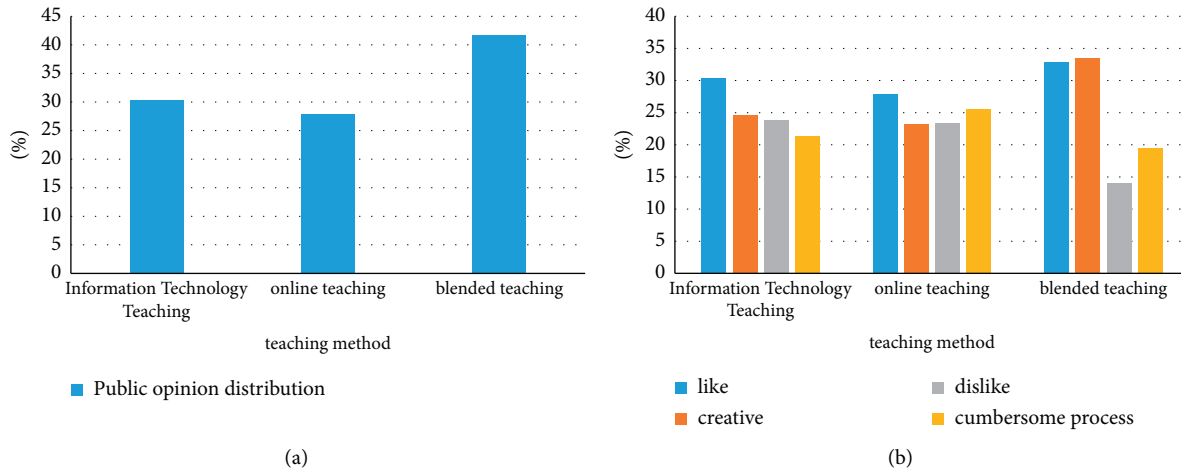


FIGURE 4: The distribution of public opinion in the last month and the distribution results of various types of public opinion.

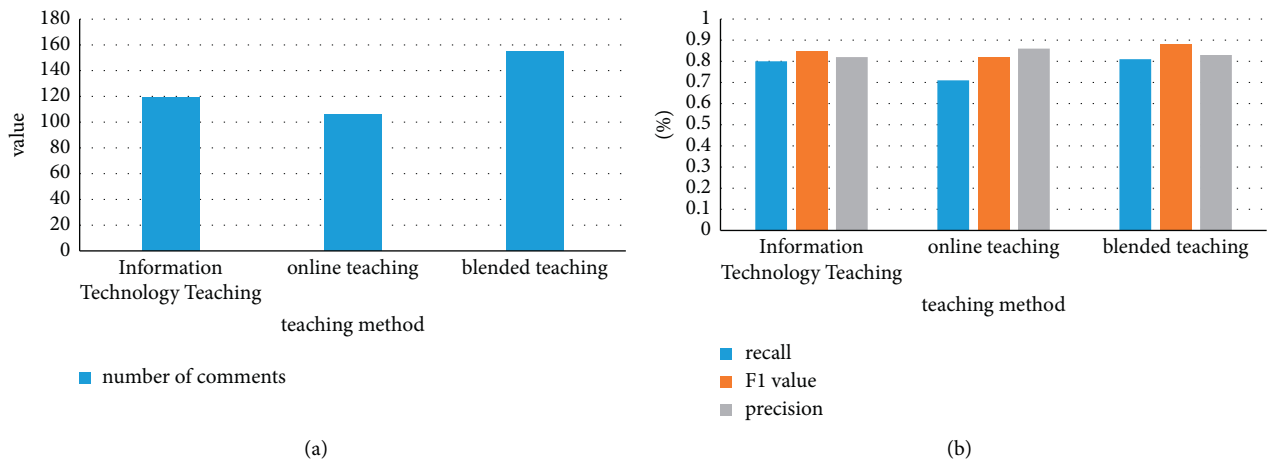


FIGURE 5: Public opinion category test results.

for multimedia technology piano teaching. By mining user interests through cluster analysis, in the face of different user preferences, user backgrounds, etc., users' potential search intentions are identified, and the information that users really need to achieve the purpose of testing is dig out.

4.3. Evaluation Results of Related Piano Teaching Methods.

Figure 5 shows the application of information technology in traditional piano teaching, online piano teaching, and blended learning mode teaching platform randomly grabbed 380 online comment pages from three teaching categories, statistics that these web pages are correctly classified into the corresponding industry category statistical distribution. As can be seen from Figure 5, the recall rate of the three piano teaching categories of the application of information technology in traditional piano teaching, online piano teaching, and blended learning mode teaching platform is above 71%, the precision rate is above 82%, and the $F1$ value is above 82%. Since the $F1$ value reflects the overall classification

effect of the categories, the application of information technology in traditional piano teaching and the mixed learning model teaching platform category has better overall effects, and the overall classification effects of the three piano teaching categories are not much different. The training sample set of information is readjusted and the appropriate initial clustering center is selected, which can improve the clustering accuracy of this category.

