International Journal of Computer Information Systems and Industrial Management Applications
ISSN 2150-7988 Volume 17 (2025) pp. 1-17

https://doi.org/10.70917/ijcisim-2025-0248
Article

Construction of Intelligent Teaching Platform for Dance Education and Teaching Data Analysis

Miao Zhou *

College of Music and Dance, Hunan First Normal University, Changsha, Hunan, 410205, China; zhoumiao20210909@126.com

Abstract: Traditional teaching methods are limited to time and place, and the performance of dance teaching resource management is poor. In this paper, with the help of development software and hardware, the physical structure of the dance teaching system, functional modules, network structure, database design, and from the function and performance of the two aspects to test the system's operating status, but also for the system formally put into use to lay a solid foundation. In order to further explore the actual teaching effect of the system, the corresponding experimental program is drawn up, and the teaching application effect of the dance teaching system is studied under the theoretical guidance of the experimental program. The experimental group and the control group show a 0.05 level of significance in music rhythm, and the average value of the experimental group is 21.36 higher than that of the control group, which is 17.42, and the other dimensions are the same. It can be concluded that the system in this paper has a higher priority in dance education and teaching compared to traditional teaching, and it also verifies the effectiveness of the teaching application of the dance teaching system.

Keywords: dance teaching system; physical structure; network structure; database

1. Introduction

Traditional dance teaching is based on oral teaching, teachers and students through face-to-face imitation, feedback, error correction, practice four links to complete the transfer of dance movements and skills [1]. The traditional dance teaching method is judged by the teacher's personal visual perception, the time for students to receive guidance is limited, the movement normative development takes longer, and the teaching effect is more inefficient [2-3]. With the advent of the 5G era, artificial intelligence and big data will also bring innovation in the depth and breadth of education informatization. In the rapid development of network technology, numerous teaching software such as recording software, music learning software, piano accompaniment software and other teaching software are quietly changing the education and teaching mode and influencing the concept of teaching [4]. How to give full play to the advantages of information technology, the rational use of teaching software, the integration of information technology and intelligence into dance education and teaching, to enhance and optimize the dance teaching classroom, has been the direction of teachers' thinking and exploration [5-6].

Since artificial intelligence entered the field of education, scholars have been exploring the role of artificial intelligence technology in teaching, and scholars at home and abroad have carried out a large number of theoretical and experimental studies, however, no consensus has yet been reached on the effectiveness of artificial intelligence in teaching. For example, Fang, Y et al. (2019) conducted a meta-analysis on the learning effectiveness of ALEKS, this study showed that the learning effect of students using ALEKS for a long period of time and the traditional classroom remained the same, but in no more than 3 months of learning, ALEKS could effectively improve the learning effect of students [7]. Currently, some researchers have begun to reform the dance teaching model by incorporating information intelligence technology. For example, Tanaka, F et al. (2005) studied a dance studio program with interactive robots (QRIO) and found that QRIO robots could imitate target movements in real time and were able to form peer-to-peer interactions with the dance objects [8]. Xu, L et al. (2025) developed a Dance Skills Teaching, Evaluation, and Visual Feedback (DSTEVF) system based on AI technology, and the system was able to feedback students' movement practice data and analyze the results in comparison with standard dance movements, which significantly improved students' dance skills and self-efficacy [9]. Lu, T and Xiao, Y (2025) combined deep learning (DL) algorithms and wearable devices to build an intelligent system for dance teaching, which collects data such as movement angle, speed, and heart rate through wearable sensors, and then inputs these into the DL algorithm. These are then fed into the DL algorithm to realize real-time feedback on dance training [10]. However, the above proposed technologies either require the construction of complex dance training spaces, or the use of advanced and expensive sensor networks to collect students' 3D coordinates and video images, and also require the use of specialized infrared tracking devices, which have more limitations on the equipment and the conditions of use, making it difficult to promote on a wide scale.

With the rapid development of artificial intelligence technology, posture estimation technology and movement recognition technology provide a new direction for dance teaching. In dance teaching scenarios, 3D posture estimation technology can accurately predict the coordinates of key points of the human body, describe a standard dance movement based on these key point coordinates, and derive the differences between students' movements and teachers' movements through comparative analysis, so as to provide guidance [11-13]. For example, Deb, S et al. (2018) experimented with the use of a single camera instead of the expensive Microsoft Kinect motion capture device, while leveraging the power of DL algorithms to optimize pose estimation, aiming to open up a new paradigm of dance learning that is capable of being interactive and, at the same time, cost-effective [14]. Wang, J and Chen, X (2024) proposed an innovative 3D dance pose estimation algorithm with the help of virtual reality (VR) technology and DL algorithm, and the experimental validation showed that it could significantly improve the accuracy and real-time feedback ability of the dance movement analysis, and the research results provided theoretical and technical support for dance teaching [15]. Zhao, Y and Yang, H (2023) proposed a dance movement recognition model based on hybrid feature-based human motion model reconstruction technique and convolutional operation, which has the advantages of high accuracy and low error and can help optimize the effect of dance teaching [16]. Hu, X and Ahuja, N (2021) proposed a Hierarchical Framework for Dance Video Recognition (HDVR) consisting of low-level information (raw images), mid-level information (body poses and motions), and high-level information (dance type), and it was found that HDVR extracts the body part motions and from this, accurately infers the dance type [17]. However, the above pose estimation techniques can only detect simple human action poses, and for complex actions, human 3D pose estimation techniques may generate human key point coordinates that do not actually exist, along with challenges such as timeliness and occlusion factors [18-20].

In the dance teaching scenario, the motion recognition technology can capture the dancer's movement data in real time and compare it with the standard dance movements to find the posture deviation. Meanwhile, in the dance examination scenario, motion recognition technology is used for exam grading. By comparing the key point data (e.g., limb angle and trajectory) of the candidate's movements with the standard template, the system can generate an objective scoring report to assist the examiner in making a comprehensive evaluation [21-22]. For example, Qiao, L and Shen, Q (2021) utilized a neural network algorithm to transform and process human movements in dance video images, combined with a feature distribution matrix and Kalman filter to achieve recognition and detection of dance movements, which improved the recognition rate of dance movements and shortened the recognition time [23]. Zhang, L et al. (2022) utilized an IoT-based Internet-based Kinect haptic camera to capture depth images and acquire 20 3D points of human skeletal structure, and designed and developed a sports dance management information system, which can provide relevant information for the training management of sports dancers, thus improving the efficiency and management level of dance teaching [24]. Sumi, M (2025) used machine learning techniques in dance movement recognition to to construct a movement classification model, which is able to accurately capture and analyze the human body's postural information, enable learners to better understand and simulate dance movements, and enhance the expressiveness and authenticity of AI robots in dance interactions [25]. In the field of dance exam scoring, automatic assessment and scoring of dance by AI methods eliminates subjective bias and has the advantages of being fast and standardized, making the scoring results more objective and fair [26].

This paper carries out the design and realization of the dance teaching system with the technical support of development software and hardware. It includes system physical structure, system functional modules, system network structure, system database, and then builds a system test environment to test the operational status and feasibility of the dance teaching system from the perspective of system function and performance. In order to further study the performance of the system after it is formally put into teaching, reference to the existing research results and information, design the actual teaching effect research program of the dance teaching system, according to the operation process of the program, explore and analyze the effect of the system's teaching application, aiming at proving the value of the system's teaching and application effectiveness.

