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Research on the strategy of optimizing the training path of sports dance and aesthetics for college students in general colleges and universities based on mathematical modeling

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Abstract In the current teaching of physical education and dance in general colleges and universities, there are problems such as insufficient standardized training of movements and poor integration of aesthetics, which affect the teaching effect and the cultivation of students' interests. Kinect 3D sensing technology provides a new way for movement detection, and the application of mathematical models can optimize the evaluation of training effect. In this study, through the world coordinate system conversion and dynamic sampling light projection algorithm, we realized the construction of three-dimensional model of human movement and assisted training based on joint coordinates and joint angle data. The experiment used random groups to conduct a semester-long comparative teaching experiment on 50 college students. The results showed that the students in the experimental group improved their sport dance motivation scores from 18.98±4.36 to 24.56±4.36 ($P<0.01$), and their skill learning scores from 18.12±3.42 to 23.73±2.55 ($P<0.01$), whereas the students in the control group did not have a significant improvement in motivation and skill learning. In terms of specialized technical performance, the experimental group was significantly higher than the control group in technical quality (82.48±7.36), music processing (81.14±6.85) and choreography and performance (79.76±4.51) ($P<0.01$). The study shows that the Kinect-based sports dance movement detection combined with aesthetic training can effectively enhance students' learning interest and special skills, providing a new optimization path for sports dance teaching in general colleges and universities.

Index Terms Sports dance, Aesthetic training, Kinect, Motion detection, Mathematical model, Optimization path

I. Introduction

With the improvement of people's living standard, sports dance has been widely popularized as a kind of healthful exercise [1], [2]. As one of the important places for training future talents, sports dance teaching is also an important path for aesthetic training, and the combination of sports dance and aesthetic education can help to improve students' physical quality and aesthetic level [3]-[5].

Sports dance is a comprehensive sports program that integrates art, sports and culture [6]. In terms of physical training, sport dance has obvious effects on body shaping, shape improvement, and cardiorespiratory function improvement [7], [8]. In addition, as an art form, sport dance can also improve students' aesthetic ability and creativity, and cultivate their ability to perceive and express art [9], [10]. In China, the teaching of physical education dance in colleges and universities has become a relatively independent physical education program [11]. However, in the actual teaching, there are still many shortcomings. First of all, the insufficiency of teachers' teaching experience and teaching ability leads to the fact that the teaching effect cannot be truly realized [12], [13]. Secondly, in the selection of teaching materials and the setting of teaching content, to a large extent, it still stays at the level of textbook knowledge, and lacks the actual teaching application of coherence and practical training [14]-[16]. The integration of sports dance teaching in colleges and universities with aesthetic education requires the combination of "artistic beauty" and "human beauty", encouraging students to connect culture and art with sports dance teaching, promoting the activation of resources in both aspects, and enabling students to discover their own interests and hobbies, thereby embarking on their own life paths [17]-[20].

Sports dance, as a kind of sport form integrating artistry, sports and socialization, occupies an important position in physical education of colleges and universities. Modern sports dance not only requires students to have good physical coordination and movement skills, but also needs to have artistic expression and aesthetic experience. However, at present, there are common problems such as single teaching method, insufficient training of standard movements and subjective teaching evaluation in the teaching of physical education dance in ordinary colleges and universities, which leads to students' low interest in learning and slow improvement of professional skills. The traditional teaching mode mainly relies on teachers' demonstration and students' imitation, and lacks objective movement evaluation standards and personalized training guidance, making it difficult to meet the needs of contemporary college students for physical education dance learning. The development of modern educational technology provides new possibilities for physical education dance teaching, especially the application of computer vision and three-dimensional sensing technology, which makes motion capture and analysis possible. Meanwhile, aesthetic education, as an important part of quality education, plays an important role in cultivating students' aesthetic ability, creativity and emotional expression. Combining sports dance training with the concept of aesthetic education can not only improve students' dance skills, but also cultivate their artistic cultivation and aesthetic interest, and promote comprehensive development. At present, the research on how to combine modern technology with the concept of aesthetic education to build a scientific and effective sports dance training system is still insufficient and needs to be further explored.

