

Design and Implementation of Virtual Simulation Experiment on Plateau Specific Sports Injury and Plateau Training Monitoring

Hangping Wang^{1,2} Zhenwu Sun^{1,2*}

¹Design and Implementation of Virtual Simulation Experiment on Plateau Specific Sports Injury and Plateau Training Monitoring, Yunnan Normal University, Kunming, Yunnan 650500, China

²Physical Education College, Yunnan Normal University, Kunming, Yunnan 650500, China

*Corresponding author.

ABSTRACT

During the construction of the national plateau training experiment center, Thinkjs language, Mysql database and Unity3D engine were used to design the virtual simulation experiment of plateau specific sports injuries and plateau training monitoring. Starting from the construction of high-simulation plateau virtual environment, plateau training base and medical monitoring process, students put themselves in the virtual experiment, deepened their learning, understanding and mastery of professional knowledge, strengthened the basic experimental skills of students majoring in sports training, and improved their sports professional literacy. It is of great significance in the experimental teaching of plateau training.

Keywords: altitude sickness, altitude training, medical monitoring, virtual simulation

I. INTRODUCTION

"Plateau environment and sports health" is a practical course closely combining with the field first aid treatment of sports injuries and the implementation of scientific plateau training in the process of plateau environment life or sports training. It is a required main course for sports training major.

However, for the "cognition and treatment of altitude reaction, treatment of snow blindness, treatment of frostbite, medical supervision of altitude training and formulation of altitude training plan" and other special field first aid treatment of altitude sports injury and experimental teaching projects of altitude training monitoring, there are some problems, such as the difficulty in obtaining altitude environment, the small number of altitude training bases, long experimental process, many steps, high cost, much difficulties and high risk. In many colleges and universities, the proportion of setting related majors is not high.

Virtual simulation experiment teaching is an experimental teaching reform and innovation carried out by the Ministry of education in national undergraduate colleges and universities in 2017. It is a

new experimental teaching method to promote the deep integration of education, teaching and profession by means of modern information technology [1]. Through the construction of highly simulated virtual experimental environment and experimental objects, human-computer interaction can be carried out by means of big data base, multimedia platform, three-dimensional mathematical modeling, artificial intelligence, cloud computing and other technical means, making up for the teaching shortage that the real experiment does not have or is difficult to complete [2]. Students' practical innovation ability has been well exercised, and the experimental teaching effect has been improved [3].

In 2018, in accordance with the information-based teaching requirements of the Ministry of education of the People's Republic of China, the national experiment demonstration center of plateau training deepened the reform in experimental teaching. Combining with the plateau training practice and the latest scientific research results, the first virtual simulation experiment course of Yunnan Normal University has been established. With the application of this new experimental teaching method, it has greatly promoted the in-depth development of experimental teaching of national plateau training.

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II. DESIGN BACKGROUND AND PURPOSE OF VIRTUAL SIMULATION EXPERIMENT

A. Background

The altitude hypoxia environment may cause the disturbance of human physiological function or the pathophysiological change, which may lead to the hypoxia injury of the body, such as the limitation of working ability, the decrease of VO₂max, the decrease of AT, the decrease of physical activity and working ability, the overall decline of human mental and physical strength, and the obvious decline of life quality. Due to the failure of the human body to acclimatize and adapt to the plateau environment, various acute and chronic altitude diseases, such as altitude pulmonary edema and altitude heart disease, are not only of high incidence but also life-threatening [4]. However, hypoxia at altitude is also beneficial to human body. People have carried out a series of altitude training and disease rehabilitation attempts by using the alpine climate and environment, and achieved remarkable results. Considering the danger of plateau environment, it can't meet the needs of most individuals to experience and try on the spot. In particular, many experimental contents of the plateau training monitoring are limited by the factors such as the long experimental period, the difficulty of obtaining the experimental site (plateau training base), etc., and the proportion of setting sports training major in colleges and universities of sports in China is relatively low. Students can only use the experimental method of demonstration in class, and finish the experiment in a short time in a hurry, lacking the initiative and innovation of learning. Due to the lack of extracurricular experimental practice opportunities, students can't exercise their thinking ability well, and the comprehensive skills in the special sports injury and experimental courses of plateau training monitoring can't be improved as much as they should [5] [6] [7].