2. Dance Teaching System

2.1. Overall system design

2.1.1. Physical structure design

System architecture as shown in Figure 1, B/S system structure is the browser/server architecture, is a more modern software system construction architecture [27]. In the traditional C / S architecture can not meet the existing Internet requirements of multiple interconnections, global network openness and the trend of information globalization, B / S structure is slowly becoming popular, the emergence of this architectural system subverted people's understanding of the traditional software structure, and provide a new way of thinking to software developers, with a more innovative structure.

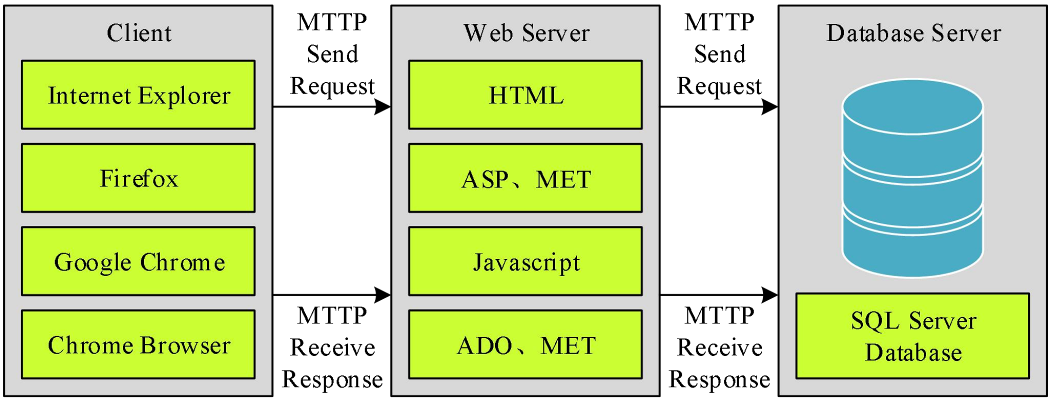


Figure 1. System architecture.

2.1.2. System functional design

The dance teaching system designed in this paper is shown in Fig. 2. This system adopts a four-layer top-level design scheme in accomplishing its functions. The first layer is mainly the user layer, which contains the teacher's end user, the student's end user and the administrator's end user. It should be noted that each end user in this is for a large group, each person in that group has a corresponding login account and password, when many people are online at the same time, whether it will produce online system crash phenomenon, which requires a powerful backend server as a supporting force. The second layer is mainly the process of logging in the account and password of all kinds of users, as well as the corresponding personal information verification; the third layer is mainly designed and developed for the core processes in the dance system of online distance learning, such as the development of the audio and video subsystems, the compression and decompression of audio and video, and the synchronization of audio and video playback, and so on; the fourth layer is the process of matching the user's logged-in information with the information in the database, and then complete the process of aligning each other. The fourth layer is to match the user login information with the information in the database and then complete the mutual alignment process.

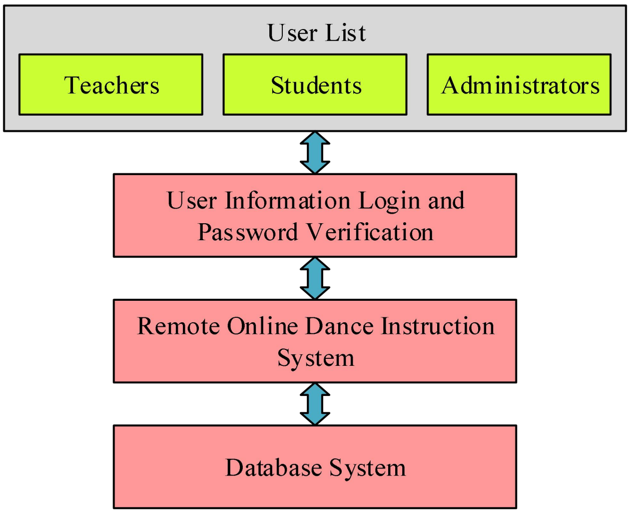


Figure 2. Dance teaching system.

2.1.3. Network architecture design

The network architecture design covers many real-life multi-faceted aspects such as the types of interfaces used by users, the network protocols used and the types of network cabling that may be used. The network architecture of the dance teaching system is shown in Figure 3, where a two-tier structure is represented at a glance, with the top tier containing the database server, application server and clients; and a tier containing the firewall, numerous clients and the network structure.

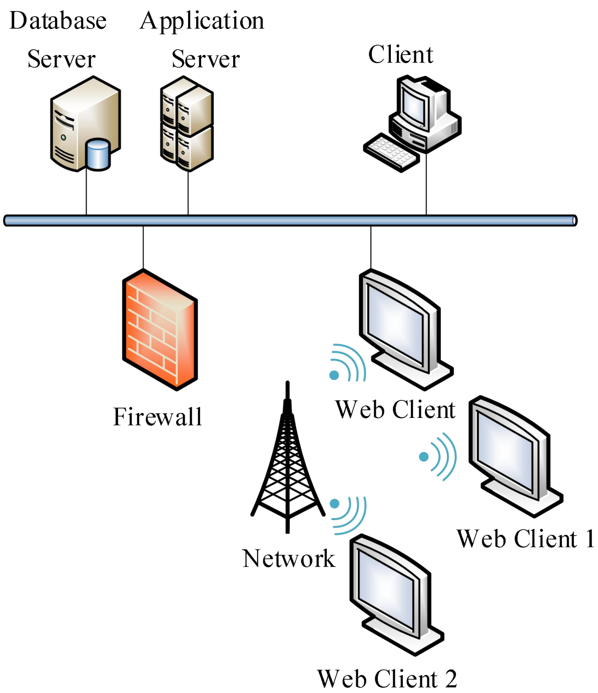


Figure 3. Network architecture of the dance teaching system.

2.1.4. System database design

The system E-R diagram is the entity description of the system, which mainly provides the entity-type representation of the system, attribute representation method and linkage method, these three methods are proposed mainly for describing the concept of the entity model of the virtual world of this system in the real world, and the E-R relationship mapping of the core of the system is shown in Fig. 4. The teacher entity mainly includes: teacher number, name, gender, title, login password and other related attributes; the student entity mainly includes: user name, course selection information, the student who started the course, login password, major, department, research direction, participation in the project and other related information; the administrator entity mainly includes a user name and login password related attributes of this teaching system mainly includes: video information, video name, video attributes, story reflection theme, dance style, dance name, etc.

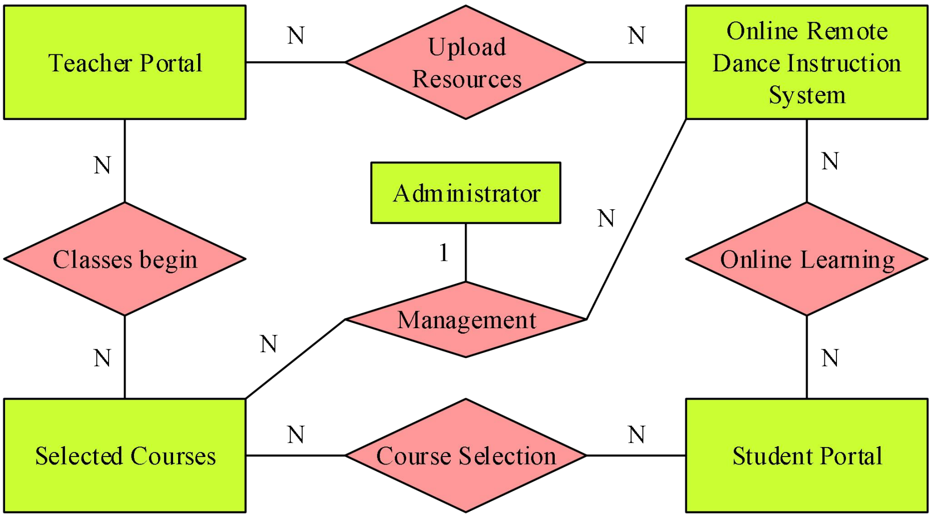


Figure 4. The E-R relationship graph at the core of the system.