Based on the actual teaching of physical education dance in general colleges and universities, this study uses Kinect 3D sensing technology and mathematical models to construct a physical education dance movement detection method to achieve standardized assessment of movement. Through the conversion of the world coordinate system and dynamic sampling light projection algorithm, the construction of three-dimensional model of human movement is completed, and the training is assisted based on the joint coordinates and joint angle data. At the same time, the research integrates the concept of aesthetic education into sports dance training, and designs the training path strategy from the three dimensions of the application of aesthetic education concept, target combination and content integration. The effectiveness of the method is verified through comparative experiments to explore the innovative teaching mode of combining sports dance and aesthetic education.

II. Kinect-based movement detection method for sports dance

II. A. Image Acquisition of Sports Dance Trainers

The Kinect 3D sensor is structurally composed of a color camera, an infrared camera, and a depth camera, and Kinect relies on the three cameras to capture the original image information of the sports dance trainer.

Kinect 3D sensor in the acquisition of sports dance training scene images, Kinect 3D sensor coordinate model is shown in Figure 1.

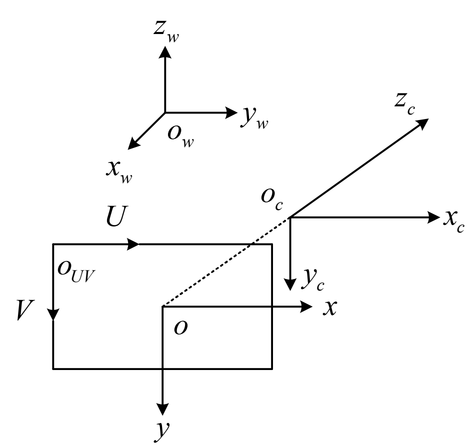

Figure 1: Coordinate model of Kinect three-dimensional sensor

In the figure, O_w is the world coordinate system, O_c is the camera coordinate system, OUV is the image pixel coordinate system, and o is the image physical coordinate system [21]. Where the camera coordinate system is Kinect's own coordinate system. When Kinect captures the content $w(x_w, y_w, z_w)$ in the world coordinate system, it needs to convert it to the camera coordinate system, and the conversion process is as follows L:

$$\begin{bmatrix} x_c \\ y_c \\ z_c \\ 1 \end{bmatrix} = \begin{bmatrix} R_{3\times3} & T_{3\times1} \\ 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} x_w \\ y_w \\ z_w \\ 1 \end{bmatrix} \tag{1}$$

where (x_c, y_c, z_c) is the coordinates of w in the camera coordinate system, and $R_{3\times3}$ and $T_{3\times1}$ are the rotation matrices and translation matrices from the coordinate system O_w to the coordinate system O_c, respectively.

The transformation process between the coordinate system OUV and the coordinate system 0 is:

$$\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} \frac{1}{dx} & 0 & u_e \\ 0 & \frac{1}{dy} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_c \\ y_c \\ 1 \end{bmatrix} \tag{2}$$

where u_0 is the projection of U in the coordinate system OUV onto the x perimeter in the coordinate system O.

At this point, $w(x_w, y_w, z_w)$ is transformed in the coordinate system OUV by the process:

$$z_e \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} z_x & 0 & u_0 & 0 \\ 0 & z_y & v_0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} R_{3\times3} & T_{3\times1} \\ 0^{\bullet} & 1 \end{bmatrix} \begin{bmatrix} x_w \\ y_w \\ z_w \\ 1 \end{bmatrix} \tag{3}$$

Through the above transformation process, the scene information of the sports dance trainer can be converted into the image information in Kinect.

II. B.Three-dimensional modeling of human movement

In the process of the human body performing sports dance movements: firstly, based on the Kinect somatosensory device to collect the depth data of the human body in a single direction, the camera origin coordinate system is converted to the world coordinate system, and a preliminary reconstruction model is obtained. Then, based on the dynamic sampling light projection algorithm, the three-dimensional model of human movement is reconstructed in depth. Finally, the real modeling of the human 3D model is completed based on texture mapping.

