

# Research on College Civil Engineering Laboratory Model Based on Cultivation of Applied Talents

Jinxia Wang

College of Civil Engineering, Baicheng Normal University, Baicheng, Jilin, 137000, China

**Keywords:** talent training; applied type; subject laboratory; virtual simulation

**Abstract:** The application of experimental technology in the field of civil engineering teaching can solve some prominent contradictions between traditional civil engineering practical teaching and modern applied talent training. Combining the requirements of local colleges and universities to meet the development needs of industry, and the practical requirements of cultivating applied talents with engineering practice, this paper discussed the construction concept of civil engineering laboratory model teaching center in local applied universities and the construction ideas of civil engineering laboratory model teaching system. The author also analyzed the function and organization model of the civil engineering laboratory model teaching resource platform.

## 1. Introduction

China's higher education has become the largest education system in the world. The development of undergraduate education in civil engineering is also unprecedented. According to the latest statistics, there are currently 362 colleges and universities in China that offer undergraduate education in civil engineering, including 65 research universities and 297 teaching colleges, which has made great contribution to China's economic construction[1]. However, in the process of economic development with the new normal, the relationship between supply and demand of civil engineering professionals has undergone profound changes. With the great adjustment of economic structure, the accelerating industrial upgrading, and innovation and entrepreneurship-driven development strategy, the structural contradictions of colleges and universities are sharply prominent. The homogenization tendency is serious. Graduates are always low-quality, making employment difficult. The applied, compound and innovative talents in production and service line are scarce. The training mechanism has not yet been established, and the structure and quality of personnel training cannot meet the requirements of economic restructuring and industrial upgrading. The reason is not that the number of graduates in civil engineering is insufficient, but the lack of high-quality applied and innovative civil engineering professionals2[.]

## 2. The Necessity of Creating a Civil Engineering Laboratory in Colleges and Universities

Laboratory construction cannot keep up with the transformation of application-oriented talent training model to cultivate applied talents. Learning without practice is insufficient and the laboratory is one of the practical platforms for students. Due to the short history of undergraduate education in local new undergraduate colleges, there is a lack of laboratory construction. The main reasons are the following. On one hand, the one-time investment of funds is large and the funds are insufficient, so that the number of equipment sets in the laboratory is small. Equipment is outdated and the space is small, which cannot meet students' need to conduct experiments in groups. On the other hand, the overall layout of the laboratory in local universities has not yet been formed. The construction model of the laboratory is greatly influenced by the traditional one. Based on the traditional core curriculum, laboratories are set up respectively, which lacks forward-looking feature, connectivity, integrity and openness. In order to adapt to the transformation of the application-oriented talent training model, the construction of the laboratory should be based on professional development and industrial needs. Colleges need to build an open, comprehensive and design laboratory to fully mobilize the hands-on ability and innovative creativity of teachers and students.

The university needs to improve laboratory management level, in order to facilitate the access of teachers and students into the laboratory. We cannot just plan experiments according to the class schedule and we need to improve the utilization and function of the laboratory[3].

### **3. Design Ideas of Civil Engineering Laboratory Model in Applied Universities**

According to the application-oriented civil engineering talent training program, the university should take the students' engineering practice ability as the core, highlight the innovation and application awareness training and closely rely on the school and school-enterprise cooperation experimental practice teaching bases. Combining with the vertical and horizontal projects, the school and enterprise can cooperate to develop multi-level, three-dimensional and modular virtual simulation teaching resource system with virtuality and reality to meet the needs of the engineering.

Colleges need to vigorously promote the integration of modern information technology and practical teaching and rely on the national experimental teaching center of civil engineering, the provincial basic class demonstration laboratory, the characteristic specialty of ordinary universities, the excellent teaching team of ordinary colleges, the innovation training center of college students, and the school-enterprise demonstration base of personnel training and other platforms. Colleges can use multimedia virtual reality technology and numerical simulation technology to build a virtual simulation experiment system with high simulation, virtual reality, openness and sharing nature, comprehensively improve experimental conditions, and carry out reform research and practical exploration in teaching methods and experimental methods, so as to broaden students' professional knowledge and vision, stimulate their sense of innovation and cultivate their engineering practice ability[4].

Colleges can make full use of the existing experimental practice teaching conditions in the school and pay attention to the construction of the teaching staff by continuously optimizing the structure and level of the teaching staff to build a virtual simulation experiment management and teaching team with theoretical and practical abilities. They can strengthen cooperation with domestic large-scale construction enterprises, introduce part-time teachers in design, construction and management from cooperative enterprises and organize virtual simulation experiment teaching. Colleges can also organize management personnel to conduct exchanges and learning in cooperative company, develop virtual simulation experiments with these companies and conduct information application skills training from time to time. Universities need to update teaching and management concepts and improve business level to ensure the smooth implementation of virtual simulation experiment teaching.

Relying on the digital campus network and with the open sharing mechanism of the virtual simulation experiment teaching platform, a highly information-based virtual simulation experiment management system can be constructed to realize the optimal allocation of virtual simulation experiment resources. Colleges need to improve the organization and open operation model of the center. They can improve a series of rules and regulations in laboratory management system, job responsibilities and work performance appraisal methods to ensure the safe and efficient operation of virtual simulation experiment teaching. By establishing the internal and external quality analysis and evaluation system and mechanism, colleges can establish experimental teaching quality evaluation mechanism, and experimental teaching tracking and monitoring mechanism which satisfies student, enterprise and society to improve the quality of virtual simulation experiment teaching. The openness of experimental teaching, standardized information release, timely communication and remote sharing of information can optimize the allocation of virtual simulation experiment teaching resources.

