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Construction of Hierarchical and Interdisciplinary Virtual Simulation Teaching System

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***Abstract*— This thesis analyzes the requirements and tasks of the virtual simulation experiment teaching center and puts forward a new idea of "hierarchical and interdisciplinary virtual simulation teaching system". This thesis focuses on the study of virtual simulation experimental platform, experimental resources sharing mechanism, open interdisciplinary experimental teaching team. Based on the example of experimental subject of "spatial information and digital technique" in computer science, this thesis introduces the construction process of "hierarchical and interdisciplinary" virtual simulation teaching system development, summarizes its result in cultivating students' independent consciousness and manipulative ability, and looks far ahead the development prospect of the model.**

***Index Terms*—Hierarchical, Interdisciplinary, Virtual Simulation Teaching System, Spatial Information and Digital Technique.**

I. INTRODUCTION

In recent years, the rise of virtual simulation technique has provided new opportunity for the reform of spatial information and digital technology cultivation experimental teaching mode. Virtual simulation technique integrates virtual reality, multi-media, human-computer interaction, data base and network communication technology and enables students to carry out efficient, secure and economic experiment in open, independent and interactive virtual environment building a realistic experiment environment and experiment subject so as to achieve the teaching effect that is not available to real experiment or difficult to be achieved. Therefore, this project caters to "hierarchy and inter-discipline" and focuses on the study of virtual simulation experimental platform, experimental resources sharing mechanism, open interdisciplinary experimental teaching team. Based on the example of experimental subject of "spatial information and digital technique" in computer science, with the combination of communication, digital media and other disciplines, this thesis establishes interdisciplinary virtual simulation experiment teaching system and develops the teaching practice of cultivating students' interdisciplinary thinking mode and comprehensive practical ability. The hierarchy refers to the rich, colorful and varied teaching content in open experiment, such as research, comprehensiveness, foundation, validation and demonstration, etc. They are of different levels. We should select the appropriate teaching content in teaching according to different teaching objects[1]. Inter-discipline not only focus on the profession and the discipline, but also extends and stretch and forms interdisciplinary and cross departmental open experimental teaching.

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II. THE DEMAND AND TASK OF THE CONSTRUCTION OF VIRTUAL EXPERIMENT TEACHING CENTER IN UNDERGRADUATE COLLEGE

How to make full use of geographical spatial information, to match social supply and human need appropriately and to achieve sustainable and wise use of resources is the goal for current digital globe, digital city, digital agriculture, digital territory and other digital industry, big data, cloud computing, intelligent transportation, logistics and Internet of things. However, relying on virtual reality, multimedia, human-computer interaction, data base, network communication and other techniques, the virtual simulation experiment teaching builds a highly simulated virtual experiment environment and experimental subject and students can carry out experiments in the virtual environment and achieve the teaching effect requested by the teaching program[2].

In recent years, the school adapts to the needs of the development of local science and technology, actively promotes the deep transformation and attaches importance to students' comprehensive quality and ability training. It has formed a new model of personnel training and has strengthened personnel training and social service function for local enterprises. In the construction process of hierarchical and interdisciplinary virtual simulation experiment teaching center, according to the fundamental principle of combination of the realistic and virtual, based on the teaching requirement of computer science and technology, communication, digital media and other disciplines, it can provide shared digital teaching resources through construction of virtual simulation teaching system, strengthening of digital resources construction and optimization experiment as well as practical teaching effect.

III. EXPERIENCE AND THINKING OF THE CURRENT VIRTUAL EXPERIMENT TEACHING SYSTEM

The third National Education Conference clearly points out "student-centered, talent innovation and open experiment teaching and the teaching concept to promote the comprehensive and coordinated development of students'

knowledge, ability, thinking and quality. After that, most colleges and universities have established and perfected open experimental teaching center reflecting discipline advantages. As the centralized disciplinary experimental teaching environment, the scientificalness, comprehensiveness, innovativeness and sharing of the open experimental teaching center have been enhanced continuously. It has played a positive role in experimental instrument technology resources, promoting sharing and improving utilization benefit.