II. B. 1) World coordinate system conversion

First, the acquired depth data is 3Dized with 2D vertices. Floating point data is used instead of the original depth frame data, and combined with the camera coordinate data, the floating point data is converted into point cloud data, which is consistent with the Kinect camera orientation [22]. The specific method is as follows:

$$M_i(u) = B_i(u)K - 1[u,1] \tag{4}$$

$$M_i^g(u) = T_i M_i(u) \tag{5}$$

$$n_i^g(u) = U_i n_i(u) \tag{6}$$

where K denotes the intrinsic calibration matrix of the camera of the Kinect somatosensory motion capture device. u denotes a known point in the image, whose depth value and normal vector are described by $B(u), n_i(u)$, respectively. The T_i, U_i denote the camera pose transformation translation matrix and rotation matrix, respectively.

Next, the pose information of human movement is estimated. The pose data during camera movement is continuously collected by the alignment algorithm, and the relative poses between the Kinect sensing device and the starting frame at each moment are calculated to obtain the displacement and rotation variables between two neighboring frames. In summary, the conversion of the camera origin coordinate system to the world coordinate system can be realized.

II. B. 2) Dynamic Sampling Ray Projection Algorithm

The traditional ray projection algorithm allows for a deep reconstruction of the initial human body reconstruction results, which is based on the following principle: from each pixel point on the sample image, a ray is released along the direction of the point of view, and the ray passes through the three-dimensional data field. On each ray, a number of equidistant sampling points are selected according to a fixed sampling frequency, and the opacity and color values of the eight nearest data points are linearly interpolated three times according to the opacity and color values of the sampling points, thus obtaining the opacity and color values of the sampling points, and the schematic diagram of the traditional ray projection algorithm is shown in Figure 2.

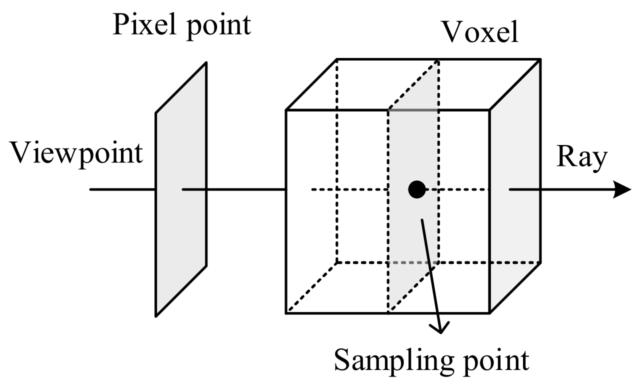

Figure 2: Schematic diagram of the traditional ray projection algorithm

In the traditional algorithm, the sampling frequency of each ray through the 3D data field is the same, and the sampling points are equidistant, which results in a large amount of computation per unit time and slow image rendering. According to the human visual characteristics, the hierarchical detail model can be dynamically adjusted to the sampling frequency when drawing, and when the object is closer to the viewpoint, a more detailed model representation is used, and vice versa, a coarse model representation is used to improve the rendering speed [23]. The schematic of the principle of improving the sampling frequency is shown in Figure 3.

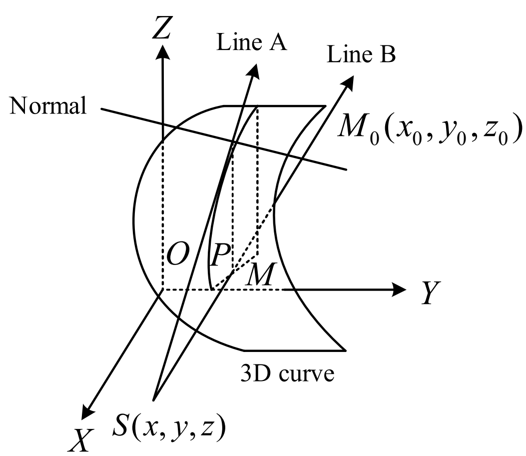

Figure 3: Schematic diagram of the principle for improving the sampling frequency