### **4. Construction of Civil Engineering Laboratory Model in Applied Universities**

In order to enhance students' sense of innovation, engineering practice ability, information application ability, comprehensive quality and self-experimental learning interest, and the training effectiveness of civil engineering applied talents, local universities should cooperate with

enterprises to develop hierarchical, modular and systematic civil engineering laboratory model teaching resources, and establish application-oriented laboratory model system with high-simulation, combination of virtuality and reality, openness and sharing nature to actively carry out civil engineering laboratory model teaching[5].

#### **4.1 Basic design.**

The construction of the subject laboratory model adapts to the transformation and development of application-oriented talent training model. The subject laboratory model is an important platform for students to integrate the professional theoretical knowledge into the specific engineering practice and it is also an important base for school-enterprise joint education.

The subject laboratory model teaching platform is mainly for the basic course learning of undergraduate students in the lower grades. It can simulate engineering practice projects, such as material testing, foundation acceptance and construction measurement at the engineering site, to strengthen students' ability to apply basic knowledge to engineering practice. The platform consists of three modules, namely experimental module of materials and mechanics, engineering measurement module and experimental module of geotechnical discipline. The experimental module of materials and mechanics mainly focuses on the experimental content of civil engineering and other related majors, such as materials mechanics, elastic mechanics, theoretical mechanics, structural mechanics and civil engineering materials. We can establish steel mechanical properties subject experiment, reinforced concrete simply supported beam mechanical properties subject experiment, asphalt performance subject experiment and concrete compressive strength subject experiment. The experimental module of engineering measurement subject is mainly for engineering measurement and testing in civil engineering and other related subjects. We can establish measurement instrument cognitive learning subject experiment, wire control measurement subject experiment, road (house building and bridge) construction measurement subject experiment.

The professional subject experiment teaching platform is mainly for the professional course and practical course learning of senior undergraduates. The main goal of the platform is to expand students' professional vision, stimulate students' interest, and guide students to update and optimize their knowledge base to enable students to skillfully use a variety of professional numerical simulation experiment software (such as Midas bridge simulation analysis, YJK house structure simulation analysis, Midas GTSNX geotechnical engineering simulation analysis and VISSIM traffic simulation analysis). This will enhance students' application ability in large-scale engineering construction, design and management, and their comprehensive problem-solving ability in large-scale engineering. The platform consists of six modules, namely bridge engineering subject experiment module, construction engineering subject experiment module, road engineering subject experiment module, geotechnical and underground engineering subject experiment module, traffic engineering subject experiment module, and water conservancy and hydropower subject experiment module.

#### **4.2 Technical model.**

(1) The experimental module of the innovation project subject of college students. This module mainly guides students to make full use of numerical simulation experiments to establish a learning model centered on projects and topics, advocates innovative experimental reforms with students as the main body, mobilizes students' initiative, enthusiasm and creativity in experimental learning, and stimulates their innovative thinking. This will improve their ability to find out innovative solutions to solve problems in engineering technology. Colleges can establish subject experiment projects with simulation analysis in open experiments, college students' innovative training experiments and transformation of research results.

(2) Experimental module of subject competition for college students. This module is a subject experimental platform for serving college students' subject competitions. Based on the relevant large, costly, high-risk and irreversible experimental projects in the subject competition, this platform is used to assist some or all of the tasks in the physical experiment in the subject competition, which can complement the physical experiments and give full play to the respective

advantages of physical and subject experiments. For example, to serve the civil engineering structural model competition, the platform develops subject experiment of bamboo structure innovation design, the experiment of space truss bridge structure innovation design, the subject experiment of two-span aqueduct structure innovation design, the subject experiment of thin-shell container structure with impact load innovation design, subject experiment of single-span space wooden structure innovation design and the subject experiment of large-span space bamboo structure innovation design.

(3) BIM technology applied subject experiment module. This module mainly applies BIM technology to comprehensive training of civil engineering graduation design and comprehensive cognitive training of complex structure in civil engineering. This realizes effective replacement and expansion of project environment cognition, construction simulation, structural decomposition and project management that are difficult to be completed in conventional comprehensive training. This will help improve students' ability to use BIM subject experiment technology for engineering design optimization, collaborative construction, virtual construction, engineering quantity calculation and innovative project management application. In addition, this will cultivate and train students' communication skills and their ability in team synergy and innovation.

## 5. Summary

The transformation and development of colleges and universities is the trend of the times. To transform into the application-oriented and innovative talent training model, there are still many problems in the training model of civil engineering in local universities. After years of experimental teaching and innovation accumulation, the civil engineering laboratory in colleges needs to enrich virtual simulation experiment teaching resources, and gradually increase the intensity and breadth of school-enterprise cooperation. With the basic principles of the combination of theory and practice, the combination of virtuality and reality, and practice first, and taking cultivating students' engineering practice ability and innovation consciousness as the core, the college comprehensively improve students' ability.

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