INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT

OPEN ACCESS JOURNAL

Vol 14, Issue 01, (2025) E-ISSN: 2226-6348

# A Study on the Digital Application of OpenPose Skeleton Tracking Technology in Sports Dance Teaching in Chinese Universities from a Modernization Perspective

Yan Ge[1], Borhannudin Abdullah[1], Hazizi Abu Saad[2]

[1]Department of Sport Studies, Faculty of Educational Studies, Universiti Putra Malaysia, 43400 UPM Serdang Selangor, Malaysia, [2]Department of Nutirition and Dietetics, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 UPM Serdang Selangor, Malaysia

Corresponding Author Email: 379848583@qq.com

**To Link this Article:** http://dx.doi.org/10.6007/IJARPED/v14-i1/24794 DOI:10.6007/IJARPED/v14-i1/24794

***Published Online:*** 04 March 2025

**Abstract**

With the modernization of sports, the application of digital technology in university physical education has gained increasing attention. This study explores the effectiveness of OpenPose skeleton tracking technology in sports dance instruction using a quantitative approach and an eight-week experimental intervention to evaluate students' movement accuracy, learning engagement, and skill improvement. The results indicate that intelligent-assisted teaching is widely recognized, with 95% of students reporting enhanced learning outcomes and interactivity. However, some teachers remain skeptical, highlighting the need for additional technical training. The experimental group demonstrated significantly higher motor skills ($T = 7.435$, $P = 0.000$) and overall scores ($T = 2.64$, $P = 0.01$) than the control group, confirming the effectiveness of the intervention. Performance improvements were notable in the first five weeks ($P < 0.05$) but plateaued after the sixth week ($P > 0.05$). OpenPose received a 72% satisfaction rate, significantly improving movement accuracy (92%), skill acquisition (92%), and motion correction (88%), though its impact on movement fluidity (56%) and injury prevention (80%) requires further optimization. In conclusion, OpenPose technology effectively enhances the quality of sports dance instruction, stimulates student interest in learning, and demonstrates the potential of intelligent technology in this field.

**Keywords:** Sports Modernization, Sports Dance, OpenPose Skeleton Tracking Technology, Intelligent Teaching, Teaching Effectiveness

## Introduction

This study focuses on AI-supported sports education, examining how AI applications enhance core competencies and movement skill acquisition within the discipline. Special attention is given to the current state of AI-assisted sports dance instruction, analyzing its effectiveness and future prospects in intelligent sports education.

With the rapid development of artificial intelligence (AI) technology, intelligent applications have gradually gained widespread attention in the field of education. They not only bring new opportunities for teaching reform but also raise higher demands for talent cultivation under the "AI + education" framework. Physical education, as an important component of quality education in China, holds particular significance in higher education institutions, especially sports dance courses, which are loved by students for their unique charm and diverse forms of expression.

The advancement of educational modernization relies on the innovation of teaching methods and tools, and this innovation is built on the foundation of information technology. In recent years, the "Opinions on Strengthening and Improving School Sports Work in the New Era" have proposed the active innovation of teaching methods, integrating artificial intelligence and human posture recognition technology to achieve intelligent, data-driven, and personalized teaching. The application of AI technology has not only caused profound changes in traditional teaching models but also brought a re-examination and new challenges to talent cultivation models. Human posture estimation technology plays a core role in various fields such as physical exercise, dance training, and sign language recognition, providing a solid technological foundation for the application of technologies such as augmented reality.

Although significant progress has been made in intelligent technology in the field of physical education, research that deeply integrates intelligent technology with teaching practices and focuses on student-centered approaches is still relatively limited. The integration of AI and education has not only brought new educational concepts but also promoted the deep integration of classroom teaching and information technology. This innovative model provides new ideas for teaching reform in courses such as sports dance, driving the development of university physical education toward intelligent and personalized directions, enhancing teaching effectiveness and improving students' learning experiences.

**Purpose and Significance**

With the development of computer and internet technology, artificial intelligence has been increasingly used as an auxiliary tool in the fields of international sports training and physical education. Currently, human pose estimation is a popular research area in computer vision. OpenPose, an open-source human pose estimation project, is suitable for both single-person and multi-person scenarios. By utilizing OpenPose skeleton tracking as a teaching tool in sports dance courses, this study aims to address issues such as non-standard movements and inconsistent performance quantification in sports dance instruction. The goal is to develop an intelligent evaluation system that uses OpenPose skeleton tracking to assist in sports dance teaching, assess the effectiveness of this technology in sports dance instruction, and explore the optimal timing for integrating human pose recognition technology into sports curricula. This research seeks to lay a foundation for future studies on AI-assisted sports dance teaching systems.