According to the principle of the algorithm shown in the figure, two lines of sight A and B are emitted from the viewpoint S, and let the line of sight A be tangent to the upper edge of the 3D surface, and the line of sight B passes through S to the nearest point of the 3D surface distance P. There exists a partial derivative $z = f' x(x_0, y_0, y_0)$ at the intersection of the surface and section normals on the line of sight A at $M_0(x_0, y_0, z_0)$, which can be expressed as:

$$f' x(x_0, y_0) = \frac{\partial f}{\partial x} \Big|_{x=x_0, y=y_0} \tag{7}$$

Eq. denotes the slope k_0 of the line of sight A with respect to the X-axis. Similarly, the tangent plane at point P is parallel to the Z-axis and has the largest value of slope k_0. When the surface is convex, the slope k_0 is positive, but when the surface is concave, the slope k_0 tends to become negative. Therefore, in this paper, we define the slope k_0 at the tangent point M_0 as:

$$k_0 = | f' x(x_0, y_0) | \leq 1 \tag{8}$$

The distance between the viewpoint S to M_0 can be expressed as:

$$| SM_0 | = \sqrt{(x_0 - x)^2 + (y_0 - y)^2 + (z_0 - z)^2} \tag{9}$$

Thus, the sampling frequency rate at point M_0 can be expressed as:

$$rate = \frac{k_0}{|SM_0|} = \frac{|f^{'}x(x_0, y_0)|}{\sqrt{(x_0 - x)^2 + (y_0 - y)^2 + (z_0 - z)^2}} \tag{10}$$

In the dynamic sampling ray projection algorithm, the closer the part to the observer's viewpoint, the larger the slope of the tangent point, the smaller the viewpoint-to-tangent point distance, the higher the sampling rate, the more pixels are projected on the screen, and the clearer the image. On the contrary, the farther away from the observer's point of view, the smaller the slope of the tangent point, the larger the distance from the point of view to the tangent point, the lower the sampling rate, the fewer the pixels projected on the screen, and the blurrier the image. The sampling frequency dynamically changes its size according to the change in the human viewpoint, which effectively reduces the amount of computation and improves the rendering speed of the image.

III. Experimentation and validation

In this section of the experiment, a dance video provided by a general college is selected to construct a standard movement database, a dance trainer is invited to learn the dance, and the information is collected and processed in real time through Kinect and computer.

III. A. Assisted training based on joint coordinates

After the experiment, the comparison table of the joint coordinates of the dance trainee and the standard movement database is shown in Table 1, from the table, it can be obtained that the value of the trainer's joint point coordinates is similar to the value of the standard dance joint point coordinates, for example, the trainer's head transverse coordinate is -72, and the standard dance head transverse coordinate is -82.8, which can be obtained that the method in this paper has a good detection effect. From the table, the specific difference between the trainer's dance action posture and the standard dance action posture can be obtained for a certain frame image, but the intuition is poor.

Table 1: Coordinate contrast

Site	The standard dance is the coordinate of the node		The trainer sets the node coordinates	
	x-coordinate	y-coordinate	x-coordinate	y-coordinate
Head	-82.8	219.4	-72	266.4
Neck	-26.2	31.7	-69.5	73.5
Left shoulder	-151.4	-52.8	-210.5	-3
Left elbow	-378.2	-50.4	-412.8	-111.2
Left hand	-654.2	-62.7	-637.7	-182.6
Right hand	93.9	-11.1	311.1	370.4
Right elbow	83.1	219.6	236.8	157.9
Right shoulder	46.5	504.8	87.5	-1.1
Right knee	-107.5	-867.7	-128.6	-3
Right foot	-67.1	-0.2	154.6	-163
Left knee	-236.5	-939.2	-23.4	-861.6
Left foot	-315.9	-1168.6	-13.6	-1002.4

Taking the right wrist joint as an example, a comparison of the trajectory of the hand joints in the dance movements is shown in Figure 4. From the figure, it can be seen that the dance trainer in the first right wrist upward movement, the height of the upward movement has not reached the requirements of the standard dance movement, and the wrist up to the highest point, the wrist retracted too quickly, and the difference with the standard movement is large. In the second right wrist raising movement, the speed of raising was too fast, and again there was a significant difference in movement. Based on the above analysis, the auxiliary training based on the change of joint coordinates can intuitively detect the difference between the training movements and the standard dance movements, and basically can meet the auxiliary training requirements of dance training.

