

Research on the Application of Artificial Intelligence in Dance and Gymnastics Training in Colleges and Universities

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Abstract: In the training of dance and gymnastics in universities, the application of artificial intelligence (AI) has injected innovative impetus into the development of curriculum activities. Leveraging the intelligent advantages of AI, it is possible to reconstruct the dance and gymnastics training system, accurately capture the characteristics of students' dance movements, and generate visual data to provide teachers with differentiated training guidance schemes. In dance and gymnastics training, AI can assist throughout the process and provide real-time data feedback, offering inspiration for teachers and students in movement creation and choreography. In addition, teachers should make good use of AI tools to construct a scientific evaluation system, formulate more reasonable and transparent rules for dance and gymnastics competitions, and conduct comprehensive evaluations from multiple aspects such as technical completion, artistic expression, and synchronicity through an intelligent scoring system, effectively improving the objectivity and fairness of competitions. Focusing on the characteristics of dance and gymnastics in universities, teachers should fully leverage the educational advantages of AI to promote the formation of a new training model featuring "data-driven, personalized customization, real-time interaction, and intelligent evaluation", further enhancing the quality and efficiency of dance and gymnastics training and achieving a deep integration of physical education and aesthetic education.

1. Introduction

Gymnastics and dance sports in colleges and universities include various events such as aerobics, cheerleading, and sports dance. While exercising students' physical fitness and promoting their physical health, these sports also reflect the positive, optimistic, and uplifting spiritual outlook of the new generation of college students. AI technology can assist teachers and students in designing innovative gymnastics and dance movements through the analysis of big data on gymnastics movements and pattern recognition. At the same time, it optimizes the competitiveness of the choreography of complete sets of movements, making the training of gymnastics and dance sports

more intelligent [1].

2. Leverage the advantages of intelligent technology to reconstruct the gymnastics and dance training system

In the training of gymnastics and dance sports in colleges and universities, the application of AI technology can dynamically track and identify students' movement data, including multi-dimensional core indicators such as changes in human joint angles, movement speed, and movement intensity, and conduct accurate analysis on the accuracy and standardization of these movements. AI teaching assistants can help teachers promptly detect problems in students' gymnastics and dance movements. For example, in aerobics training, if a student's posture is not standard, the AI system will identify the causes of the non-standard posture from joint and movement data—such as shoulder shrugging, excessive knee extension, and forward waist tilting—all of which affect the gymnastics posture and lead to non-standard movements. After the system prompts the causes of the problems, teachers can promptly correct and guide the students to prevent the problems from worsening [2].

The artificial intelligence system can also achieve high-frequency sampling and reconstruction of motion trajectories by integrating an inertial measurement unit (IMU) and a visual sensor, thereby reconstructing the entire motion process in three-dimensional space and providing a quantitative basis for motion standardization. Furthermore, AI can predict the potential risk of sports injuries for students based on historical training data, enabling early intervention and training adjustments to further enhance the scientific and safety aspects of training.

In the choreography of gymnastics and dance movements, AI generates several feasible choreography plans based on students' physical fitness assessments, skill levels, and training objectives. For instance, in aerobics choreography, AI physical fitness assessment reveals that 64% of students have the issue of forward cervical posture. To correct this postural problem, teachers incorporate elements of different dance into the movement choreography. This not only exercises students' neck muscle strength and helps realign the cervical vertebrae but also enhances the "health-preserving" function of gymnastics and dance sports while completing the sports training, making it more in line with students' practical needs.

AI can also develop differentiated gymnastics and dance training plans based on students' individual differences. These plans cover elements closely related to training outcomes, such as movement standardization, sports safety reminders, and posture & expression management. Among these, expression management during gymnastics and dance has always been a weak point for students. However, the facial recognition function of AI systems enables students to better manage their facial expressions—advising them to avoid overly serious, rigid, or dull expressions during training, and instead fully immerse themselves in the joyful, dynamic, and energetic atmosphere of gymnastics and dance. This helps reconstruct the gymnastics and dance training system and embodies the personalized characteristics of such training.