With the advancement of the "Artificial Intelligence + Education" initiative, university sports dance courses have accumulated practical experience in implementing new teaching models. However, due to the lack of systematic and comprehensive analysis of AI-assisted teaching systems in university sports dance courses, challenges and setbacks are inevitable in the development and application of intelligent teaching assistance systems. From the

perspective of "Artificial Intelligence + Education," constructing an intelligent teaching assistance system and conducting theoretical analyses of its application in university sports dance instruction can help deepen and expand research on intelligent sports education and AI-assisted sports dance teaching systems, enriching the theoretical foundation of sports dance education.

Through experimental comparative research on the OpenPose skeleton tracking-assisted teaching system, students can be guided to learn fundamental sports dance movements more effectively. This approach can enhance students' motivation and interest in learning sports dance, foster positive attitudes toward physical exercise, and encourage enthusiasm for sports, ultimately helping them develop a healthy and confident lifestyle. The integration of the OpenPose skeleton tracking-assisted teaching system also aligns with the concept of integrating information technology into curricula. Therefore, the application of this system can facilitate the updating of teachers' educational philosophies, promote the development of their information technology literacy, and contribute to their professional growth.

This study emphasizes the significant advantages of skeletal tracking technology, particularly OpenPose, in enhancing students' motor skills, precisely correcting movements, and promoting personalized learning in dance education.

**Research Objectives**

This study is guided by the following objectives:

*(1)Assessing the Application Effectiveness and Enhancement Role of OpenPose Skeleton Tracking Technology in Sports Dance Teaching*

By comparing the performance of students in the experimental group and the control group in sports dance skill assessments, this study will specifically analyze the actual impact of OpenPose technology on improving students' movement accuracy, fluidity, technical proficiency, and coordination. Furthermore, it will explore its role in enhancing students' overall skill development, particularly its advantages in correcting and optimizing fundamental dance movements.

*(2)In-Depth Analysis of Students' Attitudes, User Experience, and Influencing Factors Regarding Intelligent Assisted Teaching Systems*

Through questionnaire surveys and feedback analysis, this study aims to comprehensively evaluate students' satisfaction, adaptability to technology, learning motivation, and interactivity after using OpenPose skeleton tracking technology in sports dance instruction. It will also examine the challenges and difficulties students encounter during usage, identify areas for system functionality and user experience optimization, and provide data support and practical insights for future improvements and broader implementation of intelligent assisted teaching systems.

**Literature Review**

*Research on Skeletal Tracking Technology*

OpenPose is an open-source library developed by the Perceptual Computing Laboratory at Carnegie Mellon University, supporting human, facial, and hand pose estimation in both single-person and multi-person scenarios. The system is built using OpenCV and Caffe, implemented in C++, and utilizes multithreading to achieve multi-target human skeletal keypoint detection (Hara & Chellappa, 2017).

As the first real-time pose estimation model based on deep learning, OpenPose adopts a bottom-up keypoint detection approach, demonstrating strong practicality and robustness. Its core algorithm introduces Part Affinity Fields (PAFs) to associate different body parts in an image, utilizing bipartite matching and the Hungarian algorithm to achieve precise limb connections and multi-person pose estimation. The architecture inherits from Convolutional Pose Machines (CPM), ensuring that its accuracy remains unaffected by changes in the number of individuals in an image, thus enabling stable and efficient pose recognition.

The algorithm workflow of OpenPose, as presented in a 2017 CVPR paper, follows these steps: first, a convolutional neural network (CNN) extracts feature maps and generates Part Confidence Maps (PCM) and PAFs separately; then, a bipartite matching algorithm from graph theory is employed to correctly link the keypoints of the same individual; finally, the Hungarian algorithm is applied to integrate the skeletal frameworks of multiple individuals, achieving full-scene multi-person pose estimation.
This software is owned by Carnegie Mellon University and, according to the CMU AI initiative launched in 2017, OpenPose can be freely used for developing skeletal keypoint tracking systems for non-commercial purposes.

*Research on Intelligent Technology-Assisted Sports*

Artificial Intelligence and Educational Reform in China: Implications for Sports Dance Instruction China's current educational reform is undergoing a transformation characterized by educational diversification, diverse societal demands, and the promotion of lifelong learning. A critical research focus in academia is how to leverage next-generation artificial intelligence (AI) technologies to address challenges in educational reform.

In recent years, the application of intelligent technologies in sports has developed rapidly and gained widespread attention. The primary intelligent auxiliary devices in use today include wearable devices, virtual reality (VR) technology, sensor technology, and human pose recognition technology. These devices provide more precise and efficient support for athletes' training and competition.

Research explores how AI-driven learning analytics and user profiling techniques collect and analyze students' learning data to assess their knowledge acquisition and behavior. Through AI-powered learning maps, emotional robotics, and natural language processing, educational experiences can incorporate greater care and companionship.Additionally,AI-driven knowledge graphs facilitate adaptive assessment by helping teachers generate personalized test items and automate grading. In the realm of sports education, intelligent wearables—such as smart wristbands and lung capacity measurement tools—enable the collection of in-depth student health data, providing insights into physical fitness, motor skill development, and overall health (He & Li, 2020).