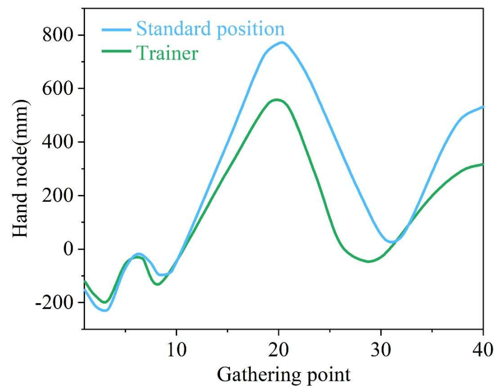

Figure 4: The movement of the movement of the movement was compared

III. B. Assisted training based on joint angles

After the experiment, the comparison of the joint angles of the dance action poses in a certain frame image is shown in Table 2. From the table, it can be seen that the joint angles of the dance action poses of the trainer and the dance instructor are more or less different, and the corresponding joint angle thresholds can be set according to their own levels to determine whether the training expectations are met during training.

Table 2: The Angle of the joint Angle of the dance gesture

Site	Action 1		Action 2		Action 3	
	Standard	Trainer	Standard	Trainer	Standard	Trainer
Left wrist - left elbow - left shoulder	166.5	169.6	173	166.7	176.3	173.6
Right hand - right elbow - right shoulder	107.4	147.7	169.1	156.9	172.5	159
Neck - right shoulder - right elbow	157.3	165.4	130.5	148.7	106.7	109.9
Neck - left shoulder - left elbow	168.3	159.2	134.2	148.8	101.3	111.2
Waist - left knee - left ankle	151.6	156.4	178.8	171.5	159.3	154.5
Waist - right knee - right ankle	152.5	159.2	160	165.7	179.5	168.6

Taking the right arm as an example, the left arm joint angles for the three movements are shown in Figure 5. Assuming that the left wrist joint is coded as A, the left elbow joint is coded as B, the left shoulder joint is coded as C, and the neck joint is coded as D. From the figure, it can be seen that the trainer's ∠ABC is on the small side and ∠BCD is on the large side for the first dance movement, and the left arm should be straightened a little bit in the subsequent training, and the waist position or the leg position should be slightly bent. In the second dance movement, ∠ABC is large and ∠BCD is large, in the subsequent training, the left arm should be straightened a little bit and the padded foot or body should be slightly straight. In the third dance movement, ∠ABC is large and ∠BCD is large, in the subsequent training, the left arm should be straightened a little and the neck lifted up.

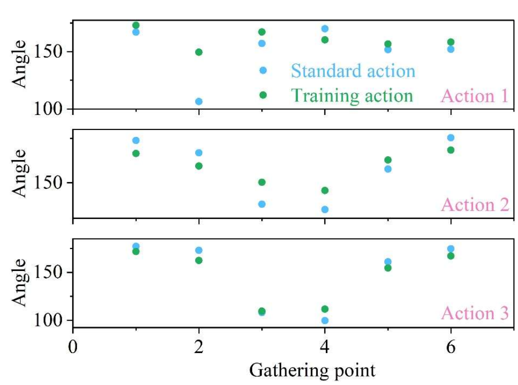

Figure 5: The Angle of the joint Angle of the left arm of the three movements

Based on the above analysis, auxiliary training based on the joint angle can be replaced to obtain the improvement direction of the subsequent dance training, which can basically meet the auxiliary training requirements of dance training.

IV. Strategies for aesthetic training paths

(1) The application of the concept of aesthetic education in dance training

The application of the concept of aesthetic education in dance training is reflected in the following aspects.

Cultivation of personality and creativity: Aesthetic education emphasizes the expression of each college student's personality and uniqueness. Dance training also focuses on cultivating students' personality expression and creativity. The choreography and creation of dance works require college students to show their personal characteristics and stimulate innovative thinking and dance creation ability.

Cultivation of Emotional Expression and Body Language Ability: Aesthetic education emphasizes the cultivation of college students' emotional expression ability. Dance, as a form of body language art, can help college students express their emotions through dance movements and gestures. Dance training cultivates college students' emotional expression ability through emotional guidance and body control training, so that they can convey real and profound emotions through dance works.

(2) Combination of the objectives of aesthetic education and dance training

Cultivate aesthetic interest and artistic cultivation: Aesthetic education aims to cultivate the aesthetic interest of college students, while dance training can let college students feel the beauty of dance art and cultivate aesthetic interest and artistic cultivation through contacting and performing excellent dance works.