2.2. Dance teaching system realization

2.2.1 Development environment

(1) Software development environment

The main software development environment included is Visual studio 2018 provided by Microsoft combined with the HTML page and .aspx page built on the IIS server in the Web systemizer, and then ADO.NET technology provided by Microsoft combined with the dynamic link database system SQL Server 2014 is used to process and obtain data in real time.

(2) Hardware development environment

The distribution of hardware development environment is a core part of the network online system development, a variety of functions on the teacher's end, the student's end, as well as video uploading compression and decompression and many other operations must be completed through the hardware system operation. The hardware system includes functions such as storing video, compressing video, decompressing video, capturing video, recording video, processing video online and displaying video in real time.

2.2.2. Video teaching subsystem realization

(1) System login interface

The initial step in the dance teaching system is to ask the user to log in to the system, which is mainly oriented to the teacher's side and the student's side, while the administrator can log in and out freely according to his/her own set account. Teachers do not need to register (in fact, the administrator has already entered all the teachers' information into the system, and preset the account number and login password for each teacher), and they can directly log in the system to complete the next operation with their teacher's work number and initial password (six zeros) automatically.

(2) Uploading teaching videos

The system supports the uploading of multiple video files at the same time, which can greatly facilitate the operation of teachers and improve efficiency. First, click the “Click to Upload” button to browse the location of the video file to be uploaded on your computer, and then select the corresponding video to be uploaded.

2.2.3. Teacher-student interaction subsystem realization

(1) Electronic whiteboard function realization

The design of this function is divided into two main blocks, the background board is white and the background board is black, choosing the former means that the marker should be black, while choosing the latter means that the marker should be a bright color similar to white, etc., in the white board can be explained to the students on a certain issue accordingly, playing a role similar to the role of the blackboard in the classroom teaching, which in the right side of the interface, including the opening of the whiteboard, the closing of the whiteboard, replacing the whiteboard On the right side of the interface, there are four functions: opening the whiteboard, closing the whiteboard, changing the whiteboard background and automatically clearing the whiteboard notes.

(2) File Transfer Function Implementation

The realization of file transfer function can actually be viewed as similar to the content mechanism of the file transfer interface, where these cumbersome interfaces for transferring multiple files are simplified into a single file transfer interface, which seems to be simple and hassle-free, and improves the efficiency of the office.

2.2.4. Control management subsystem realization

(1) Control management of teaching courses

Control management sub-system implementation of the more core teaching-related activities, on which the teacher of certain courses need to be strictly in accordance with the year's syllabus to implement the opening requirements need to be subject to the syllabus of the allocation of the interface can also be selected from the drop-down menu of the student's academic year, colleges, majors, the nature of the course and other information, to locate the course selection more accurately.

(2) Student Evaluation Control Management

The interface contains information about the campus of the class, the evaluation score of the teacher, the number of students participating in the evaluation, the number of effective students participating in the evaluation, the weighted average score of all the courses of the teacher and the summary of students' comments, and in the future, more content can be added according to the students' or teachers' reflections in order to expand the performance, better serve the majority of teachers and students of the university, and lay a foundation for the development of a better distance learning.

2.3. System testing

This subsection focuses on the application of the designed test scheme to the dance teaching system, through the practical application of the test scheme in both the functional and performance testing phases of this system, and the analysis of the system testing results. The details are as follows:

2.3.1. Test environment

Before testing the system, first of all, it should be clear that the test execution environment, the system test server and the client side of the software environment and hardware environment, respectively, as shown in Table 1 to Table 2.

Table 1. System test software environment.

Software environment	Server	Client
Operating system	CentOS release 6.8	Windows 10, Ubuntu
Database	MySQL 5.8	—
Web server	Tomcat 6.0	—
Browser	—	Chrome

Table 2. The system tests the hardware environment.

Hardware environment	Server	Client
CPU	Intel Xeon E312xx 2.9GHz	Intel(R) Core(TM) i5-4600U CPU @ 2.70 GHz 2.80 GHz
Memory	MySQL 5.8	16GB
Hard disk	Tomcat 6.0	512GB

2.3.2. Functional testing

The home page of the system in addition to play a role in the navigation of other systems, but also provides a global search, user information query interface, involving the downstream system is very much; while the online course is mainly for the creation of the course, management and maintenance of related information, processes and data management more. In the early stage of development, the quality of the code will affect the entire system functions and code maintainability, so the unit test for the system is more exhaustive, and in the late stage of development, the combination of various sub-modules together for the entire system functionality of the test is also indispensable, the results of the system test will be the end-user experience caused by the impact of a very large. Next for the system function test, to the system home page as an example.

(1) Home page

As the provider of the user information interface, whether the interface functions properly or not directly affects all the downstream subsystems, the unit test cases for the establishment of the interface are as follows:

Interface RtxUser Manager test cases are shown in Table 3. The interface mainly realizes the query operation of the database, and it needs to consider a variety of query conditions to ensure the stability and reliability of the interface function. In the implementation of the interface unit test, to consider the query conditions for null, valid conditions, invalid conditions, String for example, if the query parameter is the department, then the test needs to be constructed parameters for null, empty string, valid department name and invalid department name, other parameters are similar.

Table 3. Interface RtxUser Manager test case.

Method	Function	Input/Output
queryRtxUserOne	Query the specific information of RtxUser based on the query conditions	RtxUserCondition /List<RtxUser>
queryRtxUserList	Query the specific information in the list based on the query conditions	List<RtxUserCondition> /Map<String, RtxUser>
queryDepList	Query a certain level based on the department name of a certain level The name of the department	DepCondition /List<String>
queryRtxUserAvatar	Query the path of the user's avatar photo based on the Rtx account	String / String
queryRtxUserByRtxId	Single-user query interface, input a single Rtx account, and return the specific information of the user	String / RtxUser
isRtxUserExist	Whether a single user exists or not, true indicates existence and false indicates non-existence	String / Boolean
queryRtxUserByDep	Query all employees under the precise first-level department	String / List<RtxUser>
queryRtxUserByRtxId	Multiple user query interfaces, input multiple rtx accounts, and batch return specific user information	List<String> / Map<String,RtxUser>

2.3.3. Performance testing

Performance testing is technically more complex than functional testing. In the old days, performance testing was only an optional part of the project testing process. However, with the continuous development of testing technology, the establishment of a specialized performance testing team has gradually begun to pay attention to performance testing, and the performance test is independent.

The results of the home page pressure test are shown in Table 4, the results of the home page search pressure test are shown in Table 5, and the results of the online course video playback pressure test are shown in Table 6. According to the following table, we can see that as the number of concurrent users increases, the average response time of the home page, home page search and online course video viewing are all at the millisecond level, the throughput is kept stable, far from reaching the peak, and all the requests return the correct results to satisfy the performance requirements, and the system is more reliable and better serves the teaching of physical education and dance in colleges and universities.

Table 4. The pressure test results of the home page.

Label	Samples	Average/ms	90%/ms	Min/ms	Max/ms	Error%	Throughput/sec	KB/sec
Home page	100	10	50	5	108	0	488	680
	200	5	35	5	43	0	262	700
	300	11	70	5	109	0	560	610
	400	1	79	5	135	0	445	684
	500	2	111	5	97	0	745	813
	600	11	21	5	59	0	740	828
	700	11	94	5	157	0	351	872
	800	6	10	5	94	0	302	1000
	900	5	32	5	42	0	305	692
	1000	12	68	5	163	0	786	880

Table 5. Search for the stress test results on the home page.