It is necessary to carry out the construction of the virtual simulation experiment project of plateau specific sports injury and plateau training monitoring, build the experimental teaching platform of independent learning, and present the frontier knowledge of complex disciplines such as plateau specific sports injury prevention, plateau training plan formulation, and medical monitoring during plateau training through the virtual simulation experiment project, which will stimulate students' interest in learning, expand professional knowledge, and cultivate the innovation ability of students. It is of very important significance for the construction of virtual simulation experiment project [8] [9] [10].

B. Purpose

Through the development and application of the virtual simulation experiment teaching system for monitoring the plateau specific sports injury and sports training, the public can learn, understand and master the prevention and first aid methods of altitude diseases and sports injury. At the same time, through the study, the trainers and athletes who are going to the plateau for training can master the basic process of plateau training, the formulation of training plan and the principles and methods of revision, the self-monitoring and medical monitoring methods of altitude training, the appropriate exercise intensity and load in the process of altitude training and timely recovery of fatigue in time, providing reference for scientific altitude training.

It is required to carry out the virtual simulation experiment of plateau specific sports injury and plateau training monitoring. The plan of plateau training and the heart rate monitoring under the plateau environment effectively expand the scope and depth of the experimental teaching content, extend the time and space of the experimental teaching, and greatly make up for the limitations of the current plateau environment adaptation and experimental teaching of sports training. It has greatly improved the practical skills of the students in altitude response, treatment of altitude diseases and scientific training of altitude training.

It is required to reduce the cost of experiment and improve the participation of students. The virtual simulation system of plateau specific sports injury and plateau training monitoring is repeatable. It solves the practical problems in plateau training, such as expensive equipment, difficult control of altitude environment, and closed altitude training ground. Therefore, through the virtual simulation of real experiment, the cost of experiment is greatly reduced and the participation of students is improved.

III. OVERALL FRAMEWORK OF VIRTUAL SIMULATION EXPERIMENT

A. Overall structure

The virtual simulation system of plateau specific sports injury and plateau training monitoring is designed based on three-dimensional virtual simulation experiment system with C/S framework, and is operated after registration and download based on the management platform. The experiment uses 3D modeling. According to the real experimental scene, it uses Maya and 3DMAX software to conduct the overall laboratory modeling. The system adopts four layers of framework, including support layer, simulation and component layer, authentication layer and application layer.

The experimental system framework is composed of six parts: school management, course director management, experimental student management, personal information maintenance, teacher-student interaction and system management ("Fig. 1"). After

registration, the system will log in. The system management includes resource management, authority management, the review and correction of student experiment data and experiment report.