Cultivate creativity and imagination: Aesthetic education emphasizes the cultivation of college students' creativity and imagination, while dance training can stimulate college students' innovative thinking and independent thinking ability through dance choreography and performance, and cultivate their dance creation ability and imagination. Cultivate emotional expression and interpersonal communication ability: Aesthetic education emphasizes the cultivation of emotional expression and interpersonal communication ability of college students, while dance training can cultivate the emotional expression and interpersonal communication ability of college students through dance performances and cooperative performances, so that they can learn to cooperate, coordinate and work together with others.

(3) Integration of the contents of aesthetic education and dance training

Integration of artistic cultivation and technical training: Dance training not only focuses on the technical training of college students, but also focuses on cultivating the artistic cultivation of college students. While conducting technical training, teachers can guide college students to understand the historical background, stylistic characteristics and artistic value of dance, so as to deepen their knowledge and understanding of dance art. Integration of dance performance and creative ability: Dance training should encourage college students to try to choreograph dance works independently and give full play to their personal creativity and imagination by providing them with opportunities and space for creativity. Integration of emotional expression and thinking cultivation: Dance training should focus on cultivating college students' emotional expression ability, so that they can convey emotions through dance movements and body language. At the same time, it should also focus on cultivating the thinking ability of college students, so that they can think deeply about the meaning and expression behind the dance through studying and analyzing the dance works.

To summarize, dance training is based on aesthetic education, and by integrating the concepts, objectives and contents of aesthetic education, it can promote the comprehensive development of college students' aesthetic interest, artistic cultivation, creativity, imagination, emotional expression and interpersonal communication ability. This comprehensive education mode can not only improve the dance skills of college students, but also cultivate their comprehensive quality, so that they can become well-rounded artistic talents.

V. Effectiveness of the application of aesthetic-based training methods in the teaching of physical education dance

This study conducted an experimental test from the two dimensions of college students' interest in learning sports dance and changes in special performance. Students majoring in sports dance in the class of 2024 of a general college were taken as the experimental subjects, totaling 50 students, including 38 female students and 12 male students. On the premise of ensuring that the gender ratio and number of experimental subjects in the two groups are comparable, this study randomly divided the students into the experimental group and the control group. There were 6 male students in the experimental group and 6 male students in the control group. There were 19 female students in the experimental group and 19 female students in the control group. The experimental group was taught physical dance using the aesthetic training method proposed in this paper, while the control group was taught using the traditional teaching method.

V. A. Comparative Results of Interest in Learning Sports Dance

The results of the comparison of the experimental group's interest in learning physical education dance before and after the experiment are shown in Table 3 (***, **, and * represent the significance level of 1%, 5%, and 10%, respectively). From the table, it can be seen that the mean value of the experimental group before the experiment, and the experimental group after the experiment in terms of motivation is: 18.98/24.56. After the paired samples t-test and confirming the satisfaction of variance chi-square, the significance result of the p-value of 0.000***, so the statistical results are significant, indicating that there is a significant difference in motivation between the experimental group before the experiment, and the experimental group after the experiment. Based on the data in the table, this study conducted a paired samples t-test in order to compare the scores of the five dimensions of interest in learning physical education dance of the students in the experimental group before and after the experiment. The results showed that there was a significant increase in the scores of negativity, positivity, participation, autonomy, and physical education dance attention of the students in the experimental group after the experiment, and this increase had a highly significant difference ($p<0.01$). It indicates that students' interest in learning sport dance is positively and positively affected in the teaching mode based on the methodology of this paper. In this teaching mode, students' negative attitude scores show a significant downward trend, and this change directly reflects that students' interest in learning sports is gradually increasing. This change reflects the effective application of this paper's methodology in the teaching of physical education dance, which can significantly enhance students' learning motivation and lay a solid foundation for the cultivation of lifelong sports awareness.