Label	Samples	Average/ms	90%/ms	Min/ms	Max/ms	Error%	Throughput/sec	KB/sec
Home Page Search	100	4	34	5	31	0	1467	1012
	200	2	26	5	30	0	959	1552
	300	4	20	5	24	0	1009	1690
	400	3	25	5	43	0	1564	1610
	500	4	25	5	28	0	929	1156
	600	2	29	5	24	0	1368	1552
	700	4	28	5	29	0	1216	1524
	800	2	34	5	28	0	1323	1512
	900	5	33	5	48	0	1031	1497
	1000	2	22	5	42	0	1550	1418

Table 6. Play the pressure test results of the online course video.

Label	Samples	Average/ms	90%/ms	Min/ms	Max/ms	Error%	Throughput/sec	KB/sec
Video playback	100	89	91	5	265	0	372	379
	200	167	219	5	896	0	384	423
	300	199	552	5	930	0	389	424
	400	353	552	5	1006	0	441	448
	500	359	711	5	1366	0	454	495
	600	412	712	5	1487	0	486	499
	700	427	790	5	1543	0	504	542
	800	562	1077	5	1551	0	506	559
	900	601	1122	5	1554	0	514	565
	1000	638	1217	5	1598	0	592	661

The results of the home page (extranet) pressure test are shown in Table 7, the results of the home page search (extranet) pressure test are shown in Table 8, and the results of the online course video playback (extranet) pressure test are shown in Table 9. From the above test data, it can be seen that as the number of concurrent users increases, the average response time of the system increases, and the throughput slowly decreases, especially when the number of concurrent users is 300, it decreases faster. Especially in the home page search page, when the number of concurrent users reaches 1000, there is a request timeout and return error (0.12%), indicating that in the case of poor network, the search section can no longer support more concurrent users.

Table 7. The pressure test results on the home page (external network).

Label	Samples	Average/ms	90%/ms	Min/ms	Max/ms	Error%	Throughput/sec	KB/sec
Home page	100	614	684	51	583	0	86	167
	200	891	1708	54	1011	0	88	175
	300	1133	3675	80	1442	0	97	121
	400	2917	3757	84	1742	0	99	152
	500	3197	6128	88	2910	0	115	152
	600	3319	6382	95	3753	0	123	169
	700	3713	6730	97	5823	0	123	177

	800	4039	6787	102	6039	0	127	146
	900	4046	7200	111	6089	0	131	144
	1000	4156	7741	116	8432	0	142	136

Table 8. Search for the stress test results on the homepage (external network).

Label	Samples	Average/ms	90%/ms	Min/ms	Max/ms	Error%	Throughput/sec	KB/sec
Home Page Search	100	580	736	99	960	0	94	171
	200	1988	2341	96	2918	0	164	42
	300	2153	2438	106	3820	0	77	170
	400	2188	4051	93	6000	0	85	118
	500	2582	5356	60	6581	0	109	62
	600	3289	6511	141	8178	0	102	113
	700	4140	7526	80	8222	0	135	147
	800	4462	8172	144	12140	0	124	137
	900	4638	8194	98	12253	0	84	41
	1000	5227	9073	150	16691	0.12	145	68

Table 9. Stress test results of online course video playback (external network).

Label	Samples	Average/ms	90%/ms	Min/ms	Max/ms	Error%	Throughput/sec	KB/sec
Video playback	100	515	551	83	634	0	128	126
	200	777	1295	71	783	0	101	136
	300	835	2007	106	2240	0	165	112
	400	908	3064	97	2959	0	148	194
	500	1626	3168	83	3247	0	131	117
	600	2114	4024	86	4104	0	117	140
	700	2592	4637	73	5935	0	90	107
	800	2707	6205	83	6241	0	93	121
	900	3535	6549	86	7249	0	97	117
	1000	3626	7382	96	9010	0	122	187

3. Experimental program of the system in the physical education dance class of a general university

3.1. Subjects of study

The research object is the effect of this paper's system in the physical education dance class in general colleges and universities, and the experimental subjects are the students of a university's sophomore public class specializing in physical education dance.

3.2. Research methodology

3.2.1. Questionnaire method

Drawing on validity and reliability questionnaire materials, survey questions were designed for students taking physical education dance classes in general education colleges and universities. In addition to the questions in the questionnaire, which were designed to address the motivation and attitude toward physical activity, the questions were also adapted to the aspects of physical education and dance. Questionnaire validity testing is mainly to select the questionnaire that has passed the validity of the questionnaire, adjusted to meet the actual situation of the problem, and then carry out the expert validity of the survey, after the evaluation of 10 professors, 5 associate professors, and 5 lecturers, the two questionnaires have a high degree of validity, and can be surveyed to distribute and recover. The questionnaire survey used retesting method to detect the reliability of the questionnaire, the experimental phase of the questionnaire was issued twice, the beginning of the experiment and the end of the experiment. The first class on-site distribution of 40 questionnaires immediately after the recovery, an interval of 3 months, at the end of the examination on-site for the second paper distribution and recovery. This facilitated the completeness of data collection and the study questionnaire had a validity difference of 100%. After organizing the data for correlation coefficient test R value is 0.866, the questionnaire data reliability meets the available standards.

3.2.2. Mathematical and statistical methods

The collected data were organized and classified by using Excel to list the tables and classifications of several indicators. The mean, standard deviation and median of the experimental data of the four indicators obtained from the experiment were analyzed by using SPSS21.0 statistical software. Use ANOVA to determine the physical fitness of the experimental and control groups. Whether there are differences in the data of physical activity motivation, exercise attitude, and physical dance skills before and after the experiment, and the size of the differences. Conclusions were then drawn from the data and experimental discussions. Tests to collect data, and then add the data of physical education and dance skills performance after the experiment to test again. The four indicators were analyzed for differences before and after the experiment in the control class, differences before and after the experiment in the experimental class, and differences in the same indicator in both classes. The independent samples t-test was applied after the experiment to analyze the physical dance in both classes.

3.2.3. Experimental methods

Name of experiment: the effect of dance teaching system in the physical education dance class of general colleges and universities.

Purpose of the experiment: the control class uses the traditional teaching mode, the experimental class uses the dance teaching system, after the experiment to explore the four indicators before and after the experiment of the different teaching methods: physical fitness, motivation to exercise, attitude to exercise,

Changes in motor skills. Compare the difference in teaching effect between the dance teaching system and the traditional teaching mode, and analyze the effect of flipped classroom in sports dance class in colleges and universities.

Experimental time: May-August 2023 to conduct the practice of the experiment.

Experimental place: the gymnasium form room in the campus of a university's financial institution.

Teaching content: physical education dance textbook of a university.

Experimental subjects: a university sports dance public class, two classes of girls totaling 40 people.

Experimental test items: physical fitness, exercise motivation, exercise attitude, physical dance skills.

3.3. Experimental program

3.3.1. Experimental control

(1) The two classes have the same teaching content, the same length of class time, course objectives, and the same class location.

(2) Because the difference in students' quality and ability can cause a large impact and because of the concern about the large difference in the level of the two classes before the experiment, this experiment was conducted before the beginning of the experiment to test the students' physical fitness, attitude toward exercise, and motivation for exercise before the experiment.

(3) In order to minimize the impact of the experiment, both classes were taught by the same teacher. And in order to avoid teachers have "impression points" concept, selected two new classes, teachers and students do not know each other.

