

Research on Virtual Simulation Experiment Center Construction Practice and Resource Sharing Management Mechanism

—Taking Mechanical Foundation and Textile Equipment Experiment Center as an Example

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Abstract—In order to promote the opening and sharing of virtual simulation experiment teaching resources, this paper expatiates on the construction content and characteristics of virtual simulation experiment center of mechanical foundation and textile equipment based on the construction work of "virtual simulation experiment teaching center for mechanical foundation and textile equipment design" of school of mechanical engineering, Tianjin polytechnic university. The paper studies and proposes the sharing management mechanism of the resources of virtual simulation experiment center for mechanical foundation and textile equipment, and predicts the follow-up sharing management of the resources of virtual simulation experiment center for mechanical foundation and textile equipment.

Keywords—mechanical foundation and textile equipment, virtual simulation experiment, sharing management mechanism

I. INTRODUCTION

In order to carry out and implement the spirit of *Some Suggestions on Improving the Quality of Higher Education In a Comprehensive Way* by Ministry of Education (Professor of Engineering [2012] No.4), according to *Education Informatization Ten-year Development Plan (2011-2020)*, Ministry of Education has carried out the construction work of national virtual simulation experiment teaching center since 2013. The virtual simulation experiment teaching is the important content of higher education informatization construction and experimental teaching demonstration center construction, and the product of deep integration of subject major and information technology^[1]. "Scientific planning, sharing of resources, highlight the key points, improve efficiency, sustainable development" is the guiding ideology of the construction of virtual simulation experiment teaching center^[1,2]. Tianjin polytechnic university school of mechanical engineering was awarded the outstanding engineer training unit by the Ministry of Education in 2011. Taking this as an opportunity and relying on "mechanical engineering and automation"

national-level features professional, Tianjin mechanical foundation experimental teaching demonstration center, engineering practice education center of "textile technology and equipment" and Tianjin "modern electromechanical equipment technology" key laboratory scientific research platform, school of mechanical engineering experimental center carries out the construction of virtual simulation experiment center, and develops a series of virtual simulation experiments with professional characteristics and combined with the frontier of the discipline, and gradually constitutes a system and establishes "virtual simulation experiment teaching center for mechanical foundation and textile equipment"^[3,4].

II. CONSTRUCTION CONTENT AND CHARACTERISTICS OF VIRTUAL SIMULATION EXPERIMENT CENTER OF MECHANICAL FOUNDATION AND TEXTILE EQUIPMENT

A. Construct Experiment Teaching Platform with Textile Industry Characteristics Which "Combines Virtuality and Reality"

The traditional experimental teaching of textile machinery can only use **demo mode**. In the **experimental teaching mode of textile machinery of "reality-oriented, virtuality and reality combination, choose reality over virtuality"**, students go through the virtual simulation process of equipment design, process design and application effect to optimize the equipment design parameters and processing parameters, which improves the one-time success rate of experiment and shortens experimental time. It allows students to get more training opportunities within the original experimental time, enhancing the effect of engineering training.

Focus on improving the three abilities of students, and meet the need of mechanical engineering excellent engineer training teaching and practical tasks through the virtual experiment teaching platform of four levels and

ten modules. **The three abilities include:** practical ability, professional design ability, scientific and technological innovation ability; **four levels include:** fundamental cognitive level, comprehensive training level, professional design level, innovation research level; **ten modules include:** (1) common mechanical parts interactive cognitive virtual simulation experimental module; (2) special institutions interactive cognition virtual simulation experimental module; (3) textile equipment special parts design virtual simulation experimental module; (4) mechanism design and analysis virtual simulation experimental module; (5) structure design and analysis virtual simulation experimental module; (7) high-speed and mixed-phase device design virtual simulation experimental module; (8) textile products continuous production process and equipment virtual simulation experimental module; (9) college students extracurricular scientific and technological innovation research and practice virtual simulation experimental module; (10) scientific research results transformation virtual simulation experimental module.

Make full use of the subject advantages and industry characteristics of our school to transfer the cutting-edge scientific research achievements into teaching cases, and show them to students in the form of virtual simulation, so as to open up students' horizons, enhance their knowledge structure, cultivate their confidence to bravely climb the heights of science, and stimulate their research and innovation ability.

B. Base on Self-development to Enrich the Virtual Simulation Experiment Teaching Resources

The center adheres to self-development. Based on the requirements of virtual simulation experiment teaching, the center has independently developed 57 virtual simulation experimental projects, such as "mechanical foundation interaction virtual simulation experiment", "typical textile special parts interaction virtual simulation experiment", "textile institutions innovative design virtual simulation experiment", "textile mechanical design and simulation analysis virtual simulation experiment", "textile machinery transmission system digital design virtual simulation experiment". Most of them are used in experimental teaching, enriching virtual simulation experiment teaching resource.

The center uses more than 120 high-performance computers and network equipment to form a virtual simulation experiment system, optimizing and combining with virtual simulation experimental teaching resources and laboratory equipment. It ensures the smooth implementation of various experiments involved in the whole process of mechanical basic teaching, textile machinery design analysis, manufacturing, testing, control and operation, laying a solid foundation for the

effective improvement of the quality of virtual simulation experimental teaching.