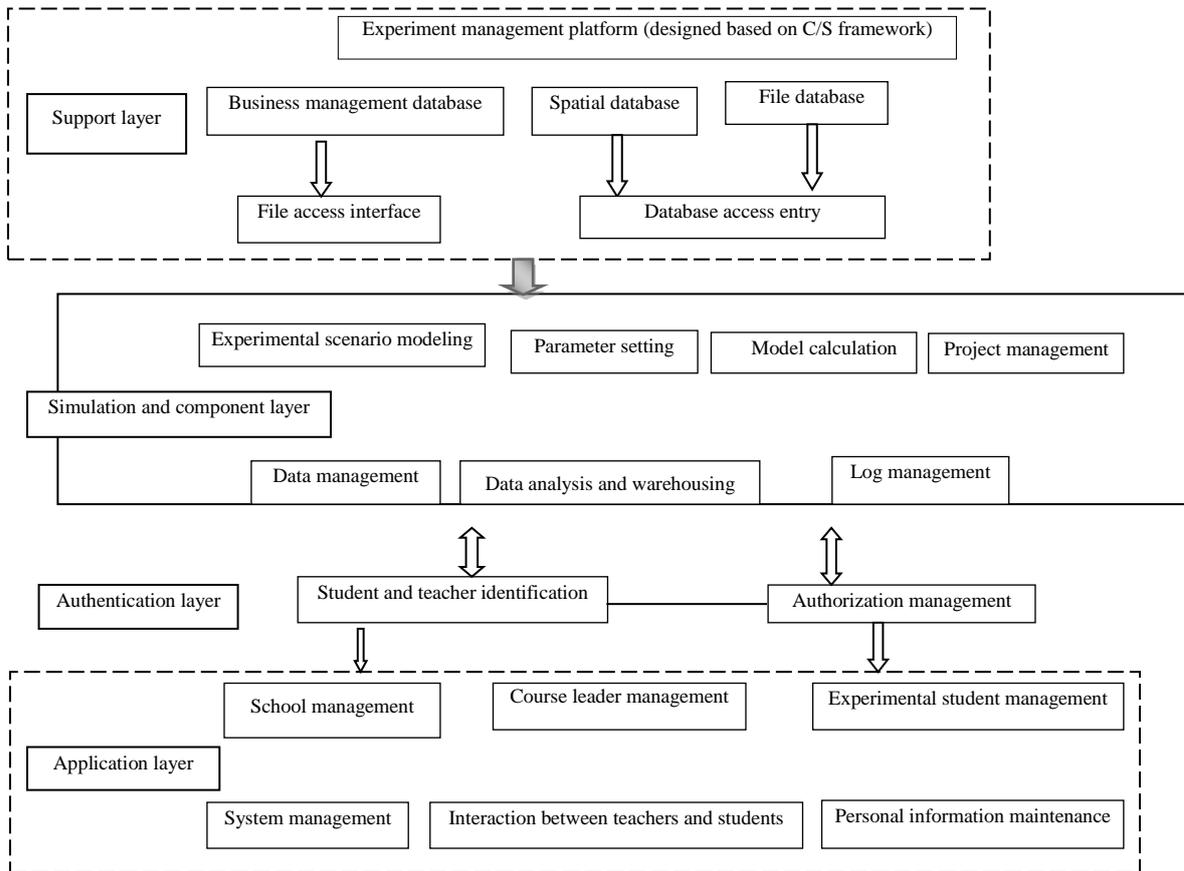


Fig. 1. Overall framework of virtual simulation system of plateau specific sports injury and plateau training.

B. Modules and functions

The virtual simulation experiment teaching system of "plateau specific sports injury and plateau training monitoring" consists of four modules, and the specific mode is as follows: (see "Fig. 2").

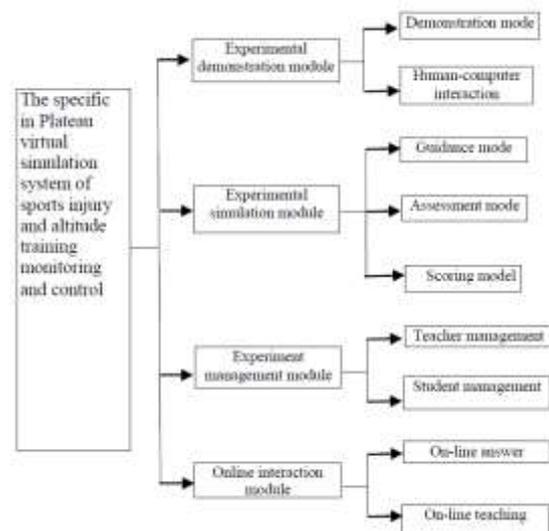


Fig. 2. Module composition of virtual simulation experiment system of "plateau specific sports injury and plateau training monitoring".

1) *Demonstration module*: In the "experiment demonstration" module, in addition to introducing the specific registration and login methods of virtual experiment project, it also focuses on the operation process and methods of the experiment, so that students can get familiar with and understand the experiment as soon as possible. On this basis, the module also solves the organic connection between the pilot course and the follow-up course, help students master the specific knowledge of plateau sports injury such as the judgment and treatment of acute plateau reaction, snow blindness, frostbite, cardiopulmonary resuscitation in plateau environment, etc. and stimulates the students' interest in learning and improves the sports professional quality of students of sports training specialty through problem design interaction, games and text reminders.

