Application of Virtual Reality Technology (VR) in Practice Teaching of Sports Rehabilitation Major

Man Fang¹, Fan You² and Rongqi Yao¹,*

¹School of Physical Education and Health, Hubei University of Chinese Medicine, Wuhan, China
²School of Physical Education and Equestrian, Wuhan Business University, Wuhan, China

*Corresponding author e-mail: jingming1992@hbtcm.edu.cn

Abstract. Patients who can receive rehabilitation training provide two types of feedback. This is the biggest advantage of virtual reality technology for rehabilitation training, and at the same time can improve the patient's perception of rehabilitation results. This article aims to study the application of virtual reality technology (vr) in sports rehabilitation professional practice teaching. This paper uses the research method of virtual scene position mapping. The virtual scene position mapping is based on the virtual realization technology of upper limb rehabilitation training, which is manipulated by the movement of the patient's upper limbs. In the experiment, all the students in the first and second classes of a sports rehabilitation major in a local university were subjected to theoretical tests and practical ability assessments to all the students in the first and second classes of the sports rehabilitation major. Experimental data shows that the excellent rate and passing rate of the experimental class's practical ability test are much higher than those of the control class. Therefore, it can be concluded that the application of virtual reality technology to sports rehabilitation teaching is beneficial to the improvement of learners' practical ability. The experimental results show that the test excellence rate of the experimental class is 24.2% higher than that of the control class, and the passing rate is 12% higher. Therefore, applying virtual reality technology to sports rehabilitation education can stimulate people's interest in learning. The virtual environment is very similar to the real world, and the motor skills learned in the virtual environment can be successfully transferred to the real world.

Keywords: Virtual Reality Technology, Sports Rehabilitation Specialty, Practical Teaching

1. Introduction
Virtual reality technology is a new type of information technology today, which is mostly used in multi-sensory teaching, pilot training and medical training (surgeon training using virtual reality technology), psychotherapy and rehabilitation training and other practical fields [1-2]. Virtual reality is
an artificial environment composed of computer hardware and software. Users immersed in it have the feeling of seeing, hearing, and touching in the three-dimensional visual space of humans and computers, and strive to create the same impression of the real environment as the real world [3]. Virtual environment is the use of virtual reality technology to simulate the real environment in the real world, and has three characteristics: autonomy, interactivity and existence [4-5].

The "preoperative planning system" of Coburn et al. uses virtual reality technology to not only display the 3D images of the patient, but also allows the doctor to perform a virtual simulated operation in advance, so that a suitable plan can be specified [6]. Ali et al. used virtual reality technology to construct virtual liver and kidney models [7]. The virtual manipulation system reproduces the experimenter's manipulation process through actual touch, force, vision and other sensory organs [8].

Human-computer interaction in virtual reality technology can be divided into two parts: stimulus signal input and action output providing feedback. The computer sends tactile, auditory and visual signals to the user by wearing input and output devices (such as data gloves, stereo headsets and display helmets) [9-10]. In order to provide accurate feedback on user responses, virtual reality technology also includes various human-machine interfaces based on special technologies, such as position trackers and eye-tracking devices, to monitor and transmit user behaviors to achieve accurate human-computer interaction processes [11-13].

2. Research on Application of Virtual Reality Technology (VR) in Practice Teaching of Sports Rehabilitation Major

2.1. Analysis of the Advantages of Medical Virtual Reality Teaching

As one of the core content of educational technology, because they want to cultivate their flexible thinking, virtual reality technology provides abundant resources and convenient space to cultivate diversified thinking, and combines learning, practice and self-testing to form a lively teaching method that goes beyond the scope of traditional teaching methods and methods. Therefore, it has irreplaceable functions and effects.

Since the medical field has a close, important and special relationship with humans, the way of interaction between humans or humans and reality in this field is restricted by certain conditions, and some of these restrictions are very dangerous for humans. Virtual reality offers great potential that is difficult to achieve with other technologies. This can reduce education costs, reduce risks, strengthen the quality of education and improve the defects of the education environment.

1) Apply virtual reality technology to make up for the lack of teaching conditions and save educational resources

The virtual learning environment constructed with virtual reality technology can improve many problems. For example, it can better handle the problems of school teaching resources, and it can also alleviate the pressure on the school's teaching economy. At the same time, it can minimize resource loss, significantly reduce training costs and save a lot of educational and social resources.

2) Apply virtual reality technology to cultivate learners’ thinking and stimulate learners’ interest in learning

The application of virtual reality technology in medical education can not only effectively combine text, graphics, images, sound and animation, but also show learners from multiple angles and directions, develop learners’ sensory sensitivity, and learners can enter a whole new learning world. Questions and heuristic teaching methods used in teaching can help learners fully mobilize their thinking ability, stimulate the brain, stimulate interest in learning and expand thinking space. Under continuous stimulation, learners' thinking can become flexible, clear, and fluent, laying an excellent foundation for developing their own innovative thinking ability.