(4) Scoring criteria: according to the student learning situation and feedback evaluation summarized for the adjustment of teaching, skills scoring as shown in Table 10.

Table 10. Skill scoring.

Scoring items	Scoring index				Scoring subject
Basic framework (20)	Image and temperament (5)	Standing posture (5)	Head (5)	Back (5)	Teacher
Technology combination (40)	Motion integrity (10)	Fluency of movement (10)	Strength and stability (20)		
Music Festival Tribute (30)	Rhythm accuracy (30)				
Expressiveness (10)	Facial expressions (5)	Dance costumes and accessories (5)			

3.3.2. Experimental testing

Experimental steps: experimental hypothesis, pre-test, experimental intervention, post-test, data analysis.

(1) The hypothesis of the experiment: the experimental class is better than the control class in three aspects: learning effect, internal motivation, and exercise attitude.

(2) The pre-test of the experiment: the two classes were uniformly given the Sports Motivation Scale and the Exercise Attitude Scale in the first class and recovered on the spot, as well as the data of the three indicators of the test of 50 meters, one-minute sit-ups and standing long jumps, and independent samples t-tests were conducted on the three data of the above two classes respectively to analyze whether there were large differences between the students of the two classes prior to the experiment, and whether there was a need to adjust the personnel of each class and other influencing factors.

(3) Implementation of the experiment: the experimental class used the flipped classroom to teach physical education dance, and the content of the teaching was: the basic step of physical education dance and the basic combination of physical education dance.

(4) Post-testing of the experiment: the two classes were tested on the basic steps and combinations of physical education dance, and the teachers were all college physical education dance teachers and had the qualification of physical education dance referee, and the average score of the three teachers was taken for the test (see Scoring Table 10 for the scoring criteria). Finally, two scales were distributed to the two classes and recovered on the spot, as well as the data of the three indicators of physical fitness, and the data of the two classes were subjected to an independent sample t-test to analyze the changes and effects of the data. Then the data of the control class and the experimental class before and after their respective experiments were subjected to paired t-tests to analyze the changes and effects of the data.

4. Experimental results and analysis

4.1. Physical fitness results

4.1.1. Analysis of Experimental Pre-test Data

The physical quality of the two groups of students were tested before the experiment, through the students' flexibility, speed and explosive force, endurance and other results of statistics and analysis, physical quality pre-test data analysis shown in Table 11. It can be seen that the experimental group and the control group of students of 50m, 800m, seated forward bending three physical quality achievement mean test difference is small. The three P-values are 0.507, 0.246 and 0.545 respectively, and the P-values are all greater than 0.05, with no significant difference. In this experiment, there is no significant difference between the experimental and control groups of students in terms of physical fitness, and the two groups are comparable.

Table 11. Analysis of pre-test data for physical fitness.

Physical fitness indicators	Experimental Group		Control group		T-value	P-value
	Mean	SD	Mean	SD		
50m	8.06	0.09	8.08	0.16	-0.628	0.507
800m	214.14	10.06	226.39	8.37	-1.037	0.246
Sit and reach	21.26	2.49	21.11	2.31	0.522	0.545

4.1.2. Analysis of Experimental Pre-test Data

After the March teaching experiment intervention, the same method mentioned above was taken to analyze the post side data of physical fitness of the two groups of students, and the analysis of the data of physical fitness post-test is shown in Table 12. By analyzing the data in the table, it can be seen that the P-values of the two groups of students in the three items are 0.521, 0.286, and 0.585, respectively, and the P-values are greater than 0.05, and there is also no significant difference, which indicates that there is no big difference in the degree of influence of the dance teaching system on the students' physical fitness.

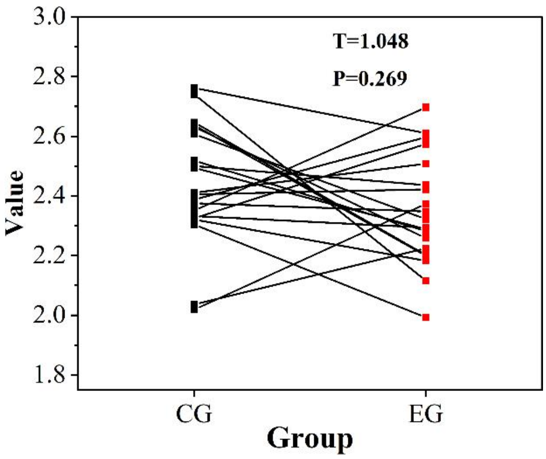
Table 12. Analysis of post-test data on physical fitness

Physical fitness indicators	Experimental Group		Control group		T-value	P-value
	Mean	SD	Mean	SD		
50m	8.09	0.14	8.12	0.26	-0.654	0.521
800m	214.17	10.16	226.86	8.67	-1.067	0.286
Sit and reach	21.48	2.64	21.01	2.57	0.537	0.585

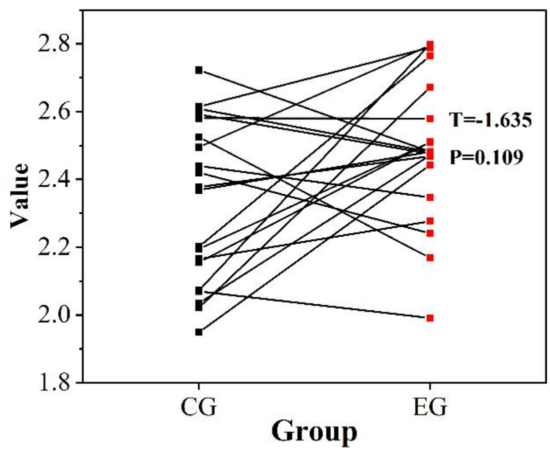
4.2. Exercise attitude results

4.2.1. Analysis of Experimental Pre-test Data

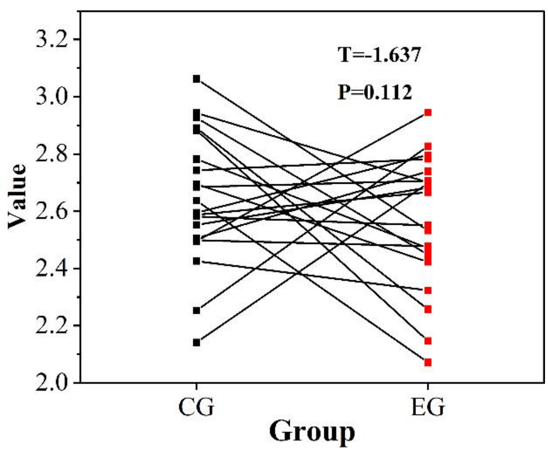
Before the experiment, students in the experimental group and the control group were tested for their exercise attitudes, and the data were subjected to independent samples using the t-test, and the analysis of the exercise attitudes of students in the control group and the experimental group is shown in Figure 5, in which (a)~(c) denote the sense of cooperation, communication, and teamwork, respectively. The p-values of the two groups of students for the sense of cooperation, communication and teamwork were 0.278, 0.100 and 0.106 respectively, all of which did not show significant differences ($p>0.05$). This can indicate that the students in the control class and the experimental class are at the same level in terms of exercise attitude, and the two groups are comparable.