2) *Experimental simulation module*: After learning the demonstration experiment module, students can enter the simulation module. Students can independently design the plateau training scheme of virtual simulation experiment according to the storage of knowledge points and theoretical knowledge,

including the selection of plateau base, the formulation of plateau training plan, heart rate monitoring, the design of maximum oxygen uptake test scheme and the modification of relevant parameters. For example, in the virtual experiment phase of the plateau training plan, students can choose the plateau training content for each day according to the time of the plateau training and the training principles. After the training plan is made, it can click the option of having the training. According to the rationality of the training plan designed by the students, the system will judge whether the athletes have sports fatigue. If there is sports fatigue, the system will prompt to modify the training plan.

3) *Management module*: It includes two parts: teacher management and student management. The teacher management module is managed by authorized full-time teachers, including the filing of students' classes, the update and maintenance of experimental projects, the upload of experimental data, the browsing of students' experimental data, performance evaluation, online interactive communication and Q & A, etc. (see "Fig. 3")

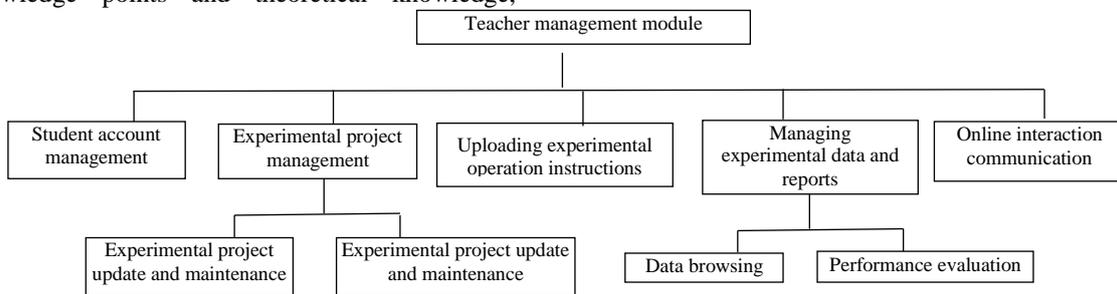


Fig. 3. Flow chart of teacher management module.

The student management module has the following functions, including the overview of the experiment, the purpose of the experiment, and the submission of the results. Students can carry out online learning of the relevant knowledge points of the experiment, such as the cognition and processing of altitude reaction, CPR (cardio-pulmonary resuscitation) under the frostbite, snow blindness, and plateau environment, the

formulation of the plateau training plan, analysis on ten items of urine, heart rate monitoring, the test of maximum oxygen uptake, and biochemistry analysis of blood and other theoretical knowledge. At the same time, students can download the experimental instruction and related materials for virtual simulation experiment. (See "Fig. 4")

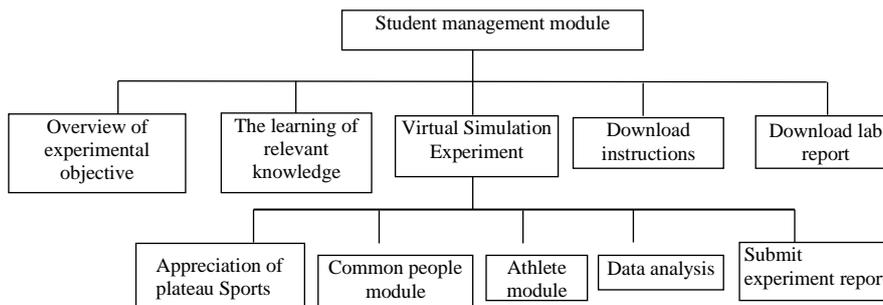


Fig. 4. Flow chart of student management module.

4) *Online interaction module*: This mode is mainly aimed at the problems that students encounter in the process of using the system. Teachers answer questions online in time to realize the function of online teaching.

