Application of Virtual Reality Technology in College Tennis Teaching

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***Abstract*—Objective: To test the advantages and disadvantages of virtual reality technology in college tennis teaching. Methods: 32 male students of school tennis team in XX University were randomly divided into experimental group (n=16) and control group (n=16). The experimental group and the control group had 8 weeks of tennis learning (The same learning content), during which the experimental group had MTC Intelligent Tennis System in the course practice stage. Results: 1) The scores of the forehand and backhand batting techniques and the action technique evaluation in the experimental group were significantly better than those before the experiment (p<0.05). 2) The control group was significantly better than the control group (p<0.05). 3) After the experiment, the scores of the forehand and backhand strokes in the experimental group were significantly better than those in the control group (p<0.05). 4) After the experiment, there was no significant difference between the experimental group and the control group (p<0.05). Conclusion: 1) Virtual reality technology can more intuitively demonstrate the standard technical actions and timely compare and correct the simulated actions. 2) Virtual reality technology can carry out accurate technical movement track comparison exercise, and speed up the speed of technical movement consolidation. 3) Virtual reality technology can establish personal technical files, personalized tracking and comparison, and facilitate technical action evaluation. 4) Whether virtual reality technology can improve the effect of practice is still lack of sufficient evidence.**

Keywords-virtual reality technology; intelligent teaching; college tennis; virtual classroom

I. INTRODUCTION

Virtual reality technology uses computers and external devices to simulate the three-dimensional space environment and human feelings (vision, hearing, touch, etc.). Objects in the construction of virtual environment can change with the change of location, creating a near real environment and feelings, just like the physical environment [1]. Virtual reality technology can not only make up for the lack of teaching site, funds and equipment, but also optimize the process of physical education, improve the environment of physical education, and improve the level of teaching and training [2-6]. At the same time, virtual reality technology is an intelligent, distributed, interactive and illustrated teaching method in physical education, which is totally different from the traditional way of Physical Education [7]. In the application of virtual reality technology in sports training, it can not only avoid the sports injury caused by high difficulty and complex technical actions, but also analyze and evaluate the actions, arrange and innovate scientifically, improve the scientific and technological content of sports training, and enable students to master the sports technical actions quickly [8-13]. With the improvement of computer virtual reality technology and the gradual promotion of education informationization, the application of virtual reality technology in college physical education must become a trend [14], and the future application mode will not only be as simple as "Virtual Glasses + Virtual Environment" [15-19].

II. METHODS

A. Object

32 tennis team students from XX University, male, are all right-handed. The subjects were randomly divided into experimental group and control group, and the number of men and women was equal (Table 1).

Table 1 The Basic Information of Subjects

Group	Height (cm)	Weight (kg)	Years of Training (year)
Control Group (n=16)	169.22±10.25	68.21±5.34	3.34±0.65
Experience Group (n=16)	168.21±11.45	67.87±6.21	3.54±0.73

B. Experimental scheme

The physical fitness (Fan-shaped Running, Solid Ball and Standing Jump) and the technical level of forehand and backhand batting of the experimental group and the control group were evaluated, and the experimental group and the control group were tested for 8 weeks (16 class hours in total).

1) In the control group, traditional teaching methods were used, such as teacher demonstration, explanation and students'

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practice. Teachers corrected the errors collectively and individually according to each group's practice.

2) In the course practice stage, the experimental group intervened the relevant exercises of the students' courses through virtual reality equipment, namely, three groups "10 minute intervention + 10 minute exercise" (Fig.1).

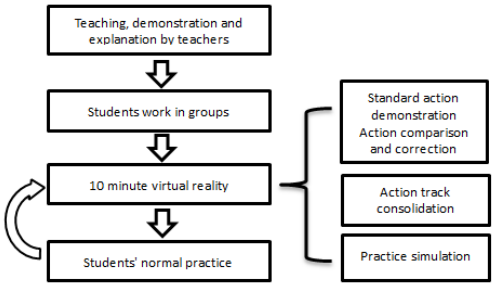

Fig. 1 Teaching Flow Chart of Experimental Group

C. *Experimental equipment*

The hardware of virtual reality technology adopts MTC Intelligent Tennis System equipment (Intelligent Racket, Intelligent Helmet, High-performance Display and Host), and the software adopts VR-Tennis software. The system includes virtual human coach system, tennis basic training course, artificial intelligence dialogue system, student tennis technology evaluation system, practitioner virtual human system, tennis game system, etc. (Fig. 2).