(a) Sense of cooperation



(b) Communication and exchange

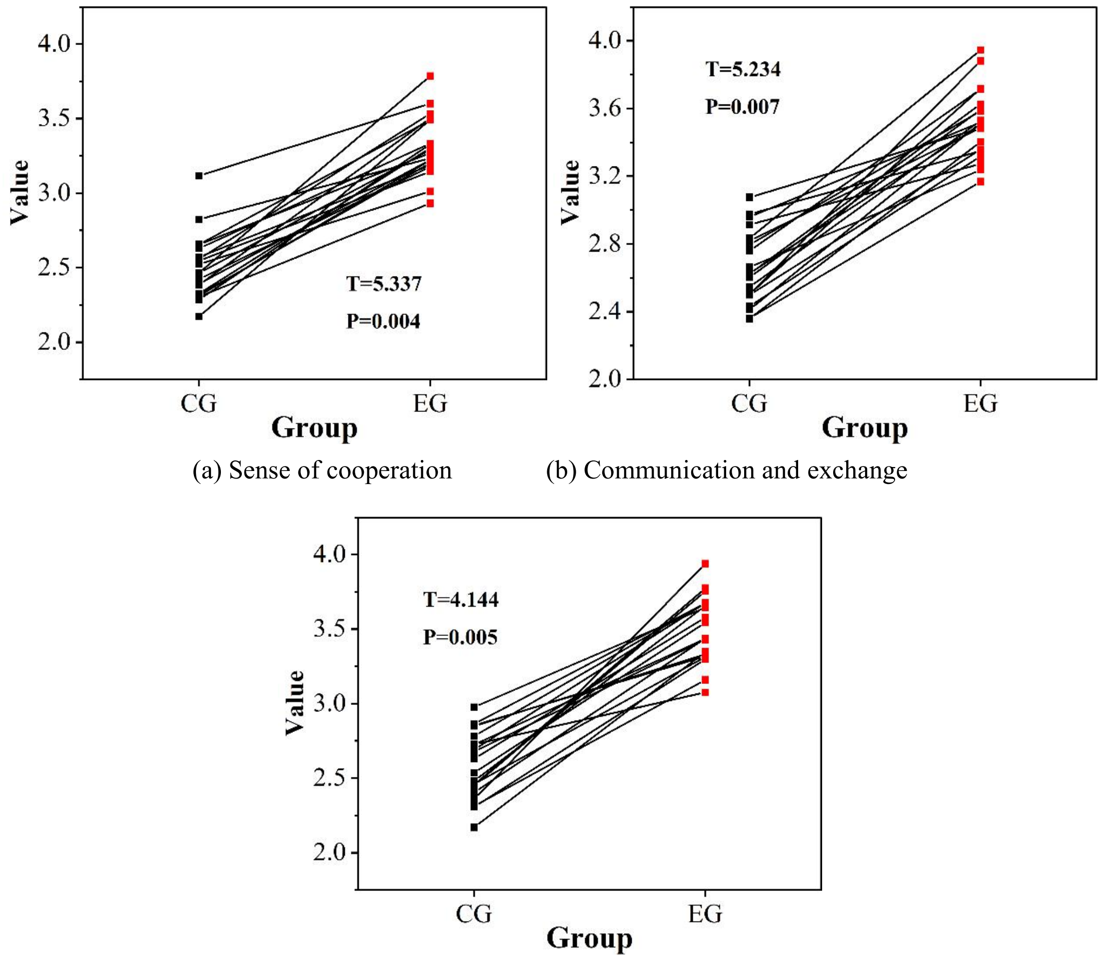


(c) Teamwork

Figure 5. Analysis of Students' Attitudes towards Exercise.

4.2.2. Post-experimental data analysis

The students in both groups were analyzed again for their exercise attitudes after the teaching intervention, and the results of the experimental posttest data analysis are shown in Figure 6. The students in the experimental group and the control group showed significant differences ($p<0.05$) in the three items of cooperative consciousness, communication and teamwork. Specific analysis shows that the two groups showed 0.05 level of significance ($t=5.337$, $p=0.004$) for the sense of cooperation, as well as the specific comparison of the differences, the mean value of the experimental group was 3.43 significantly higher than the mean value of the control group was 2.49, and the mean value of the experimental group was 3.39 significantly higher than the mean value of the control group was 2.51, and the mean value of the control group was 2.51 significantly higher than the mean value of the control group. Significantly higher than the control group 2.51. For teamwork showed 0.05 level of significance ($t=4.144$, $p=0.005$), the mean of the experimental group 3.52 was significantly higher than the mean of the control group 2.61. To summarize, it can be seen that: there is a significant difference between the students of the experimental group and the control group in terms of the ability to cooperate in learning. The experimental group students' exercise attitude was improved in all three indicators, which indicates that the stage teaching system can improve students' exercise attitude.



(a) Sense of cooperation (b) Communication and exchange

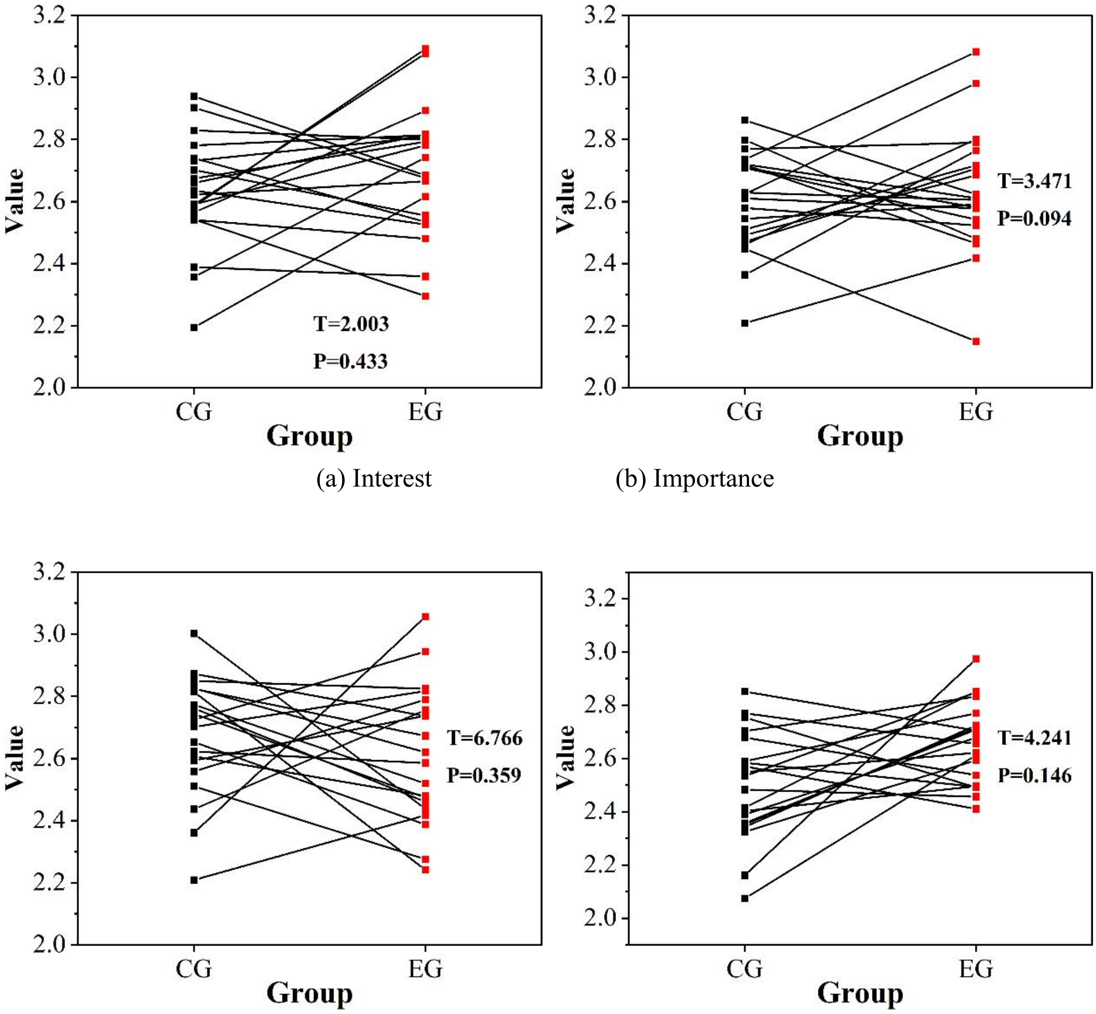
(c) Teamwork

Figure 6. The results of the post-experiment data analysis.