3) Apply virtual reality technology to break the limitations of teaching space and time

Constructivist learning theory believes that context is an important factor in learning, and learning context should be combined with actual context, because only vivid and rich actual context can enable
learners to master advanced knowledge. But in real life, the actual situation does not exist all the time, there are time and space constraints. If learners are in different situations in different eras and backgrounds, they will have different feelings, which is easy to cause deviation. Virtual reality technology eliminates this deviation, it can reproduce a specific era environment to learners, and provide a situation and experience that can be produced in real life.

2.2. Virtual Scene Location Mapping

The virtual realization of upper limb rehabilitation training is to manipulate the game through the movement of the patient’s upper limbs. The movement of each joint of the upper limb drives the rotation of the corresponding degree of freedom of the manipulator in the rehabilitation mechanical system, and the rotation of the degree of freedom of the manipulator drives the rotation of the sensor, and the sensor voltage changes with the rotation.

Taking the "shoulder adduction and abduction" of the left upper limb as an example, we will explain the mapping relationship between the patient's upper limb movement position and the virtual game scene position. The evaluation voltages of shoulder abduction and abduction range of motion are set to $V_l$ and $V_r$, respectively, and the patient is receiving rehabilitation training. When the voltage reaches $V_l$, it means that it reaches the left edge of the virtual scene. When the voltage reaches $V_r$, it means that it reaches the right edge of the virtual scene. The intermediate voltage value of the evaluation value is $V_{mid}$, as shown in formula (1).

$$V_{mid} = \frac{(V_r + V_l)}{2}$$  \hspace{1cm} (1)

The current voltage value of the patient during training is $v$, then the position of the patient’s upper limbs corresponds to the abscissa $x$ of the virtual scene as in formula (2):

$$x = \frac{(v - V_{mid}) \times 2}{V_r - V_l}$$  \hspace{1cm} (2)

According to the analysis, the range of the $x$ value obtained by equation (2) is [-1, 1], and the $x$ value can be converted into the coordinate value of the actual game scene according to the size of the specific game. Assuming that the leftmost coordinate of the virtual game scene is $x_l$, and the rightmost coordinate is $x_r$, the horizontal axis $X$ of the virtual game scene corresponding to the value of $x$ can be obtained from the linear equation of equation (3).

$$X = \frac{x_r - x_l}{2} x + \frac{x_r + x_l}{2}$$  \hspace{1cm} (3)

After the patient undergoes rehabilitation training, the system can intelligently score the patient's training results. The smart score is based on the number of patients with an intensity level of 5 completed within 5 minutes of the same game. This article takes the "fried egg" game as an example. If the game is difficult to operate, a patient with an intensity of 5 can complete $n$ fried egg tasks within 5 minutes. The difficulty level of the game set by the patient during the rehabilitation training of the game is three different levels of "low", "medium" and "difficult", and within 5 minutes $n/3$, $2n/3$, and $n$ can be completed by frying The egg mission reaches full marks. The corresponding values of the “low”, “intermediate” and “difficulty levels” of the game in the system are 1, 2 and 3. Assuming that the patient’s current rehabilitation training time is $t$ minutes, the game difficulty value is $lev$, and The number of completion of the omelette task is $nt$, and the intelligence score result of the patient's rehabilitation training is the score shown in equation (4).

$$score = \frac{n_t \times 5 \times 3}{t \times n \times lev} \times 100$$  \hspace{1cm} (4)
The formula for matching using Euclidean distance is shown in (5):

\[ D_{ij} = \left( \sum_{k=1}^{n} \left| L_i(k) - L_j(k) \right|^2 \right)^{\frac{1}{2}} \]  

(5)

\( L_i(k) \) and \( L_j(k) \) in formula (5) represent the feature descriptors of points \( i \) and \( j \) to be matched, respectively. Because it is tested by the distance method, the \( D_{ij} \) value in the formula represents the degree of matching between two points. The larger the value, the lower the matching between the two points. We set a range for the value of \( D_{ij} \). When this value is less than the set value \( t \), it means that the matching degree of the two points is acceptable. It can be considered that they are a pair of feature points that are successfully matched, so that the matching of a pair of feature points is completed.

### 2.3. Application of Virtual Reality Technology in Sports Rehabilitation Engineering

Not only measuring diagnosis, auxiliary support and social entertainment, the most important use of virtual reality technology in the field of sports rehabilitation is to perform rehabilitation training on the sports functions of the disabled. The key to successful rehabilitation training is whether the amount of exercise required for rehabilitation training is appropriate, whether the exercise is stable, and whether the exercise method is suitable for general living habits. According to the classification of sports training, virtual reality is mainly used in the following two aspects of sports rehabilitation.