Fig. 2 Schematic diagram of MTC Intelligent Tennis System equipment

D. *Test methods and standards*

1) Physical fitness test

Fan-shaped Running can reflect the movement ability and emergency stop and start ability of the subjects, Solid Ball throw can reflect the strength and explosive force of the upper limbs of the subjects, Standing Jump can reflect the strength and explosive force of the lower limbs of the subjects, these physical qualities play an important role in tennis.

a) Fan-shaped Running: place a racket behind the midpoint of the baseline, point the head of the racket at the net, and the position of five balls is shown in Fig.3. Starting from the midpoint of the baseline, take back 5 balls in turn in the counter-clockwise direction, and place the ball retrieved each time on the racket surface. After the tester yells "prepare to start", the stopwatch will start timing and record the completion time.

b) Solid Ball Throw Far: Front hands 2kg solid ball throw far, measure the throw distance.

c) Standing Jump: Take off with both feet from the jumper and measure the distance.

For the above three test items, the subjects were tested three times, and the best record was taken.

2) Technical test of baseline forehand and backhand

The baseline forehand and backhand pull requires the subject to have accurate prediction, rapid movement and standard hitting technical action, which is the embodiment of tennis comprehensive ability. The subjects were tested after full preparation and 3 minutes of forehand and backhand practice.

a) Standard Test of forehand and backhand hitting technique

The subjects and the same coach made 3 times 1-minute continuous forehand and backhand strokes at the baseline, recording the maximum number of strokes (Excluding excessive ball and other hitting techniques), and required the subjects to use forehand and backhand strokes alternately.

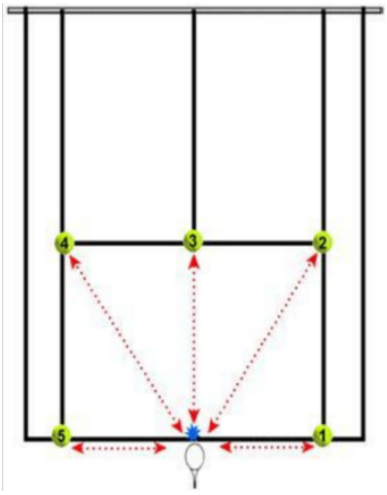

Fig. 3 Diagram of Fan-shaped Running

b) Evaluation of forehand and backhand batting techniques

Five tennis teachers with more than 10 years of teaching experience scored the experimental group and the control group according to the technical action scoring standard

(Table 2). The final score of the technical evaluation was taken from the average score of five judges.

Table 2 The Evaluation Standard of Forehand and Backhand Technical Action

Rating	Technical Evaluation Standard	Score
Excellent	Accurate prediction, full rotation, in place movement, coordinated effort, accurate hitting point, complete with swing.	90−100
Good	The prediction is basically accurate, the rotation is relatively sufficient, the movement is basically in place, the power is relatively coordinated, the hitting point is basically accurate, and the swing is relatively complete.	80-89
Commonly	The prediction is basically accurate, the rotation is not enough, the movement is basically in place, the power is not coordinated enough, the hitting point is not accurate enough, and the swing is relatively complete.	70-79
Poor	The prediction is not accurate, the rotation is not sufficient, the movement is not in place, the force is not coordinated, the hitting point is not accurate, and the swing is not complete.	＜69

E. Experimental control

In the process of the experiment, the teaching environment and content of the experimental group and the control group are exactly the same, and the same teacher is responsible for the teaching task. During the test process before and after the experiment, the tester could not identify the members of the experimental group and the control group.

F. Analysis

The data were expressed by $M \pm SD$.Spss20.0 was used for statistical analysis independent sample *t*-test for test data before the experiment and the paired sample *t*-test for test date after the experiment.

III. RESULTS

A. Before the experiment

1) There was no significant difference between the experimental group and the control group in Fan-shaped Running, Solid Ball throwing distance and Standing Jump tests.

2) There was no significant difference between the experimental group and the control group in the technical standard of forehand and backhand batting and the action technical evaluation (Table 3).

B. After the experiment

1) After the experiment, the scores of the forehand and backhand hitting technique and the action technique evaluation in the experimental group were significantly better than those before the experiment ($p<0.05$).

2) After the experiment, the control group was significantly better than before in both hitting and action skill evaluation ($p<0.05$).

3) After the experiment, the scores of the forehand and backhand strokes in the experimental group were significantly better than those in the control group ($p<0.05$).

4) After the experiment, there was no significant difference between the experimental group and the control group in the technical standard of forehand and backhand strokes ($p>0.05$) (Table 3).