4.3. Motivation results

4.3.1. Pre-test data

Before the beginning of the experiment, all students in the experimental and control groups were tested with the scale. Independent samples t-test was conducted on the pre-test data of the experimental and control groups, and the results of the pre-test data analysis are shown in Fig. 7, where (a) to (d) denote interest, importance, subjective ability, and tension, respectively. It was found that there was no significant difference between the four dimensions of exercise motivation: interest, importance, subjective ability, and tension, and its $P>0.05$, which indicates that before the beginning of the experiment, the internal motivation in exercise of the students in the experimental group and the control group was at the same level, and that the experimental subjects had a high degree of similarity.



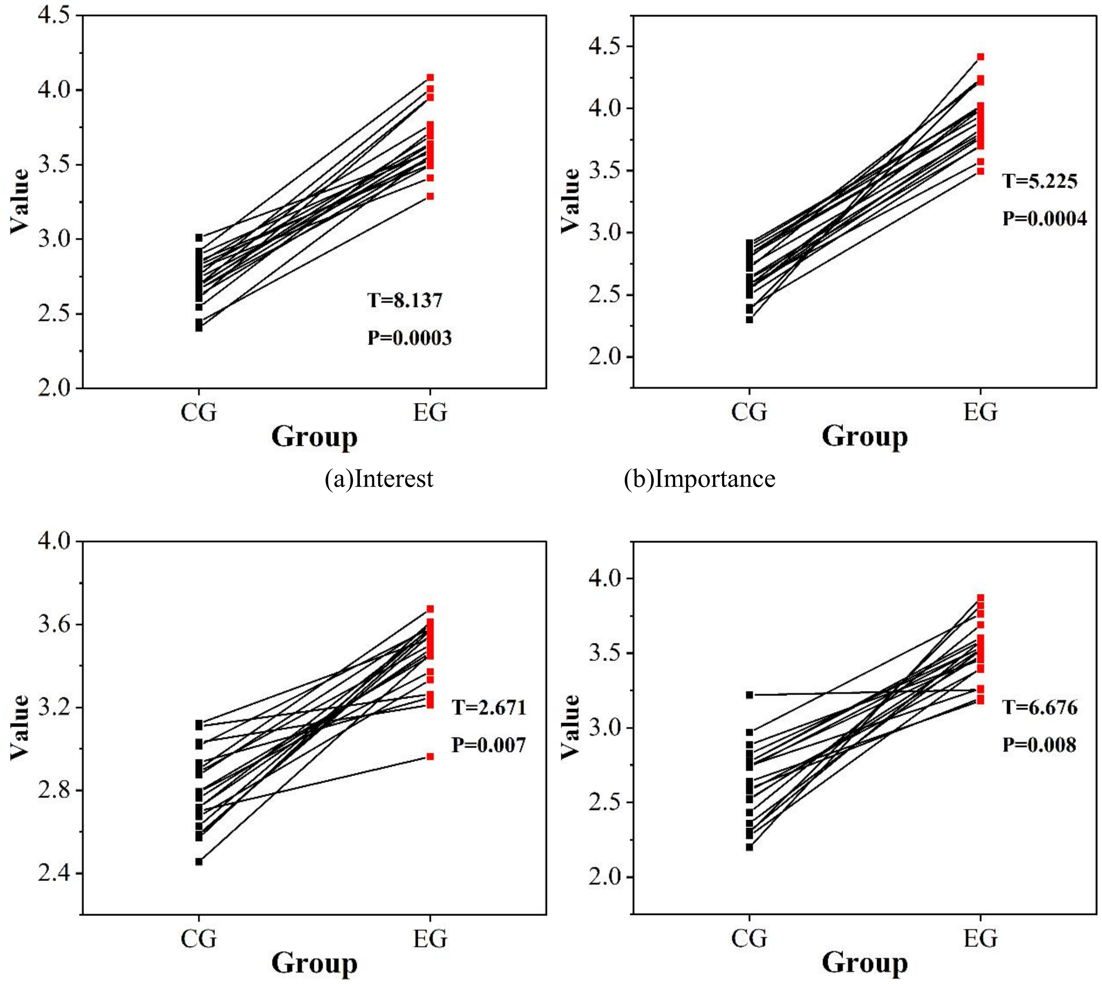
(a) Interest (b) Importance

(c) Subjective ability (d) Nervous

Figure 7. Pre-test data analysis results.

4.3.2. Post-measurement data

After the experiment, both groups of students were tested with the scale, and the post-test data were subjected to a paired-samples t-test, and the post-test data were analyzed for differences as shown in Figure 8. It was found that among the four dimensions of exercise motivation: interest, importance, the difference was extremely significant ($P < 0.001$). Subjective ability, the difference was highly significant ($P < 0.01$), and nervousness, no significant difference. This indicates that through the 3-month teaching experiment intervention, the teaching system in this paper effectively increased the level of students' internal motivation in sports.



(a)Interest (b)Importance

(c)Subjective ability (d)Nervous

Figure 8. Post-test data difference analysis

4.4. Sport Dance Skills Outcomes

At the end of the teaching experiment, the students in the experimental group and the control group were respectively assessed on the technical evaluation of sports dance techniques in the same class. According to the judgment standards, the students were scored on the four indexes of basic framework (20 points), technical combination (40 points), dance expression (10 points), and music rhythm (30 points), and the final scores were evaluated. After the teaching experiment, the t-test was used to study the differences between the classes for the basic framework, technical combination, dance expression, music rhythm, and total score for a total of five items, and the results of the difference analysis are shown in Table 13. It can be seen that the experimental group and the control group showed significant differences ($p<0.05$) in the five items of basic framework, technical combination, dance expression, music rhythm, and total score. Specific analyses show that: for the basic framework presents a 0.05 level of significance ($t=4.425$, $p=0.003$), as well as a specific comparison of the differences shows that the mean of the experimental group is 14.42 higher than that of the control group, which is 10.26. For the combination of techniques presents a 0.05 level of significance ($t=3.927$, $p=0.001$), and the mean of the experimental group is 33.26 higher than the mean value of 25.06 for the control group. For dance expression showed 0.05 level of significance ($t=1.045$, $p=0.034$), the mean of the experimental group was 8.49 higher than the mean of the control group which was 5.36. For musical rhythm showed 0.05 level of significance ($t=2.362$, $p=0.004$), the mean of the experimental group was 21.36 higher than the mean of the control group which was 17.42. The class for the total score presents a 0.05 level of significance ($t=6.391$, $p=0.009$), as well as a specific comparison of the differences can be seen, the experimental group's mean value of 78.53 is significantly higher than that of the control group's mean value of 58.1. It can be concluded that the system in this paper can effectively improve the students' technical level of physical dance.

Table 13. Results of difference analysis.