C. Focus on Scientific Research Achievements Transformation and Experimental Resources Sharing and Promotion

According to the basic conditions, equipment condition and class arrangements of the laboratory, share the experimental teaching resources based on experimental content, experiment time, innovation practice and external service. According to the basic content of mechanical specialties and professional direction of students, the center has scientifically formulated different levels of experimental projects and supporting teaching resources. The students can independently select project and content, plan, equipment and time, meeting the requirements of autonomous learning. At the same time, open to the national college students mechanical innovation design competition, college students research and training programs, college students innovation and entrepreneurship projects, robotics contest and other practical activities, and also provide training services for enterprise personnel.

Independently developed virtual simulation experiment teaching resources have been used in teaching, scientific research, production and other fields with remarkable effect of promotion. The self-compiled experimental instruction book *Typical Textile Machine Design Virtual Experiment*, task book and other auxiliary experimental teaching materials, and virtual experiment platform have been promoted and applied in some colleges and universities; through virtual experiments, the center have independently developed "roving spindle wing comprehensive parameter experiment table", "yarn winding rule experiment table", "electronic roller drafting experimental equipment", "yarn intelligent detection and analysis instrument" and "self-parking device" and other equipment. The related technology has been used by textile machinery manufacturing enterprises and textile mills.

After nearly a decade of construction and development, the center has built an experimental teaching team with reasonable structure, high teaching and scientific research level and strong development strength, which meets the needs of cultivating undergraduate innovative talents, forming a laboratory management system with strong security, efficient management and open operation. It has become a virtual simulation experiment teaching center with advanced laboratory equipment and first-class experimental conditions, which has great influence in the country. It provides a strong support for the innovative talents cultivation in our school.

III. THE SHARING MANAGEMENT MECHANISM OF RESOURCES OF VIRTUAL SIMULATION EXPERIMENT CENTER FOR MECHANISM FOUNDATION AND TEXTILE EQUIPMENT

The construction work of virtual simulation experiment center for mechanism foundation and textile equipment adheres to the guiding ideology of "scientific planning, resources sharing, highlight the key points, improve efficiency, sustainable development". It takes high quality resource sharing as the core and all-around serving teaching as starting point, and realizes "three open" of intramural sharing, mutual support of platform sharing, and value creation with off-campus sharing.

A. *Intramural Sharing*

Center has achieved the three open of "time, space, content," so as to provide high-quality experimental teaching services for students from all the colleges and majors in the university to the utmost extent. In time, most laboratories open for 24 hours/7 days a week; in space, students not only can enter relevant open laboratory for virtual experiments in opening hours, but also can access to the online experimental system of virtual experiment through the campus network to complete experimental operation; in content, students not only can operate according to the experiment guidebook provided by teachers, but also can design their own experimental projects and experimental processes, and complete the experimental content they are interested.

Students can select courses freely. Students of different majors all have the opportunity to share the experimental course of the center. At present, we have realized the standardized construction and sharing of the virtual simulation teaching resources within school. Our school has integrated teachers, virtual laboratory personnel and network center personnel. Firstly, we will launch the majority of subject teachers, and conduct standardized integration and construction of the existing virtual simulation teaching resources based on the network. Secondly, we have carried out the construction of virtual simulation teaching resource base, conducting centralized storage and management of distributed resources with cloud technology. Thirdly, establish corresponding teaching management platform, providing support for online experiment, network competition, classroom teaching and self-learning. Transfer scientific research achievements into teaching to meet the needs of teaching and learning, providing a solid foundation for the sharing of virtual simulation teaching resources.

In addition to the experimental class, students can enter the laboratory for experiments at any time according to their actual situation. Students can do experiments repeatedly. Experiment is optional, and students can choose the experiment they like. The virtual simulation experiments can be treated as separate

experiments, or be used for experiment preview and review, or be used for real-time demonstration in theoretical class teaching.

B. *Platform Sharing*

The center works with various research and teaching platforms inside and outside school and provides experimental platform for them, such as Zhongxin Jingwei Textile Machinery Yuci Branch, Qingdao Hongda Textile Machinery Co., Ltd, Beijing Rainier Network Technology Co., Ltd and other famous enterprises. They have realized mutual access and resource sharing, supporting each other to further enhance the scientific and technological innovation power and competitiveness of platforms and center.

C. *Off-campus Sharing*

At the same time, the center also opens virtual experiment platform for relevant enterprises, research institutes and brothers universities, and provides training services through network experiment appointment and network virtual training to help develop new products and create value. And it also establishes school-enterprise R&D center and school-enterprise joint training base to deliver new knowledge close to the industry, such as new equipment, technology and process, to the students, so that students can understand the needs of enterprises and their shortcomings, and constantly improve themselves.