(Cao et al. 2017) introduced the OpenPose model, which utilizes Part Affinity Fields (PAF) to achieve efficient and accurate 2D pose estimation, providing reliable data support for motion analysis and optimization. Similarly, (**Zhou & Huang ,2024)** explored motion capture technology based on Kinect. While primarily focusing on Kinect, their study offers valuable insights into skeletal tracking technology and its potential applications in dance education.

In recent years, skeletal tracking technology, particularly OpenPose, has been widely applied across various fields, including sports dance education. Studies have shown that OpenPose enables real-time multi-person pose estimation, accurately capturing and analyzing key skeletal points, thereby providing strong technical support for dance instruction.(Zhang ,2012) conducted in-depth analyses of Kinect and various pose estimation methods, discussing how skeletal tracking technology enhances movement skill acquisition in dance instruction and athletic training.This study systematically explores the impact of machine learning on dance choreography, posture detection, data training, and visual representation. It not only enhances the innovation of dance art but also raises ethical challenges regarding artistic ownership (Nogueira et al., 2024).

These studies highlight the significant advantages of skeletal tracking technology, particularly OpenPose, in enhancing students' motor skills, precisely correcting movements, and facilitating personalized learning in dance education.

In recent years, the application of intelligent technologies in sports has developed rapidly and gained widespread attention. The primary intelligent auxiliary devices in use today include wearable devices, virtual reality (VR) technology, sensor technology, and human pose recognition technology. These devices provide more precise and efficient support for athletes' training and competition.

*Wearable Devices*

Wearable devices enable real-time monitoring of athletes' physiological responses and physical states, allowing coaches to efficiently gather data during training sessions. For example,utilized a GPS device with a 10Hz sampling frequency combined with a 1000Hz tri-axial accelerometer to assess the physical responses and heart rate of university students participating in football, volleyball, and basketball.
(Li et al, 2021)

*Virtual Reality Technology*

Virtual reality (VR) technology creates simulated training environments that enable personalized training plans tailored to each athlete’s needs and performance data. By simulating various opponents and environments, VR enhances the interactivity and enjoyment of training sessions. According to (**Zhou,2021)**, VR environments not only improve athletes' engagement but also help refine their technical skills, thereby increasing training effectiveness. Additionally, (**Li &S un ,2024)** emphasize the role of VR in sports training, highlighting its potential to optimize performance and skill development.

*Sensor Technology*

Sensor technology has seen significant development in sports such as fencing and taekwondo. For example, in fencing, modern computer vision-based scoring systems track and evaluate athletes' movements in real time using both wired and wireless systems. (**Athow&McGough ,2021)** explored the efficiency of these systems in enhancing the accuracy of competition results.

*Human Pose Recognition Technology*

Human pose recognition has become a focal point in the field of intelligent sports technologies.OpenPose, a library based on convolutional neural networks and supervised

learning, is capable of estimating human body movements, facial expressions, and skeletal joints. This system is applicable to both individual and multi-person analysis. For instance, (Yang et al. 2021) developed a monocular image recognition system using OpenPose technology.(Wang ,2020) designed and trained a badminton player posture evaluation model based on concepts such as similarity and local assessment.(Li ,2020) developed and implemented action classification methods based on handcrafted features and high-precision action detection methods from the perspectives of action classification, action detection, and action evaluation.(Li et al.(2022) designed and implemented an intelligent evaluation system for standing long jump movements based on human posture recognition to address issues of non-standard movements and inconsistent performance quantification in teaching scenarios.

## Methodology

*Questionnaire Survey*

To understand the application effect of OpenPose skeleton tracking technology in sports dance teaching, the study designed two types of questionnaires, one for teachers and one for students. The design of the questionnaires was based on sports science research methods and sought the opinions of sports dance experts and teachers. The first type of questionnaire aimed to investigate teachers' needs and feedback on the intelligent system in teaching, while the second focused on students' experiences and feelings after using OpenPose skeleton tracking technology to assist in sports dance teaching.

*Questionnaire Design*

The questionnaire design in this study focused on the current status of intelligent-assisted sports dance teaching, including existing teaching methods, the use of teaching aids, the construction of teaching staff, and the demand for intelligent teaching assistance systems. Additionally, it covered a survey of student satisfaction with the teaching effectiveness after using OpenPose skeleton tracking technology. The questionnaire was electronically designed using the Wenjuanxing platform for efficient data collection and analysis.