In order to further verify the performance of the cluster analysis system in the application of public opinion analysis, Figure 6 shows the performance analysis results of text classification based on the number of web pages, which are mainly based on the accuracy rate and recall rate for performance evaluation. In the figure, it can be seen that, with the increase of the number of web pages, the accuracy rate and recall rate of web page classification decrease. The reason is that the classification algorithm does not take into account the large amount of web page information. This is also an issue that needs to be further studied and analyzed in the next step.

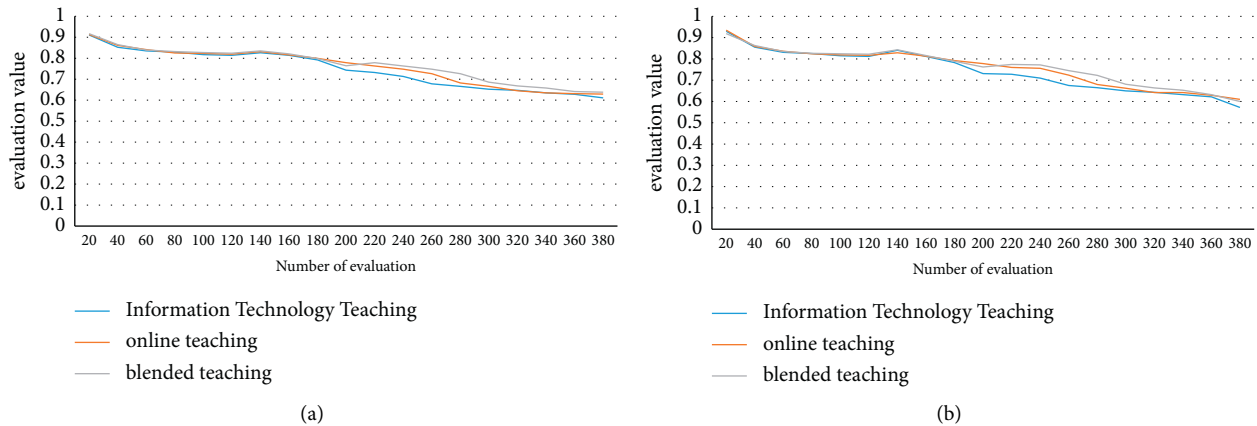


FIGURE 6: Evaluation results of precision and recall based on the web page text classification performance test. (a) Accuracy. (b) Recall.

5. Discussion

In order to change the excessive limitations in traditional teaching, through the combination of information technology and traditional piano teaching, this paper used information technology to perform video processing of piano teaching and used the Internet to integrate resources. By changing the original teaching method, urging students to practice, giving feedback in time, mastering the students' learning dynamics, finding and capturing them, and improving them, it had a good effect of supervising students' learning. In the process of combining piano teaching and digital technology, teachers are required to continuously broaden their horizons and students must constantly accept new things, so as to jointly promote the optimization of the teaching environment for solfeggio.

Affected by the epidemic, traditional teaching methods have been hindered. Online teaching is used to meet the learning needs of students. Taking advantage of the Internet, classes are suspended without stopping. This online teaching method synchronizes students' learning conditions. Through the blended teaching mode, the teaching activities are carried out with students as the leading role to achieve the teaching purpose. Through the questionnaire and cluster analysis, the user experience effect of using the three teaching methods was analyzed and the feasibility of multimedia technology online piano teaching was understood. By comparing the two survey methods, the credibility of the survey was improved and the feasibility of cluster analysis was also demonstrated.

6. Conclusions

Multimedia teaching has the characteristics of flexibility, nonlinear structure, and the combination of multiple senses, which can fully mobilize the enthusiasm and initiative of students. This paper investigated the status quo of college students' piano courses and understood the market of multimedia online teaching through students' demand for multimedia online piano courses and the feasibility analysis of the course. In order to ensure the reliability of the survey, cluster analysis was used at the same time. The system

extracted and analyzed the evaluation of multimedia upward piano teaching in the web page, and the performance of the system was evaluated through the accuracy rate and recall rate. Through the analysis of multimedia online piano teaching by the above two methods, the vast majority of students had a positive attitude towards this kind of multimedia online teaching. More than 60% of the students in the questionnaire believed that online teaching piano courses were needed to improve their academic performance, and there were good comments on the teaching mode of this method, so multimedia online piano teaching still had a certain market orientation.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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References

- [1] Y. T. Chen, C. H. Chen, S. Wu, and C. C. Lo, "A two-step Approach for Classifying music Genre on the Strength of AHP weighted musical features," *Mathematics*, vol. 7, no. 1, p. 19, 2018.
- [2] L. Li, "An online Arrangement method of difficult actions in competitive aerobics based on multimedia technology," *Security and Communication Networks*, vol. 2021, no. 3, pp. 1–12, 2021.
- [3] B. Yan, "Problems and Countermeasures in the process of applying multimedia technology in basketball teaching," *Wireless Communications and Mobile Computing*, vol. 2021, no. 24, pp. 1–8, 2021.
- [4] Y. Yuan and G. Wu, "Potentials and problems of teaching design thinking as massive open online courses in the Chinese context," *SN Social Sciences*, vol. 1, no. 6, pp. 143–227, 2021.