**IV. VIRTUAL SIMULATION EXPERIMENT
EXAMPLE OF PLATEAU SPECIFIC SPORTS INJURY
AND PLATEAU TRAINING MONITORING**

According to the design purpose of the virtual simulation experiment system, the virtual simulation experiment is mainly composed of three parts: appreciation of plateau sports, teaching demonstration and practice.

A. Appreciation of plateau sports

Five virtual scenes of plateau environment and plateau sports are designed in the system. Students can enjoy the unique scenery of plateau and the exciting experience brought by sports in the plateau environment through VR and PC, so that they can have a preliminary understanding of the plateau environment. (See "Fig. 5")



Fig. 5. Appreciation module of plateau sports.

B. Teaching demonstration

Through the form of animation demonstration, combined with the purpose of the experiment, teachers set questions in the relevant links of the experiment, allowing students to watch, study and think with the questions, and cultivating the students' ability to observe the experiment and think about the problems. The students will master the first aid for plateau specific sports injury and special knowledge of altitude training monitoring, and be familiar with and master the experimental operation process and basic operation skills. (See "Fig. 6")

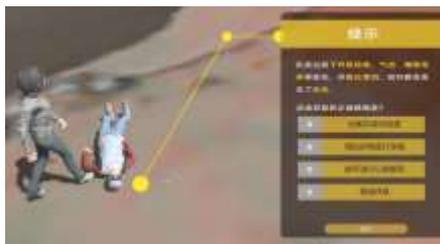


Fig. 6. Illustration of teaching demonstration.

C. Practice

This part is the comprehensive training part, which is the core of this experimental project. It can be divided into two modules: first aid for plateau specific sports injury and plateau training monitoring. The first aid module of plateau specific sports injury includes four virtual scenes: cognition and treatment of altitude reaction, cardiopulmonary resuscitation in high altitude environment, treatment of snow blindness and frostbite.

Students choose the virtual experiment scene. According to the prompts, the students have the practice on the basis of choosing the right options. Students master the basic theory and knowledge of common plateau environment specific sports injury, and skillfully apply the common treatment methods and means of plateau sports injury.

The plateau training monitoring module includes five virtual scenes: the formulation and implementation of plateau training plan, the application of heart rate in plateau training monitoring, the application of maximum oxygen uptake of plateau training monitoring, the application of blood detection indicators in plateau training, and the application of urine indicators in plateau training. The students are in the virtual training environment of the plateau. After selecting the identity information, they train and monitor. According to the heart rate monitoring information of morning pulse and sports training, they modify the training plan. After the stage of plateau training, the students can master the operation methods and data analysis of the maximum oxygen uptake test, analysis on ten items of urine and blood index. Through the virtual simulation system, they can select the experimental steps, set the corresponding experimental parameters. The system interacts with the students according to the completion of the experiment, scores and uploads the assessment. (See "Fig. 7")



Fig. 7. Practice.

V. THE IMPLEMENTATION EFFECT OF VIRTUAL SIMULATION EXPERIMENT TEACHING PLATFORM

After the first phase of virtual simulation experiment project "plateau specific sports injury and plateau training" was completed, the center applied and evaluated the students of sports training major in 2017, and optimized the content and function of the virtual simulation experiment teaching platform according to the evaluation results.

A. The construction of overall assessment and evaluation mechanism of curriculum

The virtual simulation experiment course of "plateau specific sports injury and plateau training

monitoring" actively promotes the implementation of process evaluation, which runs the assessment and evaluation through the online learning process. Students' endogenous learning motivation and learning effect can be improved. Teachers can carry out process evaluation from students' attendance, class discussion, process assessment and so on. Considering the initial use of virtual policy teaching method, the course temporarily sets the virtual simulation experiment score to 5% of the total score, which is composed of theoretical test and practical operation. After each operation step, students can automatically grade through human-computer interaction function. ("Table I")

TABLE I. ASSESSMENT METHODS AND STANDARDS OF VIRTUAL SIMULATION EXPERIMENT COURSE OF "PLATEAU SPECIFIC SPORTS INJURY AND PLATEAU TRAINING MONITORING"