The distribution and collection of the questionnaires were conducted through the Wenjuanxing platform. The teacher questionnaire was distributed to sports dance teachers from five universities in Xi'an,Shaanxi Province,China, with 200 questionnaires distributed and 187 returned. Of these, 176 were valid, resulting in an effective rate of 88%. The student questionnaire was distributed to students participating in sports dance special courses, general education courses, and elective courses, with 350 questionnaires distributed and 331 returned. Of these, 320 were valid, giving an effective rate of 91.4%.

*Experimental Method*

This study adopted an experimental control method, setting up an experimental group and a control group to explore the impact of OpenPose skeleton tracking technology on students' mastery of movements and teaching effectiveness. The experimental group used OpenPose skeleton tracking technology for assisted teaching, while the control group used traditional teaching methods. The participants were 50 students from the 2023 cohort of elective sports dance courses at Xi'an International Studies University. The experiment lasted from September 1 to November 1, 2024, consisting of 16 class hours with 2 hours of teaching per week. The experiment took place in the physical training room at Xi'an International Studies University, with the content being the five-level routine of sports dance. After the

experiment, students were assessed for skills, comprehensive quality, and interviewed to obtain experimental data and analyze the teaching effectiveness.

*Statistics Method*

This study used Excel software to organize the collected questionnaire data and presented the analysis results through charts. Additionally, SPSS 26.0 was used to conduct an independent sample t-test on the pre- and post-experiment data of students in the experimental and control groups to assess the differences between the groups. According to the statistical results, if the p-value > 0.05, the difference is not significant; if the p-value < 0.05, the difference is significant; and if the p-value ≤ 0.01, the difference is very significant.

*Ethical Considerations*

Ethical approval for the study was obtained from the research ethics board of the institution. Participants were informed about the purpose of the study, and their participation was voluntary. Informed consent was obtained prior to data collection, and confidentiality of responses was maintained throughout the study.

**Results and Analysis**

*Overall Design of OpenPose Skeleton Tracking-Assisted Sports Dance Teaching System*

Based on the above, in response to the need for intelligent teaching in schools, an intelligent system using OpenPose skeleton tracking for sports dance teaching is developed. The system establishes a standard movement information database for sports dance by extracting movement features from specified standard sports dance videos. It then uses cameras, such as mobile phones or video cameras, to capture video data of students' practice in sports dance classes. The system estimates the posture of key body points in the video and evaluates the participation of skeletal key points in the process of completing technical actions at each stage by matching them with key movements in the standard information database. This is used as an evaluation criterion to assist students in assessing and guiding the correctness of their movements during sports dance practice.

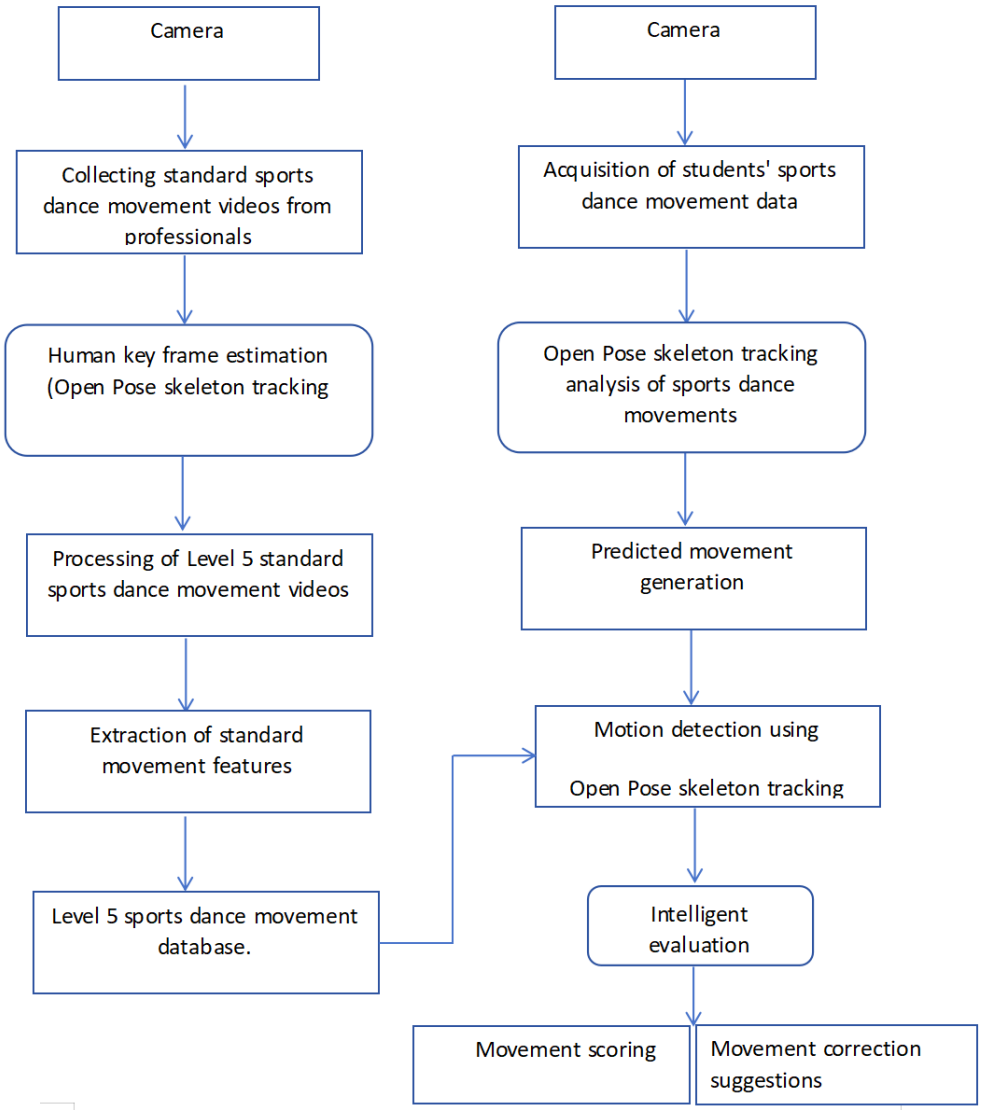
The system will design the skeleton positioning and motion analysis system as a whole based on the system's requirement analysis and relevant technologies. The system includes the following modules: motion data collection module, standard motion posture setting module, motion posture skeleton motion positioning analysis module, and intelligent evaluation feedback module.