Table 3: Comparison results of experimental experiment of dance learning

Dimension	Experimental group (SD)		T value	P value
	preexperiment	After control		
Positivity	18.98±4.36	24.56±4.36	-4.444	0.000***
Negativity	9.57±3.33	7.24±2.95	-2.624	0.016**
Skill learning	18.12±3.42	23.73±2.55	-6.164	0.000***
Extracurricular activities	17.82±2.69	21.25±2.26	-4.471	0.000***
Sports dance attention	17.65±3.46	21.83±3.39	-4.158	0.000***

V. B. Results of Comparison of Interest in Learning Sports Dance

The results of the comparison of learning interest in physical education dance in the control group before and after the experiment are shown in Table 4. From the table, it can be seen that the mean values of the control group before the experiment and the control group after the experiment in terms of motivation are: 18.909/20.941. After the paired samples t-test and confirming the satisfaction of chi-square, the significance result of the p-value is 0.160, which yields a statistical result of non-significance, indicating that there is no significant difference between the pre-experiment of the control group and the post-experiment of the control group in terms of motivation. Based on the data provided in the table, the study executed a paired samples t-test with the aim of comparing the scores of the five dimensions of interest in learning physical education dance of the control group students before and after the experiment. The results of the analysis showed that the control group students showed a significant increase in skill learning scores after the experiment, with a highly significant difference ($p<0.01$). However, there were no significant changes in the motivation, participation, autonomy, and sport concern scores, and no significant differences existed ($P>0.05$).

Table 4: Comparison of sports learning in control group

Dimension	Control group (SD)		T value	P value
	Preexperiment	After control		
Positivity	18.909±4.65	20.941±4.75	-1.503	0.16
Negativity	9.078±3.99	8.506±3.92	0.679	0.491
Skill learning	17.821±4.26	20.117±4.23	-1.76	0.076*
Extracurricular activities	17.553±3.68	18.016±3.55	-0.908	0.353
Sports dance attention	18.283±4.26	19.045±3.95	-0.678	0.485

After the exhaustive analysis above, we can clearly conclude that the control group did have a certain positive promotion effect on the learning interest of the general physical education dance course when adopting the traditional physical education teaching mode, however, this enhancement effect was not significant.

V. C. Comparative Results and Analysis of Specialized Technical Achievements

The results of the comparison between the experimental group and the control group in terms of specialized technical scores after the experiment are shown in Table 5. From the table, it can be seen that the experimental group, the control group in the technical quality of the average value are: 82.48/73.63. After independent samples t-test, and confirm the satisfaction of the premise of the chi-square, the significance of the results of the p-value of 0.000***, so the statistical results are significant, indicating that the experimental group, the control group in the technical quality of the significant differences. Based on the analysis of the tabular data, this study used independent samples t-test to compare the scores of the experimental and control groups in comparison of their special technical performance after the experiment between the groups. The results of the analysis showed that the experimental group scored significantly higher than the control group in the three areas of technical quality, music processing, and choreography and performance, with a highly significant difference ($p<0.01$).

Table 5: Comparison results of special technical achievements

Dimension	After the experiment(SD)		T value	P value
	Experimental group	Control group		
Technical quality	82.48±7.36	73.63±8.26	4.138	0.000***
Music processing	81.14±6.852	74.958±6.69	3.315	0.001***
Choreography and performance	79.76±4.51	73.294±5.826	4.448	0.000***

VI. Conclusion

The combination of Kinect somatosensory equipment and aesthetic training methods applied to the teaching of sports dance in general colleges and universities has achieved remarkable results. The experimental data showed that in the evaluation of the special technical performance of sports dance, the experimental group using the aesthetic training method scored 82.48±7.36 in terms of technical quality, which was significantly higher than that of the control group, which was 73.63±8.26 ($P<0.001$); in terms of choreography and performance, the experimental group scored 79.76±4.51, which was higher than that of the control group, which was 73.29±5.83 6.47 points ($P<0.001$). In terms of changes in learning interest, the experimental group increased from 17.65±3.46 to 21.83±3.39 in the dimension of sports dance attention ($P<0.001$), while the control group increased from 18.28±4.26 to 19.05±3.95 only, which was not a significant difference ($P=0.485$). The experiential aesthetic training path effectively improved students' motivation to learn physical dance and the level of specialized skills by integrating the three dimensions of artistic cultivation and technical training, dance performance and creative ability, and emotional expression and thinking cultivation. Kinect-based movement detection provides objective evaluation standards for training, while the integration of aesthetic concepts enhances learning motivation and artistic expression. This comprehensive training model not only improves college students' sport dance skills, but also promotes the overall development of their aesthetic interest, creativity and emotional expression ability.

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