3. Accurately capture dance movements and provide guidance on personality differences

The application of artificial intelligence vision technology can accurately capture the characteristics and problems of students in dance movements, and unlike simple camera video playback, artificial intelligence uses deep learning algorithms to analyze the details of students' movements and generate three-dimensional action models, so that students can more clearly see whether their joints and center of gravity are controlled correctly in dance training; Teachers can also use intelligent data analysis to identify specific directions that need to be strengthened and corrected [3].

For example, in the cheerleading "lifting and throwing" training, AI data suggests that the shoulder joint abduction angle of student L is too small when completing the throwing action, which is about 15 less than the standard value, and the internal buckle phenomenon occurs when the wrist is exerted, which will cause the upward trajectory of the lifted student to deviate from the preset trajectory by 5-9 cm, thereby increasing the difficulty of pressing. The system also prompted the students with L physical fitness test data: the explosive power of the upper limbs was up to standard, and the flexibility of the shoulders was insufficient, so the teacher formulated a personalized guidance plan based on the series of data prompted by AI: students first performed horizontal stretching training with elastic bands, and each training time was about 15 minutes, and the flexibility of the shoulders was improved through intensive training; At the same time, teachers assist students in completing the "wrist fixed ball throwing" training, and use the fixation belt to correct students' force posture to avoid students from encountering sports injuries. With the assistance of AI equipment, the student's action data is continuously recorded 10 times until the student's action error angle is less than 3, and the teacher will reduce the auxiliary tools to observe the standardization of the student's independent completion of the action.

AI systems can further analyze force application habits and muscle coordination through multimodal data fusion, such as combining electromyographic signals with motion images, thereby providing more refined and scientific training suggestions. This personalized coaching based on data not only improves training efficiency but also significantly enhances students' movement expressiveness and stage appeal.

Under such personalized guidance, teachers can improve the pertinence of dance training guidance based on students' practical problems and real demands, so as to improve the adaptability of the guidance plan and students' needs, and improve the accuracy and aesthetics of students' dance movements.

4. Collaborative training real-time feedback captures inspiration for action innovation

Artificial intelligence-assisted dance training can compare the real-time data of students' movements with standard data, and generate playback videos from them, allowing teachers and students to see the details of the movements more intuitively through slow motion, motion freeze-frame, and frame-by-frame analysis, and using AI data feedback to help students improve their technical movements. Although AI has not yet been able to achieve a full set of independent choreography of gymnastics movements, through intelligent models, it can combine students' physical fitness, technical level, dance themes and other reasonable choreography of the difficulty of movements, especially in the movement connection, spatial layout, rhythm control, etc., to improve the ornamentation of the dance [4].

For example, in the choreography of the sports dance "Silk Road Flower Rain", a total of 12 students participated, and AI data showed that 8 of them had high hip flexibility and 6 students had good ankle control. The system also generated a specific choreography plan based on the training theme and music rhythm: the action of "rebounding pipa" in Dunhuang murals was added to the rumba paragraph, focusing on the connection of the movements of the hands and hip joints. In the AI-generated motion simulation video, you can see that the flexibility of the hip joint is fully demonstrated; In the cha-cha action section, a series of ankle rotation actions are designed to give full play to the advantages of students' ankle control. Teachers adjust the training plan based on AI prompts, and AI prompts the stuck points according to the connection of dance movements, which can not only improve the coherence and fluency of dance movements, but also reduce students' movement mistakes and improve the quality of training.

AI technology can also utilize Generative Adversarial Networks (GAN) and reinforcement

learning algorithms to simulate action combinations of different styles and difficulty levels, providing teachers and students with more innovative ideas. The system can automatically generate multiple alternative choreography schemes, accompanied by completion predictions and physical exertion assessments, helping teachers balance artistic effects and students' actual abilities when making choices.

In such an intelligent training environment, it is more conducive to stimulating students' innovative thinking and creative inspiration, and constantly adjusting, optimizing and improving under the real-time feedback of AI, which can not only improve students' dance skills, but also stimulate students' enthusiasm for exploring art and beauty, so that students have a greater sense of accomplishment in training.