However, there are some problems of the current virtual simulation experiment teaching system. The virtual simulation experiment teaching system is responsible for the experimental practice teaching of the corresponding disciplines with rich experimental content. With the gradual deepening of interdisciplinary integration, the laboratory needs to have a variety of software and hardware environment to meet the teaching needs. Meanwhile, the purchasing and maintenance cost of some professional experimental installation and instrument is high and the utilization efficiency is relatively low, which results in the waste of resources. Therefore, the traditional laboratory management mode of operation has been unable to meet the requirements of the current experimental teaching system because of the high investment, complex environmental configuration, low utilization rate and so on.

In order to solve the above problems, we need to explore a new experimental teaching system in order to realize the hierarchical and interdisciplinary open experiment teaching. The virtual simulation experiment platform provides a good opportunity for solving the above problems. Relying on the principle of integration of the realistic and the virtual, the virtual simulation experiment platform replaces some experimental installation with virtual technology and presents the experiment scene of precise operation, complex process and large scale[3]. For example, in the field of computer science, it can insulate hardware and software technical details on the bottom and form the abundant virtual desktop in network environment through virtualization of computing, storage, networking, software, data and other experimental resources, thus providing innovative experimental teaching mode and improve the efficiency of telescopic structure management as well as the use of resources and knowledge sharing at the same time.

IV. The Construction of Hierarchical and Interdisciplinary Virtual Simulation Teaching System

We believe that the design of experiment teaching should not only cater to the need of scientific research in the future and make students consolidate their theoretical foundation and grasp the research tool method systematically, but also cater to the demand of practical work and provide the necessary work skills training in practical work. The basic idea of our construction includes theoretical level promotion and actual operation ability promotion. The former should get close to air data computing in reality as far as possible and let the students understand the theoretical mechanism through the operation experiment. The latter emphasizes highly simulation of the working environment, the integrity of the workflow, the same business content and business assessment with reality. According to the characteristics of spatial information technology talents training and different functions, we divide the center into 4 levels of teaching system, which covers all aspects of spatial information and digital technology experiment.

A. Construction of hierarchical virtual simulation teaching system

Based on quality engineering construction and innovative education, it focuses on cultivation of students' exploring spirit, scientific thinking, scientific experimental ability and innovative consciousness. Hierarchical teaching of spatial information and digital technique in experiment center is not to simply stratify students according to their marks, scientific and reasonable stratification on all the experimental projects that are open through analysis, screening and reorganization. According to the goal of undergraduate education in our university, the teaching in this course and the experimental setting are divided into four levels, cognitive experiment, basic experiment, comprehensive and applied experiment as well as innovative experiment.

The experiment in the first level is mainly to visit, present and practice, which is an important part of professional cognitive education, aiming to cultivate and arouse students' professional cognitive ability and help students establish the professional perceptual knowledge of spatial information and digital technology, internalizes the understanding of professional knowledge, rise their own cognition to the level of sense of value, and establish clear learning and struggling objectives.

The basic experiment of the second level is mainly demonstration and application experiment, attached to the theoretical courses, and is the most basic requirement which should be achieved according to the professional training objectives. It is to carry out strict training for the use of basic instrument, basic experimental skills and basis measurement. In this process, students should be assessed gradually and students who fail to pass it will have re-training and make-up examination.

The comprehensive and application experiment of the third level focuses on the practical application problems of spatial information and digital technology, mainly including professional skill training and utilization training of modern large-scale testing instrument, which aims to cultivate students' comprehensive application theory, method and apparatus, including basic knowledge, basis skill and basis experimental method of digital mapping, GPS positioning technology and multimedia technology.

The innovative experiment of the fourth level is to guide the students to carry out study on experimental subject in the form of systematic project training by teachers of high academic level and to lead the students to the palace hall of scientific research by setting up examples for others with both precept and practice. Meanwhile, the experiment center evaluates the award grading and scores according to students' scientific thesis, scientific works and thesis defense through the organization of spatial information technology

competition. Many students' scientific research and innovation ability have been greatly improved through competition.