IV. PREDICTS THE SHARING MANAGEMENT OF THE RESOURCES OF VIRTUAL SIMULATION EXPERIMENT CENTER FOR MECHANICAL FOUNDATION AND TEXTILE EQUIPMENT

A. *Protect Independent Intellectual Property Rights Reasonably and Legally to Ensure Coordinated and Orderly Development of Sharing and Cooperation*

Virtual simulation experiment teaching resource is a typical information resource. In the information age, information knowledge is the most important commodity. It is the crystallization of knowledge creators' wisdom and hard work. Knowledge creators should be protected and respected in the dissemination and exchange of knowledge information^[6,7]. From the perspective of information resources, intellectual property protects knowledge producers' motivation to produce knowledge, and ensures the fountain of sharing of information resources^[8]. How to comprehensively and correctly understand the impact of intellectual property system on the sharing of virtual simulation experiment teaching resources, so as to maintain the inviolability of intellectual property rights and ensure the extensive exchange and sharing of virtual simulation experimental teaching resources. This is a problem needs to be solved when carrying out the sharing activities of virtual simulation experiment teaching resources currently. The

construction of coordination mechanism of information resources sharing and intellectual property protection is beneficial to the interests of the subjects of virtual simulation experiment teaching resources sharing and intellectual property rights protection, forming a virtuous circle of sharing.

B. Gather Related Disciplines Forces to Build Large Disciplines Base of "Leap-Style Sharing"

Under the condition of higher education resources being relatively scarce, we need to break the barrier, and conduct reorganization and optimization within school or even crossing schools to build large discipline base of "leap-forward sharing": "cross-direction, cross-specialty, cross-disciplinary". Carry out the integration and sharing of experimental resources in the school, improve the virtual experiment project resource library, and achieve opening and sharing based on the network. Develop mutual-aid and virtual experimental community, explore refined, networked and remote experimental resources, and achieve experiments of "anyone, anywhere, anytime".

C. Use Public Platform to Serve the Public to Improve the Utilization Efficiency of Shared Resources

On the basis of intramural sharing, the center plans to properly place the public physical resources of teaching and research in the public service institutions, for example open to the society comprehensively and all time through the provincial excellent courses website and national quality resources sharing courses. Strengthen exchanges and cooperation with domestic fraternal colleges and universities, and actively participate in the national academic exchange seminars of virtual experiment teaching or management, so as to expand the demonstration and impact of the center. This paper discusses the integration of virtual simulation experiment resources between universities and colleges of textile and equipment design, and that several people share a laboratory instrument and operate it in different time, or several people cooperate in different places to complete the experiment process. Adopt the system of specially designated person being responsible for particular things, and realize that enterprises, institutions or individuals outside school use virtual network teaching platform or virtual simulation experiments with or without pay, so as to expand the scale-economy of public resources.

D. Establish Teaching and Scientific Research Sharing and Mutual Aid Mechanism to Promote Talent Construction and Innovation Power

On the basis of serving teaching function, the center will also expand the sharing level, attracting talents with different disciplines background and different potentials with advanced equipment to carry out scientific research and achieve creative research results. The center will

actively strengthen cooperation with the relevant enterprises. Through cooperation, introduce advanced technology and equipment, train and cultivate teachers team, so as to promote the development of enterprises, research institutes and colleges, better serve both in and out of campus, and create better social and economic benefits. Under the conditions of school resources shortage, concentrate on purchasing the world's most advanced equipment to construct a research base which can be shared by different disciplines, so as to attract first-class professors and students. Here, teachers and students can use advanced research equipment and means to communicate with each other, conduct free exploration, so as to produce new academic ideas, achievements and thoughts and find new research directions.

E. Strengthen the Contact and Cooperation with Enterprises and Serve the Technical Personnel Education of Tianjin Textile Industry

The center will also expand the experimental capacity training of in-service teachers. It will construct enterprise-related virtual simulation experimental base, and explore the organic integration of textile industry base practice and undergraduate teaching, so as to cultivate multi-talented teachers, actively undertaking the relevant teacher training work in the city and all over the country.

It is an important guideline for our development to explore the new mode and new way of co-building and co-management of school and enterprise, and establish a sustainable virtual simulation experimental teaching service support system. Build an extensive, compatible and forward-looking management and sharing platform to efficiently manage experimental teaching resources, so as to achieve experimental teaching resources sharing in and out of campus, within the region or even a much wider range. Our construction goal is to meet the virtual simulation experiment teaching needs of multi-regions, multi-schools and multi-disciplines.

V. CONCLUSION

Opening and sharing of virtual simulation experiment teaching resources is the core task of the construction of virtual simulation experiment teaching center, and it is also a necessary requirement of universities optimizing the structure of virtual simulation experiment teaching resources and improving the efficiency of resource use^[5]. Through the cooperation and coordination of scientific research, reduce the management costs of teaching and research, and encourage researchers to explore actively, so as to enhance the innovation vitality and ability of researchers to obtain original achievements. So the center actively explores in the construction process, and

constantly promotes the optimization and innovation of opening and sharing mechanism.

Authors' contribution

Wang Zhifang and Yang Jiancheng are joined first authors of this publication.

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