Motion Data Acquisition Module: Used to obtain standard motion posture images from standard videos and capture image sequences from action videos.

Standard Motion Posture Setting Module: Trains a target detection model and posture recognition based on standard posture image sequences, forming a two-dimensional model of standard motion postures for each movement.

Motion Posture Skeleton Positioning Analysis Module: Uses the student's motion posture detection model to analyze each frame of test images, identifies similar movement postures through OpenPose, and obtains skeletal key point information, followed by skeleton positioning analysis.

Intelligent Motion Evaluation Feedback Module: Displays the results processed by the motion posture skeleton positioning analysis module, including scoring the posture and providing suggestions for movement correction.




*Current Situation of Intelligent Auxiliary Teaching Methods in Sports Dance Movement Instruction*

Table 1
*Analysis of College Teachers' Attitudes Toward Intelligent Auxiliary Teaching (n=200)*

| | Teacher Number | Percentage |
|---|---|---|
| Agree | 181 | 90.5% |
| Disagree | 19 | 9.5% |

According to the results of the questionnaire survey of 200 college teachers, about 90.5% of the teachers expressed support for intelligent auxiliary teaching. They believe that intelligent technology plays a positive role in sports dance teaching, improving teaching efficiency, enhancing teaching quality, increasing student engagement, and enabling personalized learning. This result indicates that most teachers hold a positive attitude toward intelligent technology and are willing to try and integrate this emerging teaching method. It

also reflects the current recognition of educational modernization by college teachers, especially the acceptance of information-based and intelligent teaching methods. However, 9.5% of teachers expressed disagreement or lack of support. Possible reasons for this include unfamiliarity with new technologies, doubts about the effectiveness of technology implementation, or reliance on traditional teaching methods. These teachers may be concerned that intelligent tools cannot fully replace teaching experience and teacher-student interaction or that there are operational difficulties and insufficient technical support in practical applications. Therefore, despite the broad recognition and support for intelligent auxiliary teaching, it is still necessary to consider and address the concerns of the minority of teachers during the promotion of this teaching model, providing more technical training and practical support to improve its effectiveness in real teaching environments.

*Analysis of Students' Attitudes Toward Intelligent Auxiliary Teaching*

Table 2

*Analysis of Students' Attitudes Toward Intelligent Auxiliary Teaching (n=320)*

| | Student Number | Percentage |
|---|---|---|
| Agree | 304 | 95% |
| Disagree | 16 | 5% |

According to the questionnaire survey of 320 students, 95% of the students expressed support for intelligent auxiliary teaching, believing that this approach can significantly enhance learning outcomes and participation. The majority of students think that using intelligent tools such as OpenPose skeleton tracking technology can accurately correct dance movements and provide timely feedback on their performance, helping them grasp the key points of movements more quickly and making the learning process more interactive and enjoyable. Additionally, students generally reported feeling more confident in the learning process because they could view their movement data in real-time and clearly understand areas for improvement. However, 5% of the students expressed disagreement or hesitation, with the main reasons possibly including the long adaptation period to new technology or concerns about technology replacing traditional teacher guidance. These students may be more reliant on traditional face-to-face instruction or feel unfamiliar with the technology, which impacts their acceptance. Therefore, in the process of promoting intelligent teaching, in addition to optimizing the technology and teaching content, attention should also be paid to students' technological adaptability. More training and support should be provided to help students overcome their unfamiliarity with new technologies and improve the overall effectiveness of teaching.