IV. DISCUSSION

A. Skill mastery

Correct sports image plays an important role in the early stage of learning new sports skills. In the early stage of motor skill learning, students receive the information expressed by teachers in teaching technical actions by means of vision, hearing, and proprioception and so on. This process is also the formation of motor imagery in the brain. The correct and clear sports image is the premise and foundation for students to master technical actions in skill teaching [20]. After the experiment, both the experimental group and the control group have significant improvement in the evaluation of forehand and backhand hitting technology and technical action technology, which shows that traditional teaching and artificial intelligence video feedback system teaching are very effective for students to master skills, but there is no significant difference between the experimental group and the control group. The test of tennis forehand and backhand's hitting technology up to the standard requires students to predict the ball accurately, move quickly, hit accurately and coordinate the effort, which is a test of students' comprehensive ability. Virtual reality technology has a certain gap in the simulation of real-world confrontation on the hitting rhythm, the direction of the ball (Height, Angle, Depth, Strength, Rotation) and other aspects, resulting in students' hitting rounds not much help. In the action evaluation of forehand and backhand stroke technology, virtual reality technology provides students with a more intuitive visual effect. Through the imitation and practice of standard actions, students can quickly establish the correct technical action model and improve the speed of students' mastering skills.

B. Skill correction

The technical action of tennis is more complex, which requires high details of some limbs and wrists. When finishing the tennis stroke, it is necessary to ensure the consistency of the action, so as not to cause the disconnection of technical action and not affect the transmission of strength. In the course of class, due to the fast speed of teachers' demonstration and the poor observation angle of students, it will inevitably affect the speed of students' mastering technical actions [20]. When teaching with traditional teaching method, it is difficult for students to form correct and clear action image simply through the explanation and demonstration of teachers. In the process of technical practice, it is also easy to make mistakes, but only

rely on the oral guidance of teachers and language description for error correction, coupled with the lack of understanding of their own technical actions, it is difficult for students to understand the specific form of their own wrong technical actions and the wrong content that needs to be corrected, which leads to the long-term existence of technical actions, while teachers and students also need to repeatedly correct This greatly reduces the efficiency and effect of learning [20]. The application of virtual reality technology in the teaching process can capture the technical action of students' forehand and backhand batting practice and carry out three-dimensional human body modeling. Through the comparison with the standard technical action, it can correct in time and quickly. Virtual reality technology can also establish their own tennis virtual human files for practitioners, which can be used for technical movement tracking and evaluation, and personalized course customization.

C. Skill consolidation

The forming process of sports skills should go through three stages: generalization differentiation automation. In this process, students need to constantly collect information and correct technical actions in time to form a fixed correct action [21]. In the process of teaching, it can be found that students in the experimental group can not only watch the teacher's demonstration actions, but also imitate and practice through the standard technical action demonstration and action track of virtual reality equipment, constantly improve their own technology and enhance their awareness of technology. The students in the control group can only teach through the teacher's language explanation and demonstration, but can't directly understand their own action playback. For some beginners, simple language explanation and action demonstration cannot regulate their own technical actions, so they will feel confused in the actual learning process, and it is relatively difficult to master the standard actions [22]. In the final stage of consolidation and improvement, because students can continue to practice repeatedly through standard technical action comparison, and then can clearly find their progress and improvement, so it can effectively meet the students' sense of achievement, improve the students' motivation to learn tennis, so it can also improve the efficiency and initiative of students' learning, and also can accelerate the students' palm on sports skills hold [21]. Virtual reality equipment, as a new training means, can only be used as an auxiliary tool for the time being in the whole process of sports training. It is also necessary to improve the interactivity and real-time transmission through 5G network for innovative access to sports training. In addition, the optimal use of single time and staged time also needs further study [23].

Table 3 Statistical Table of Physical Fitness of Experimental Combination Control Group before Experiment

	Experience Group (n=16)		Control Group (n=16)	
	Before the Experiment	**After the Experiment**	**Before the Experiment**	**After the Experiment**
Fan-shaped Running（s）	19.45±2.12	—	19.52±1.98	—
Solid Ball Throw Far（m）	6.97±1.14	—	6.85±1.23	—
Standing Jump（m）	2.26±0.38	—	2.27±0.41	—
Standard Test of forehand and backhand hitting technique（n）	10.98±3.56	14.69±2.76*	10.36±3.45	14.66±2.45*
Evaluation of forehand and backhand batting techniques（score）	56.65±5.23	72.54±7.87*#	55.98±5.43	61.23±6.76*

Note: * indicates that there is significant difference ($p< 0.05$) compared with before the experiment;
# indicates that there is significant difference ($p < 0.05$) compared with the control group.

V. CONCLUSION

1) Virtual reality technology can more intuitively carry out standard technical action demonstration and timely simulation action comparison correction.2) Virtual reality technology can carry out accurate technical action track comparison exercise and speed up the speed of technical action consolidation.3) Virtual reality technology can establish personal technical files, personalized tracking and comparison, and facilitate the evaluation of technical actions.4) Whether virtual reality technology can improve the effect of actual combat training is still lack of sufficient evidence.

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