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The Application of Motion Capture Technology in Dance Teaching

Yaxin Wen

University of Edinburgh, Edinburgh EH89JU, Scotland

***Abstract*:** Motion-assisted *technology* is a scientific and technological research project developing and growing in recent years. It has realized the imaging of human motion through the motion capture system, the research of digital human motion posture analysis assisted by university teaching, and provided scientific guidance (Wang, 2016). The use of the technology can fill the immediate vacancy of the traditional teaching model, and can also give students' timely feedback, and has flexibility for students to perform dance exercises. First, the concept of motion capture technology will be introduced. Followed by the specific application of motion capture in dance teaching and the effects for teachers and students.

***Keywords*:** Motion Capture Technology; Dance Teaching; Traditional Dance Classes

Dance is a practical course. Most dance training uses oral teaching and movement demonstrations (Wang, 2016). The teaching model has certain limitations. The progress of individual trainees depends on the trainee's comprehension practices and the teacher's teaching by their aptitude (Yan, 2020). For the same exercise content, the learning progress of different trainees is different. Even two professional dance teachers may still give different evaluation results on the same student's performance.

However, the combination of motion capture technology and dance teaching will make up for the shortcomings of traditional teaching methods and have advantages that traditional teaching does not acquire and transmit movement skills. Further analysis of the information captured by the students' dance movements will allow us to have a deeper understanding of the performance of the students' practice.

1. Concept of motion capture technology

The motion capture system is based on the principle of computer graphics (sensor technology). Through the sensor installed on the moving object, the motion status of the object is captured and recorded in the three-dimensional coordinates in the form of an image, thereby obtaining the object's motion trajectory and movement (Rao, 2013).

The calculated data can also be directly imported into animation software and displayed through a three-dimensional virtual animation image. As the technology matures, it has gradually expanded to sports, film and dance (Rao, 2013).

2. The specific application of motion capture technology in dance teaching

The working principle is to apply motion capture technology based on conventional dance teaching content. First, set the performer's dance movement and its range of motion, then capture the performer s dance movement with three-dimensional data and establish a three-dimensional dance teaching model database. Finally, the dance movement database is made into 3D animation and applied to teaching practice.

The teaching design process follows 3D data acquired by motion capture technology is bound to the human body model and presented on the computer, and animation is generated for demonstration during teaching（Pang, 2020）. Students use the motion capture system to compare the dance movements they learned with the teachers' standard movements in sections so that they can quickly find out the shortcomings and facilitate partial correction.

Furthermore, teachers can correct and guide students' movements purposefully according to the learning movements of students

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captured by teaching (Wang, 2016). The capture system can capture the dance movements of teachers and students. According to the computer processes, adequate three-dimensional data, dance movement accuracy, and standardization can be detected in real-time.

Proper guidance can help students to improve and learn effectively. Several kinds of feedbacks are provided in our proposed learning tool. Such detection is the feedback of motion capture technology. According to Chan (2011) and his colleagues' research, there are three common types of feedback. The first type of feedback is direct feedback. When students receive training, the movement is captured and displayed in real-time by a virtual representative and a virtual teacher, composed of pillars representing different parts, and red refers to the correct and wrong parts. Through this vision, students will quickly find mistakes and correct their actions. This error may be due to a time error or error. Then students can look at the virtual teacher and track the correct move. These feedbacks are helpful in learning long-term exercise.

The second type of feedback is the score report. Show students a summary report on their performance. Students can know which joint is better and which joint needs improvement from the report. The third type of feedback is a slow-motion replay. This type is for students to understand how and where the error occurred. Through the playback, students can recognize the error of each gesture by observing the colour of the virtual representative. The colours indicate the correctness of the limb movement from dark red to white and are arranged in ascending order of correctness. When a student finds a red body part, he/she will check the correct position from the virtual teacher, who will also be shown in the replay.

Besides, many scientists have invented some technology or application combined motion capture technology with dance teaching. Alexiadis (2018) used Kinect to capture three-dimensional human motion data, and then used related plug-ins to import these data into Unity 3D to drive the movement of the character model and developed a dancer motion evaluation system. After analysing these data with MATLAB, a dancer's movements can be well evaluated. Liu (2014) uses Kinect motion capture technology to propose a real-time virtual human motion image reconstruction method combining Kinect SDK and graphics rendering engine OGRE and uses dynamic time warping algorithm (DTW) to analyse the difference between student movements and standard movements in the teaching process, to give a correct evaluation of the student's movement learning quality.

3. The usage of motion capture for students and teachers

It is recommended that students use the system to watch demonstrations, practice, and understand feedback through the following steps. Students can first understand the basic knowledge of movements in the demonstration. Then can practice these movements with the learning tools we propose. Students find errors from feedback and understand how to improve. Then they can go back to the presentation for timely information. After that, they can practice again.

According to previous research surveys, the application of motion capture technology in dance teaching can stimulate the subjects' interest in learning (Chan et al., 2011) and enable students to better master dance techniques in dance classes and improve classroom efficiency (Wang, 2016).

In addition, dance teaching under motion capture technology is better than traditional teaching to a certain extent. Wang (2016) tested the effectiveness of dance teaching effects based on motion capture technology in ensuring that the sample selection is representative and meets the needs of this experiment. He selected 60 students majoring in dance in their university to conduct a two-month controlled experiment. He divided these students into two groups: the control and experimental groups. The students in the control group took the traditional dance teaching. The students in the experimental group were arranged in the laboratory to watch the 3D dance teaching videos generated by the motion capture system and then completed the motion teaching under the motion capture system. The final experimental results show that the students who use motion capture for earning have a better mastery of dance movements than those who follow the routine learning.

Teachers can prepare teaching materials by capturing their dance movements. At the same time, they can prepare an appropriate syllabus for students (Chan et al., 2011).

However, some people have shown that technology in dance threatens the physical classroom to a certain extent. This is because they believe that with the guidance and feedback of motion capture technology, students can complete the dance learning at home and correct their mistakes by themselves. Therefore, there is no need to concentrate on the traditional dance classroom and follow the arrangements and guidance of dance teachers. However, the application of motion capture technology in dance teaching can assist dance teachers, but it is far from replacing traditional dance classrooms and dance teachers. Because dance is an art of communication. It requires the addition of dance aesthetics and emotional value. A machine without emotions cannot be achieved when creating a touching narrative dance repertoire. In addition, some problematic technical skills and movements need the support of professional dance teachers.

Parrish (2007) mentioned that technology is only a tool to improve dance and dance teaching; It enhances body movements instead of replacing them. It maximizes the diversity of dances students can create. It enables students to practice dance in other locations and create their dances, thereby increasing the development of dance faster and better.

4. Conclusion

In this paper, the benefits of motion capture technology to dance teaching are pointed out. Specific applications in dance teaching are introduced. The classroom is equipped with the training system we recommend, and students' real-time actions can be captured so that the system generates real-time feedback. After analysing the captured movements, teachers can point out the mistakes made by the students and advise them to improve by focusing on specific movements. This system could effectively improve classroom efficiency and better stimulate participants' interest in learning.

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