*Analysis of the Experimental Results of OpenPose Skeleton Tracking Technology in Sports Dance Teaching*

Table 3

*Comparison of Motion Skill Assessment Between the Experimental Group and Control Group After the Experiment*

| Group | Number of Students | X±S | T-value | P-value |
|---|---|---|---|---|
| Experimental | 25 | 88.12±1.95 | 7.435 | 0.000 |
| Control | 25 | 81.37±2.10 | | |

Note: P ≤ 0.05 indicates significant difference; P ≤ 0.01 indicates very significant difference; P > 0.05 indicates no significant difference.

After the experiment, a comparative analysis of the motion skill assessment scores of the experimental group and control group showed a significant difference between the two groups. The average score of the experimental group was 88.12 with a standard deviation of 1.95, while the average score of the control group was 81.37 with a standard deviation of 2.10. From the data, it is clear that the experimental group performed significantly better than the control group, with scores being more concentrated, indicating a more consistent overall performance. Further analysis using a T-test yielded a T-value of 7.435 and a P-value of 0.000, which is much smaller than 0.05, indicating a high statistical significance in the difference between the two groups. This result suggests that the significant improvement in the motion skill assessment of the experimental group is likely closely related to the specific intervention measures used during the experiment. Therefore, it can be preliminarily inferred that the teaching or training method employed by the experimental group played a positive role in enhancing students' motion skills.

*Comparison of Total Scores Between the Experimental Group and Control Group After the Experiment*

Table 4

*Comparison of Total Scores Between the Experimental Group and Control Group After the Experiment*

| Group | Number of Students | X±S | T-value | P-value |
|---|---|---|---|---|
| Experimental | 25 | 90.50± 2.231 | 2.64 | 0.01 |
| Control | 25 | 83.00 ± 5.00 | | |

Based on the data analysis after the experiment, there was a significant difference in total scores between the experimental and control groups. The experimental group had an average score of 90.50 with a standard deviation of 2.231, and the scores were more concentrated. In contrast, the control group had an average score of 83.00 with a standard deviation of 5.00, and the scores showed more fluctuation. A T-test resulted in a T-value of 2.64 and a P-value of 0.01, indicating statistical significance ($P < 0.05$). This means that the experimental group had a significantly higher total score than the control group, and the intervention measures taken in the experimental group may have effectively improved students' overall scores. Therefore, it can be concluded that the intervention method used by the experimental group had a positive effect on improving students' total scores.

*Comparison of Stage Assessment Scores Between the Experimental Group and Control Group After the Experiment*

Table 5

*Comparison of Stage Assessment Scores Between the Experimental Group and Control Group After the Experiment*

| Assessment Stage | Experimental Group (X ± S) | Control Group (X ± S) | T-value | P-value |
|---|---|---|---|---|
| Week 2 | 71.80 ± 1.85 | 69.20 ± 1.90 | 3.271 | 0.003 |
| Week 3 | 75.20 ± 1.80 | 70.50 ± 1.40 | 7.458 | 0.000 |
| Week 4 | 82.60 ± 2.05 | 74.00 ± 3.20 | 10.84 | 0.000 |
| Week 5 | 83.00 ± 2.00 | 77.90 ± 3.50 | 7.412 | 0.000 |
| Week 6 | 83.60 ± 2.00 | 80.00 ± 1.90 | 5.602 | 0.000 |
| Week 7 | 85.00 ± 1.50 | 84.30 ± 1.80 | 1.032 | 0.308 |
| Week 8 | 85.50 ± 1.40 | 84.80 ± 1.50 | 1.473 | 0.146 |

The experimental results showed that the intervention measures in sports dance had a significant effect on improving the motion skills of students in the experimental group during the early stages (Weeks 2 to 5), particularly in terms of movement coordination, fluidity, and technical mastery. The differences were statistically significant ($P < 0.05$). From Week 3 to Week 5, as training progressed, the gap between the experimental and control groups widened, and the experimental group demonstrated significant improvement in movement accuracy and fluidity. The T-values and P-values indicated that the experimental group outperformed the control group in skill improvement. However, by Week 6, although the difference still existed, it had narrowed, suggesting that the intervention effect slowed down at this stage. In Weeks 7 and 8, the gap between the two groups further decreased, and the differences were no longer significant ($P > 0.05$). This change may reflect that students achieved rapid improvement in the early stages due to the intervention, but as their skills approached a plateau, progress slowed down, and the intervention effect gradually diminished in the later stages. In conclusion, although intelligent interventions significantly promoted skill improvement, their effectiveness gradually stabilized in the later stages, possibly due to the limitations of reaching a skill plateau.