1. **Balance and posture rehabilitation training**
   Proprioception is used to perceive the position and movement status of each part of the body. If the balance receptors in the vestibular system of the inner ear or the kinesthetic receptors in the muscles and joints are damaged, the patient will experience symptoms of loss of balance and uncoordinated movements.

2. **Walking sports rehabilitation training**
   Using the visual presentation technology of virtual reality, a visual clue is provided on the virtual road of walking training, which can effectively guide the patient to take the first step of walking; during the walking process, the clue is always located in front of the patient’s feet to indicate the direction of advancement. To help patients continue to walk, the more realistic the visual cues, the more beneficial to the rehabilitation of patients' walking ability.

### 3. Application Experiment of Virtual Reality Technology (Vr) in Sports Rehabilitation Professional Practice Teaching

#### 3.1. Subjects

The research objects in this study are all students in the first and second classes of a sports rehabilitation major in a local university. The first class of undergraduate is used as an experimental class, which is taught in the computer room of the Modern Education Technology Center of the Medical College, and this courseware is used to assist teaching; the second class of undergraduate is used as a control class and uses ordinary classroom teaching methods in the multimedia classroom. The students in these two classes initially involved Chinese medicine knowledge in classroom teaching. Among them, there are 40 students in the first class and 45 in the second class.

#### 3.2. Experimental Process

Discuss the teaching effect of "sports rehabilitation professional practice teaching", and guide the design of medical virtual teaching system from the perspective of teaching.

1. **Analysis of experimental results**
   All the students in the first and second classes of the sports rehabilitation major were tested on theory and hands-on ability, and their test results were analyzed.

2. **Questionnaire survey**
   After the test, the instructor distributed the questionnaire to 40 students in the first class, and took it
back after filling it out. Count the results of the questionnaire survey, and then analyze and process the results of the experiment.

(3) Teacher's feelings
Through interviews with actual teachers, understand the use of the courseware (virtual teaching system) in teaching, and put forward reasonable suggestions.

4. Discussion on Application of Virtual Reality Technology (VR) in Practice Teaching of Sports Rehabilitation Major
(1) After passing different classes, the scores of the experimental class and the control class were significantly different in the theoretical test and hands-on ability assessment of the two classes with roughly the same results. The theoretical test scores are shown in Table 1 after SPSS processing. According to the survey data, the t value is 16.65 and the p value is 0.000 (when p<0.05, it means there is a significant difference before and after the experiment). We can see that after the experiment, the theoretical score of the experimental class is 8.56 points higher than that before the experiment, which is a significant improvement; the standard deviation is 0.011. Therefore, we believe that there is a significant difference in the theoretical scores of the experimental class before and after using virtual reality courseware. .

Table 1. Theoretical test score statistics before and after the experiment in the control class

| Compared    | Before the experiment | Average score | Number of people | Standard deviation |
|-------------|-----------------------|---------------|------------------|--------------------|
|             |                       | 71.26         | 40               | 7.772              |
|             | After the experiment  | 79.92         | 40               | 7.783              |

Figure 1. Theoretical test score statistics before and after the experiment in the control class

(2) The application of virtual reality technology in sports rehabilitation teaching can stimulate interest in learning and help improve learners' mastery and understanding of theoretical knowledge. After the experiment, the experimental class and the control class's practical ability test results are shown in Table 2 and Figure 2. It can be seen from Table 2 that after using virtual reality courseware for teaching, the excellence rate of the experimental class test is 24.2% higher than that of the control class, and the passing rate is 12% higher. The excellent rate and passing rate of the experimental class practical ability test are far It is much higher than the control class, so it can be concluded that the application of virtual reality technology in medical teaching is beneficial to the improvement of learners' practical ability.
Table 2. Comparison of student skill appraisal test scores

| Class            | Excellent (person) | Good (person) | Pass (person) | Fail (person) | Total people | Excellent rate | Passing rate |
|------------------|--------------------|---------------|---------------|---------------|--------------|----------------|--------------|
| Experimental class | 15                 | 20            | 36            | 4             | 40           | 37.5%          | 90%          |
| Control class    | 6                  | 29            | 35            | 10            | 45           | 13.3%          | 78%          |

Figure 2. Comparison of student skill appraisal test scores

5. Conclusion
The application of virtual reality technology to the medical field of sports rehabilitation can effectively solve the limitations of traditional rehabilitation training methods. With the continuous advancement of virtual reality technology itself, as well as the continuous promotion and deepening of this technology in the field of rehabilitation, it will surely bring a far-reaching revolution in rehabilitation training and promote the improvement of sports rehabilitation training technology. Through actual investigations, the experiment in this paper understands the use of the virtual teaching system in teaching, and puts forward reasonable suggestions. The experimental results show that the test excellence rate of the experimental class is 24.2% higher than that of the control class, and the passing rate is 12% higher. Therefore, the application of virtual reality technology to sports rehabilitation professional teaching can stimulate interest in learning.

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