B. The construction of hierarchical and interdisciplinary virtual simulation teaching system

From the perspective of experimental teaching, the spatial information and digital technology needs students have comprehensive ability of multisource spatial data acquisition and processing, real-time dynamic information storage, content management, cross-media information sharing and service. Therefore, it intends to carry out demonstration from the following aspects.

(1)It aims at multisource spatial data acquisition and processing of spatial information and digital technique and cultivates students' spatial cognitive ability. It should carry out a comprehensive experiment based on virtual simulation platform. The experiment content includes multiresolution, multidate remote sensing image data, digital elevation model data and other urban spatial data integrated representation and organization, urban 2D vector map, remote sensing image, fusion of 3D terrain surface model data.

(2)It aims at real-time dynamic information storage and management of spatial information and digital technique and cultivates students' ability to store and manage real-time dynamic information. It should carry out comprehensive experiment based on virtual simulation platform. The experiment content includes the dynamic storage and management of the sensor data, the description of the multi-source dynamic data and the method of content organization, specifically, the virtual typical environmental monitoring, such as air quality, environmental noise, etc. It coordinates with physical sensor to obtain continuous video data and to coordinate the experiment.

(3)It aims at cross media information sharing and service of spatial information and digital technique and cultivates students' ability to use new media technology to solve practical engineering problems. It should carry out comprehensive experiment based on virtual simulation platform to realize multi-media messaging service.

(4)It should have overall consideration of the running condition, personnel training, maintenance of the virtual simulation platform and other evaluation mechanism in order to evaluate the experiment teaching system.

V. TEACHING EFFECT ANALYSIS

Virtual simulation experiment teaching has remarkable result in cultivating students' independent experiment consciousness and manipulative ability, which is shown in the following two aspects.

A. Virtual simulation experiment teaching can deepen students' understanding of abstract theory

According to the traditional teaching mode, theoretical course teaching is often carried out by classroom teaching, students' notes, homework and examination. Because the teaching content is abstract, it is difficult for students to understand and grasp it. Although some teachers apply their own animation and teaching aids in the classroom, it can not achieve good results. If the teaching experiment design in theory curriculum in integrated with the requirements of the knowledge points, according to the theoretical hypothesis and relevant virtual experiment environment for spatial data construction, to let the students complete manipulative experiment not only can make the students deepen their understanding between relation of the abstract pure theory and reality and the basic conclusion deducted from the theory. It can also help students have a complete understanding of the mechanism, effect and applicable conditions of the various operation methods adopted by the spatial data.

B. The hierarchical and interdisciplinary experiment teaching can promote students' active exploration and cultivate their innovative ability

In the future, whether students are engaged in scientific research or practical work, they need to have the ability to solve the practical problems by using the theories and tools they have learned. The design of innovative experiment project not only can improve the students' ability to use all kinds of methods and software, but also cultivate their innovation ability. We design the integrated design experimental project. Teachers guide the experiment process from different level and students choose suitable experimental subjects. Students start from the literature review, determine the experimental scheme, select the reasonable method, carry out independent experiment design and operation and write laboratory report in the thesis form. It is not only helpful to cultivate students' innovation ability and research ability, but also to cultivate students' comprehensive analysis ability and ability to solve practical problems to implement interdisciplinary comprehensive design experiment teaching.

VI. CONCLUSION

The construction of hierarchical and interdisciplinary virtual simulation teaching system is an important means to further strengthen the cultivation of students' quality education and practice ability, an important method to develop innovative talents training system and an important method to cultivate the exploration spirit, scientific thinking, practical ability and innovation ability of students. Its importance has become increasingly prominent. Under the condition of limited investment of college and universities, it will be the trend and only route to construct spatial information and digital technology experiment teaching system, to realize the sharing of resources, to give full scope to the talents and to make the best use of everything for the development of spatial information and digital technology teaching.

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