*Experimental Group's Feedback on Using the OpenPose Skeleton Tracking Auxiliary Teaching System*

Table 6

*Experimental Group Students' Feedback on Using the OpenPose Skeleton Tracking Auxiliary Teaching System (n=25)*

| | Very Satisfied | Satisfied | Neutral | Dislike |
|---|---|---|---|---|
| Number | 3 | 15 | 5 | 2 |
| Percentage | 12% | 60% | 20% | 8% |

Based on the feedback data from the experimental group students on their use of the OpenPose skeleton tracking auxiliary teaching system (n=25), it is evident that most students had a positive attitude toward the system. 60% of students were "satisfied," and 12% were "very satisfied," indicating that the system was widely recognized and effectively improved their learning experience and training outcomes. However, some students provided more neutral or negative feedback, with 20% stating they felt "neutral" and 8% saying they "disliked" the system. These responses suggest that there is still room for improvement in areas such as ease of use and user interface friendliness. Therefore, while the overall evaluation is high, it is essential to further understand the needs of the few dissatisfied students and optimize the system’s functions and user experience.

Table 7

*Experimental Group Students' Perceived Key Areas of Help from the Intelligent Auxiliary Teaching System in Sports Dance Teaching (n=25)*

| | Motion Accuracy | Motion Correction & Optimization | Movement Fluidity | Skill Improvement | Injury Prevention |
|---|---|---|---|---|---|
| Number | 23 | 22 | 14 | 23 | 20 |
| Percentage | 92% | 88% | 56% | 92% | 80% |

According to the survey results, the vast majority of students believed that the intelligent auxiliary teaching system had significant help in improving motion accuracy (92%) and skill improvement (92%). This indicates that the system effectively helps students ensure the

accuracy of movements and promotes skill development, particularly in mastering and executing basic movements. Regarding motion correction and optimization, 88% of students felt the system provided significant help, indicating that it could promptly correct errors in student movements, especially in the case of non-standard movements or bad habits. In contrast, only 56% of students felt the system had a significant effect on improving movement fluidity, suggesting that the system has some limitations in enhancing movement continuity. Lastly, 80% of students thought the system helped prevent sports injuries. Although the results were positive, some students felt its role in injury prevention was limited, suggesting that the system may need further development, considering factors like exercise intensity and fatigue.

## Conclusion and Suggestions

*Conclusion*

*Teachers' Attitudes Toward Intelligent Auxiliary Teaching*

Around 90.5% of teachers support the use of intelligent auxiliary teaching, believing it can enhance teaching efficiency, improve teaching quality, and foster personalized learning. However, 9.5% of teachers remain skeptical, likely due to unfamiliarity with the technology or a strong reliance on traditional teaching methods. To better promote this teaching model, additional technical training and support are needed.

*Students' Attitudes Toward Intelligent Auxiliary Teaching*

95% of students are in favor of intelligent auxiliary teaching, recognizing its potential to improve learning outcomes and increase engagement, particularly in areas like motion correction and real-time feedback. Nonetheless, 5% of students have concerns about adapting to new technology and would benefit from more training and support.

*Comparison Between Experimental and Control Groups*

The experimental group significantly outperformed the control group in both motion skills and overall scores. T-test results revealed that the experimental group showed greater improvement, especially during the early stages (Weeks 2-5), where the gap between the two groups was more pronounced. However, as students approached a skill plateau, progress slowed in the later stages.

*Progress Over Time*

During Weeks 2-5, the experimental group made considerable progress, with the gap between groups widening. By Weeks 6-8, the difference narrowed, indicating that skill improvement slowed down as students reached a plateau.

*Feedback on the OpenPose System*

Most students were satisfied with the OpenPose system, with 60% reporting satisfaction and 12% very satisfied. However, some students expressed neutral or negative feedback, suggesting that improvements in user interface design and ease of use are needed.

*Perceived Benefits of the Intelligent Auxiliary System*

Students reported that the system was particularly effective in improving motion accuracy (92%) and skill development (92%). 88% of students believed the system helped correct movement errors. However, its impact on improving movement fluidity was more limited (56%), and 80% of students felt it contributed to injury prevention.

**Suggestions**

*Enhance Teacher Training and Support*

Although 90.5% of teachers support intelligent auxiliary teaching, 9.5% remain skeptical due to unfamiliarity with the technology. It is recommended to focus on providing targeted training and support for teachers during the implementation of intelligent teaching methods. This can include online and offline training sessions, hands-on practice, and sharing best practices to help teachers become familiar with the new technology. Addressing teachers' concerns will increase their technical adaptability and encourage broader adoption of intelligent teaching tools.

*Improve Students' Technological Adaptability*

While 95% of students support intelligent auxiliary teaching, some still struggle to adapt to the new technology. It is suggested to introduce a technology adaptation phase in the curriculum, offering detailed user guides, tutorials, and FAQs to help students quickly master the tools. Additional support, such as online courses, technical assistance, and personalized guidance, should be provided to help students overcome their unfamiliarity with the technology and ensure they can fully benefit from intelligent teaching.