5. Assist in formulating competition strategies and intelligent scoring objectively and fairly

In accordance with the guiding spirit of "replacing training with competitions" in the reform of physical education curriculum, teachers can organize different types of competition activities in college dance training. On the one hand, this can stimulate students' enthusiasm for participation, and on the other hand, it can promote the exchange and interconnection of excellent experiences and high-quality resources. AI can assist teachers in formulating competition strategies and utilize AI for intelligent scoring, thereby enhancing the objectivity and fairness of dance competitions [5].

For example, in aerobics competitions, AI can assist teachers and students in analyzing the combinations of movements of competitors in previous competitions, the distribution of scoring points and conceding points, etc. For example, the system prompts the opponent to be good at lifting movements, but there are weak links in the transition connection, and suggestions are made from this: strengthen the fluency in the choreography of aerobics and pay attention to the beauty of the movement connection, so as to form a differentiated advantage. The AI system detects the physical fitness changes of the main team members, finds out their endurance peaks, and adjusts the distribution of high-energy-consuming actions in the action choreography to avoid high-energy-consuming actions when physical consumption is high, and reduce students' action mistakes.

At the same time, the AI system can also assist the competition referees, such as evaluating the difficulty of student action choreography, the overall completion of actions, prompting action mistakes and deduction suggestions, recording wonderful moments, prompting scoring points, etc., and visualizing data and scenes further improves the accuracy and credibility of the game referees, so as to make the evaluation data more convincing.

In short, the application of artificial intelligence can innovate the training form of gymnastics and dance sports, so that students can clearly recognize their own strengths and weaknesses in the competition, and experience the charm of gymnastics and dance sports in a fair competitive environment, so as to attract students to actively participate in gymnastics and dance training and achieve dual improvement of skills and literacy.

6. Application of artificial intelligence in sports injury prevention and rehabilitation

Artificial intelligence also plays a significant role in the prevention of sports injuries and rehabilitation training. By learning from a vast amount of data on sports injury cases, AI systems are capable of establishing injury risk prediction models, providing real-time alerts for potential sports injury risks during training. The system takes into account students' physical fitness, technical characteristics, and fatigue levels, offering personalized injury prevention advice, such as adjusting the range of motion and incorporating additional warm-up activities for specific muscle groups.

During the rehabilitation training phase, the artificial intelligence system can devise a scientific

rehabilitation plan and ensure the accurate execution of rehabilitation training through motion capture technology. For example, for students with ankle joint injuries, the system will dynamically adjust the rehabilitation training program and intensity based on their recovery progress, and guide students to correctly complete rehabilitation exercises through real-time feedback. This intelligent approach to rehabilitation training not only enhances rehabilitation efficiency but also prevents secondary injuries caused by incorrect training.

In addition, the AI system can establish students' health records, track their physical development and skill development over time, and provide data support for teachers to develop long-term training plans. Through analyzing historical data, the system can identify the growth patterns and critical periods of skill development of students, helping teachers seize the best training opportunities and maximize training effectiveness.

7. Conclusions

In summary, the application of artificial intelligence in college dance sports training has established a new educational paradigm of "intelligence + sports + aesthetic education". Advanced technologies such as AI-assisted big data analysis and computer vision play a significant role in precise motion analysis, improving choreography efficiency, and developing personalized training programs. Currently, the integration of artificial intelligence and college dance training is still in the exploratory stage. The exploration and application of AI tools, optimization and innovation of functions, and standardization and improvement of evaluation indicators all relate to the quality of AI application. In the future, with the integrated application of technologies such as 5G, edge computing, and virtual reality, AI will demonstrate greater potential in real-time interaction, immersive training, and remote collaboration. At the same time, we must prioritize the enhancement of teachers' AI literacy, enabling them to proficiently utilize AI technology to optimize teaching processes through training and practice. Furthermore, it is imperative to establish a comprehensive data security and privacy protection mechanism to ensure that student data is properly safeguarded and utilized. It is believed that in the near future, AI will become an indispensable and crucial component in university dance training, providing robust support for cultivating high-quality dance talents.

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