Physical fitness indicators	Experimental Group		Control group		T-value	P-value
	Mean	SD	Mean	SD		
Basic framework	15.42	0.43	10.26	1.26	4.425	0.003
Technology combination	33.26	1.44	25.06	1.07	3.927	0.001
Dance expressiveness	8.49	0.49	5.36	0.59	1.045	0.034
Musical rhythm	21.36	1.17	17.42	1.12	2.362	0.004
Total score	78.53	3.53	58.1	4.04	6.391	0.009

5. Conclusion

With the rapid development of information technology, traditional teaching methods have been difficult to meet the increasingly complex modern teaching needs. Especially in the field of dance education, how to realize the combination of theory and practice, improve teachers' teaching efficiency and students' learning experience has become an urgent problem. In this regard, this paper combines the development of software and hardware to design a dance teaching system, in order to explore the value of the system in the practical application of sports dance teaching in colleges and universities, to develop a corresponding research program. Under the guidance of the research program in this paper, the teaching practice value of the dance teaching system is explored. Its conclusions are:

(1) When the number of users increases from 100 to 1000, the response time of the system shows an increasing trend, with the value rising from 614ms to 4156s, while the throughput shows a decreasing trend, with the corresponding value dropping from 167sec to 136sec.Overall, although the increase in the number of concurrent users leads to a decreasing trend in the performance of the system, the system is still able to meet the demands of teaching dance courses in colleges and universities. Dance course teaching requirements.

(2) After three months of teaching experiment intervention, the experimental group and the control group have significant correlation ($p<0.05$) in the basic framework, technical combination, dance expression, music rhythm, and total score, with p-values of 0.003, 0.001, 0.034, 0.004, 0.009, respectively, which indicates that compared with traditional dance teaching, the dance teaching system has more obvious effects on the enhancement of various indexes of students, and also demonstrates the effectiveness of this paper. The effect is more obvious, which also shows the application value of the system in college teaching in this paper.

Funding

This research was supported by the 2023 Hunan Philosophy and Social Sciences Fund General Project: "Development and Digital Construction of Opera and Dance in the North of Hunan Province" (Fund Number: 23YBA280).

References

1. Gao, J. (2018). Research on the weakness of college dance teaching and its innovative solutions. In 2018 8th international conference on education, management, computer and society (EMCS 2018) (pp. 801-803).
2. Sööt, A., & Viskus, E. (2014). Contemporary approaches to dance pedagogy–The challenges of the 21st century. Procedia-Social and Behavioral Sciences, 112, 290-299.
3. Zhang, D. (2023). Analysis on the Path of Integrating Traditional Cultural Education into Dance Teaching in Colleges and Universities. International Journal of New Developments in Education, 5(11).
4. Chen, J. (2025). Dance education using digital technologies: enhancing effectiveness by facilitating student–teacher feedback. Theatre, Dance and Performance Training, 16(1), 12-31.
5. You, Y. (2022). Online technologies in dance education (China and worldwide experience). Research in Dance Education, 23(4), 396-412.
6. Xu, W., Xing, Q. W., Zhu, J. D., Liu, X., & Jin, P. N. (2023). Effectiveness of an extended-reality interactive learning system in a dance training course. Education and Information Technologies, 28(12), 16637-16667.
7. Fang, Y., Ren, Z., Hu, X., & Graesser, A. C. (2019). A meta-analysis of the effectiveness of ALEKS on learning. Educational Psychology, 39(10), 1278-1292.
8. Tanaka, F., Fortenberry, B., Aisaka, K., & Movellan, J. R. (2005, July). Plans for developing real-time dance interaction between QRIO and toddlers in a classroom environment. In Proceedings. The 4th International Conference on Development and Learning, 2005 (pp. 142-147). IEEE.
9. Xu, L. J., Wu, J., Zhu, J. D., & Chen, L. (2025). Effects of AI-assisted dance skills teaching, evaluation and visual feedback on dance students' learning performance, motivation and self-efficacy. International Journal of Human-Computer Studies, 195, 103410.

10. Lu, T., & Xiao, Y. (2025). Development and Implementation Effects on the Evaluation of Dance Teaching System Integrated with Wearable Devices. International Journal of High Speed Electronics and Systems, 2540811.
11. Tang, T., & Hyun-Joo, M. (2022). Research on sports dance movement detection based on pose recognition. Mathematical Problems in Engineering, 2022(1), 4755127.
12. Huang, Y. (2025). Enhancing ballet posture Teaching: Evaluation of a scientific computing model with motion capture integration. Entertainment Computing, 52, 100824.
13. Chen, J. (2023, December). Motion Decomposition and Guidance Technology in Dance Teaching Based on Motion Feedback System. In 2023 International Conference on Intelligent Computing, Communication & Convergence (ICI3C) (pp. 162-166). IEEE.
14. Deb, S., Sharan, A., Chaturvedi, S., Arun, A., & Gupta, A. (2018). Interactive dance lessons through human body pose estimation and skeletal topographies matching. International Journal of Computational Intelligence & IoT, 2(4).
15. Wang, J., & Chen, X. (2024). Advanced artificial intelligence-based dance posture correction technology and its application in virtual reality. Journal of Computational Methods in Sciences and Engineering, 14727978251363042.
16. Zhao, Y., & Yang, H. (2023). Implementation of Computer Aided Dance Teaching Integrating Human Model Reconstruction Technology. Computer-Aided Design and Applications, 21(S10), 196-210.
17. Hu, X., & Ahuja, N. (2021). Unsupervised 3d pose estimation for hierarchical dance video recognition. In Proceedings of the IEEE/CVF International Conference on Computer Vision (pp. 11015-11024).
18. Jiang, D. (2022). Matching model of dance movements and music rhythm features using human posture estimation. Computational Intelligence and Neuroscience, 2022(1), 7331210.
19. Tang, H., Luo, Y., & Yang, J. (2022, August). Research on dance movement evaluation method based on deep learning posture estimation. In 2022 2nd International Conference on Big Data Engineering and Education (BDEE) (pp. 173-177). IEEE.
20. Gong, N., & Du, W. (2025). Dance Movement Recognition and Analysis Based on Motion Capture Data and Machine Learning Models. Mediterranean Archaeology & Archaeometry, 25(1).
21. Wei, Y., Yan, H., Bie, R., Wang, S., & Sun, L. (2014). Performance monitoring and evaluation in dance teaching with mobile sensing technology. Personal and ubiquitous computing, 18(8), 1929-1939.
22. Wu, L. F. (2023, April). Evaluation on Multimodal Dance Action Recognition Based on Artificial Intelligence Image Technology. In Proceedings of the 2023 International Conference on Frontiers of Artificial Intelligence and Machine Learning (pp. 112-117).
23. Qiao, L., & Shen, Q. (2021). Human action recognition technology in dance video image. Scientific Programming, 2021(1), 6144762.
24. Zhang, L., Ding, C., Wu, D., Liu, S., & Zhao, Q. (2022). Application of Blurred Image Processing and IoT Action Recognition in Sports Dance Sports Training. Computational Intelligence and Neuroscience, 2022(1), 6189396.
25. Sumi, M. (2025). Simulation of artificial intelligence robots in dance action recognition and interaction process based on machine vision. Entertainment Computing, 52, 100773.
26. Xu, S., Wan Yahaya, W. A. J., Rahim, N., & Zeng, S. (2025). The Impact of Mobile AI Scoring Technology-Assisted Dance Practice on Dance Education: Improving Students' Achievement, Learning Motivation and Engagement in China. International Journal of Chinese Education, 14(2), 2212585X251372981.
27. Mengying Li. (2025). The analysis of dance teaching system in deep residual network fusing gated recurrent unit based on artificial intelligence. Scientific Reports,15(1),1305-1305.