Assessment Method	Ratio/%	Specific Content of Assessment
Attendance	10	Absence, Leave, Etc
Classroom Discussion	20	Group Discussion on A Problem
Quiz	20	4 Points/Time, 5 Times In Total
After-Class Assignments	10	Release Once After Each Unit
Lab Report	30	Write 6 Lab Reports
Virtual Experiment	10	1 Online Virtual Simulation Experiment

B. Preliminary implementation effect of virtual simulation experiment teaching

In the 2018-2019, the authors selected 30 students from two classes of sports training major to test the teaching effect. Among them, it only conducts virtual simulation experiment teaching for Class 1. While, it not only conducts virtual simulation experiment, but also takes online test content for Class 2. The results show that 23 students (76.7%) in Class 1 got full marks, and 7 students made mistakes in different degrees in the process of experimental assessment, 1 student got 4 points and 6 students got 3 points. Only 16 students (53.33%) in Class 2 got 5 points, which led to the result that in addition to the experimental operation factors, the online theoretical test also affected the students' performance to a certain extent.

After investigation, through two semesters of online open virtual simulation experiment teaching, students think this new experiment teaching method is very good. Because of its simple operation and clear process, it plays a significant role in students understanding and mastering the operation requirements and methods of the virtual simulation experiment of plateau specific sports injury and plateau training monitoring. It overcomes the disadvantages of traditional one-way teaching, such as monotony, long experiment period and huge waste of experiment. However, there are still some problems to be solved in the process of using, such as the lack of mobile phone interface, the unlimited time of experimental operation and so on. Above all, the system will be gradually improved in the second phase of construction. ("Fig. 8")

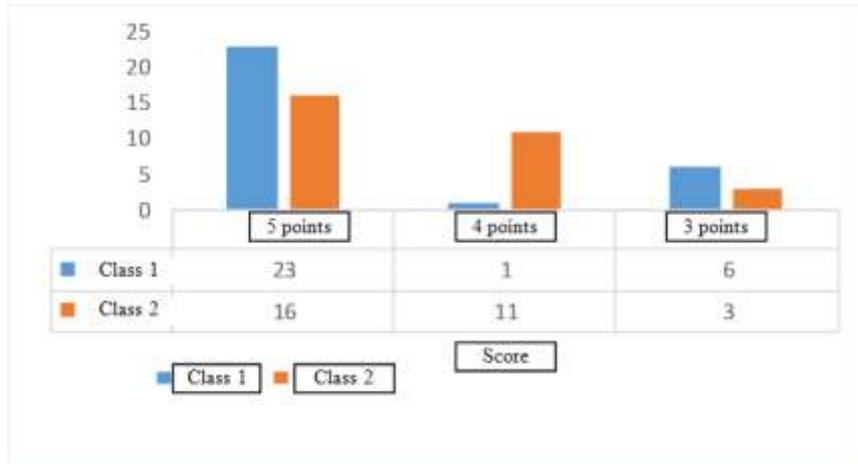


Fig. 8. Virtual simulation experiment score of "plateau specific sports injury and plateau training monitoring".

VI. CONCLUSION

Through the development and application of the virtual simulation experiment system of "plateau specific sports injury and plateau training monitoring" course, the following points are summarized:

It is necessary to combine the development theory of higher education closely, actively develop the virtual simulation experiment project, explore the new concept and implementation path of virtual simulation experiment teaching, and improve the training quality of undergraduate sports training professionals.

Virtual simulation teaching is not isolated. Under the overall framework of the course objectives, it can promote the realization of the teaching objectives by means of the combination of specific course practice and training.

The evaluation method of virtual simulation experiment course of plateau specific sports injury and plateau training monitoring needs further research and practice.

The construction of the virtual simulation experiment project of "plateau specific sports injury and plateau training monitoring" will further deepen the combination of virtual simulation experiment and plateau training practice, enable students to establish a systematic and perfect plateau training framework under the links of establishing, formulating, organizing and realizing training objectives. The students preliminarily master the ability of exercise load monitoring, adjustment and exercise medicine monitoring in hypoxic environment.

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