*Optimize System Interface and User Experience*

Although most students are satisfied with the OpenPose system, some have raised concerns about its usability and interface. It is recommended that the development team optimize the system based on user feedback, simplifying the interface and improving the intuitiveness of the design. Implementing real-time help tips and error feedback mechanisms will ensure that students can use the system smoothly, enhancing the overall learning experience.

*Enhance the System's Capabilities for Improving Movement Fluidity*

Data from the experiment showed that only 56% of students felt the system was effective in improving movement fluidity. To address this, it is suggested that the OpenPose system be further optimized to provide better feedback on movement fluidity and continuity. By refining the real-time feedback on movement transitions and flow, the system can assist students in improving not only the technical accuracy of their movements but also the overall fluidity and smoothness of their dance routines.

*Provide Personalized, Differentiated Feedback*

While 92% of students found the system effective in improving motion accuracy and skill development, every student progresses at a different rate and has unique needs. It is recommended to incorporate personalized feedback features in the system, which would assess students' progress, movement performance, and technical limitations. This tailored approach would allow for more targeted advice and support, helping students address their specific weaknesses and further enhance their overall skill development.

*Continuously Assess and Adjust Teaching Methods*

As students' skills improve, progress may slow down in later stages. It is suggested to regularly evaluate the effectiveness of intelligent auxiliary teaching and adjust the teaching methods accordingly. After students reach a certain level of proficiency, more complex tasks or increased feedback frequency could be implemented to maintain motivation and prevent

stagnation. This adaptive approach ensures that teaching remains effective as students progress and helps sustain their engagement.

**References**

Athow, S., & McGough, J. (2021). Using computer vision to assist the scoring of modern fencing. *Proceedings of the 49th Annual Midwest Instruction and Computing Symposium (MICS).*

Cao, Z., Simon, T., Wei, S.-E., & Sheikh, Y. (2017). Realtime multi-person 2D pose estimation using part affinity fields. *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2017*, 7291–7299.

Chen, X. (2018). *Motion evaluation system based on human 3D posture* [Doctoral dissertation, Zhejiang University]. Zhejiang University Repository.

Hara, K., & Chellappa, R. (2017). Growing regression tree forests by classification for continuous object pose estimation. *International Journal of Computer Vision, 122*(2), 1–21.

He, D., & Li, L. (2020). A new Kinect-based posture recognition method in physical sports training based on urban data. *Wireless Communications and Mobile Computing, 2020*, 1–10.

Li, D., & Sun, Y. (2024). Improvement of students' sports performance in VR-based smart sports teaching in colleges and universities. *Applied Mathematics and Nonlinear Sciences, 9*(1), 1–13.

Li, P., Zhang, H., Zhang, D., Jiang, G., He, J., & Liu, H. (2021). Using wearable electronic devices to quantify the physical and physiological response of collegiate students participating in leisure-time team sports. *2021 International Conference on Information Technology and Contemporary Sports (TCS)*, 1–5.

Li, R. (2020). *Research on fine classification and evaluation methods of human motion based on visual data* [Doctoral dissertation, University of Chinese Academy of Sciences, Xi'an Institute of Optics and Precision Mechanics, Chinese Academy of Sciences].

Li, S., Song, K., Ouyang, B., Zhang, B., Liu, C., Liu, P., & Liu, R. (2022). Intelligent evaluation system for standing long jump movements based on human posture recognition. *Artificial Intelligence, 2022*(02), 75–87.

Mu, J. (2022). Pose estimation-assisted dance tracking system based on convolutional neural network. *Computational Intelligence and Neuroscience, 2022*, 1–10.

Nogueira, M. R., Menezes, P., & de Carvalho, J. M. (2024). Exploring the impact of machine learning on dance performance: A systematic review. *International Journal of Performance Arts and Digital Media, 20*(1), 60–109.

Wang, Y. (2020). *Human motion posture estimation and recognition based on deep neural networks* [Doctoral dissertation, University of Electronic Science and Technology of China].

Yang, J., Zhang, S., Zhang, C., & Huang, J. (2021). Comparative study on human motion recognition based on OpenPose. *Sensors and Microsystems, 40*(1), 11–14.

Zhang, Z. (2012). Microsoft Kinect sensor and its effect. *IEEE Multimedia, 19*(2), 4–10.

Zhou, J. (2021). Virtual reality sports auxiliary training system based on embedded system and computer technology. *Microprocessors and Microsystems, 82*, 103944.

Zhou, X., & Huang, J. (2024). Motion capture sensor-based pose estimation for dance canonical movements. *Applied Mathematics and Nonlinear Sciences, 9*(1), 1–14.