- [5] F. Neunhoffer and T. Teubner, "Between enthusiasm and refusal: a cluster analysis on consumer types and attitudes towards peer-to-peer sharing," *Journal of Consumer Behaviour*, vol. 17, no. 2, pp. 221–236, 2018.
- [6] C. Pang, "Simulation of student classroom recognition behavior based on cluster analysis and random forest algorithm," *Journal of Intelligent and Fuzzy Systems*, vol. 40, no. 2, pp. 2421–2431, 2021.
- [7] I. Muthahharah and A. Juhari, "A cluster Analysis with complete linkage and Ward's method for health service data in Makassar City," *Jurnal Varian*, vol. 4, no. 2, pp. 109–116, 2021.
- [8] X. Li, X. Zhan, and J. Jiang, "Comprehensive evaluation of Tourism development potential in Anhui Province based on cluster Analysis and factor Analysis," *Open Journal of Business and Management*, vol. 09, no. 02, pp. 866–876, 2021.
- [9] Y. Yuejue, S. Xinze, L. Bingyue, and W. Xiaoyuan, "Construct a teaching system combining image Linguistics and multimedia technology," *Wireless Communications and Mobile Computing*, vol. 2021, no. 1, pp. 1–11, 2021.
- [10] K. Lu, "Experimental research of English teaching management model based on personalized multimedia technology," *OALib*, vol. 07, no. 04, pp. 1–13, 2020.
- [11] Z. Zhou, Z. Qingshan, L. Dongyi, and T. Weihong, "Three-dimensional Reconstruction of Huizhou Landscape combined with multimedia technology and Geographic information system," *Mobile Information Systems*, vol. 2021, no. 5, pp. 1–13, 2021.
- [12] N. Martin, R. Priya, and F. Smarandache, "Decision making on teachers' adaptation to Cybergogy in Saturated interval-valued Refined Neutrosophic overset/underset/offset environment," *International Journal of Neutrosophic Science*, vol. 12, no. 2, pp. 58–70, 2020.
- [13] S. Sun, "Evaluation of potential correlation of piano teaching using Edge-Enabled data and Machine learning," *Mobile Information Systems*, vol. 2021, no. 5, pp. 1–11, 2021.
- [14] M. Khalifa and A. N. A. Al-Masri, "An optimal teaching and learning based optimization with Multi-key Homomorphic Encryption for image Security," *Journal of Cybersecurity and Information Management*, vol. 7, no. 2, pp. 77–84, 2021.
- [15] W. Fu, J. Leung, Y. Wang et al., "Random network calculation under the background of 5G network in remote piano music video teaching application," *Turkish Journal of Gastroenterology: The Official Journal of Turkish Society of Gastroenterology*, vol. 32, no. 1, pp. 1–10, 2021.
- [16] T. Rao, "Analysis on the Ideological and Political construction of colleges piano teaching in the new Era," *Region-Educational Research and Reviews*, vol. 2, no. 4, pp. 20–24, 2020.
- [17] K. Leahy, C. Gallagher, P. O'Donovan, and D. T. O'Sullivan, "Cluster Analysis of Wind Turbine Alarms for characterising and Classifying Stoppages," *IET Renewable Power Generation*, vol. 12, no. 10, pp. 1146–1154, 2018.
- [18] Y. Kozu, Y. Kurosawa, S. Yamada et al., "Cluster analysis identifies a pathophysiologically distinct subpopulation with increased serum leptin levels and severe obstructive sleep apnea," *Sleep and Breathing*, vol. 25, no. 2, pp. 767–776, 2021.
- [19] K. Tejaswini, S. Manukonda, and P. Rao, "Cluster analysis studies in rice (*Oryza sativa* L.) using wards minimum variance method," *The Open Agriculture Journal*, vol. 4, no. 9, pp. 129–139, 2021.
- [20] C. Ekhart, F. van Hunsel, E. van Puijenbroek et al., "Post-marketing Safety Profile of Vortioxetine using a cluster Analysis and a Disproportionality analysis of Global Adverse event reports," *Drug Safety*, vol. 45, no. 2, pp. 145–153, 2022.
- [21] Z. Sheikhhosseini, N. Mirzaei, R. Heidari, and H. Monkarezi, "Delineation of potential seismic sources using weighted K-means cluster analysis and particle swarm optimization (PSO)," *Acta Geophysica*, vol. 69, no. 6, pp. 2161–2172, 2021.
- [22] A. Wong, C. C. S. Lai, A. K. Y. Shum, and P. S. F. Yip, "From the hidden to the obvious: classification of primary and secondary school student suicides using cluster analysis," *BMC Public Health*, vol. 22, no. 1, pp. 693–697, 2022.