

# “Three-Education” mode of Civil Engineering talents Based on “Double Chain Fusion”

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**Abstract**—The core of developing application-oriented undergraduate education is to create a first-rate ecology that is most conducive to the cultivation of undergraduate talents. Based on the education chain and industrial chain, the civil engineering talent cultivation mode of moral education, practical education and innovative education is constructed. The national excellent party building model branch has been established, and the “model worker” training studio has been set up to play the leading role of party building education. Engineering experience, scientific research experience and other practical education methods are explored. Innovation education mechanism of teaching practice, innovation activities, and science and technology service has been constructed. The results show that the model enables students to succeed, enterprises to improve economic efficiency and market competitiveness, and teachers to benefit a lot.

## 1 Introduction

Due to the continuous expansion of higher education scale, higher education has realized the transformation from elite education to popular education mode, and higher education has also been upgraded from the original stage and one-time education mode to life-long education mode. College students are not only the carrier of knowledge inheritance, but also the active group to explore the future and realize innovation [1]. Therefore, the cultivation of college students’ innovation ability is an important task of higher education. As an engineering university focusing on application-oriented talents, especially newly-promoted undergraduate universities, the cultivation of students’ innovation ability is always one of the important tasks facing them while focusing on the cultivation of students’ application and practical ability [2].

Undergraduate education is a complex system, involving teachers, students, disciplines, classrooms, training subjects and other resources [3, 4]. For a long time, education and industry have been used to working independently, with the phenomenon of “two skin”. Therefore, integration can enlarge the advantages of both sides, and it is necessary to promote the organic connection of education chain, talent chain, industrial chain and innovation chain in an all-round way.

The core of developing application-oriented undergraduate education is to create a first-rate ecology that is most conducive to cultivating undergraduate talents [5]. Through the systematic layout, all kinds of education and teaching subjects, elements, links and resources can highly match the growth needs of undergraduates, maximize the educational effect, and realize the close

coordination between disciplines and majors, teaching and education, teachers and teaching, resources and security [6,7]. This paper introduces a civil engineering talent cultivation mode of moral education, practical education and innovative education.

## 2 Double chain Fusion

Innovative collaborative education concept requires the establishment of relevant mechanisms to stimulate enterprises’ enthusiasm for collaborative education and increase their participation. It is necessary to change the previous single “school-enterprise” collaborative education and cooperation model into “education-industrial chain” collaborative education and cooperation model to adapt to the requirements of the new economy on talents, so as to ensure the collaborative win of internal development of universities and social needs. It is necessary to mobilize and integrate all relevant platform resources to build collaborative education platform, maximize the collection and optimization of the comparative advantages of practitioners in each different field, and realize the overall advantage of human resources integration greater than the partial advantages. At the same time, the enterprise access system of the education platform should be established and improved. From the perspective of the whole industrial chain, high-quality enterprises should be selected to join the platform, so as to jointly cultivate high-quality talents facing future needs and industry development, and improve the competitiveness of talents and their adaptability to the new economic development.

In the perspective of “education-industrial chain”, the original pattern of interests is broken, so that individual

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interest groups can pursue common interests through knowledge media. Under the guidance of common interests, disciplines and majors, corresponding enterprises can pursue their own interests in a chain of interests. Different interests of intellectual property owners can be pooled into collaborative education, which can greatly enhance their enthusiasm to participate in collaborative education and industrial practice.

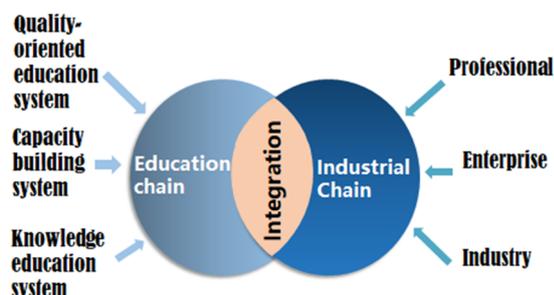


Fig 1. “Education chain - industrial Chain” integration model

“Education chain-Industrial chain” collaborative education can not only change the previous deficiencies such as relying on interpersonal relationship as a bond, and the cooperation period is not fixed, but also ensures the results of collaborative education. In addition to practice, the college also invites enterprises and industry experts to participate in the formulation and improvement of talent training programs, the reconstruction of the curriculum system, the reform of talent training mode, the construction of teaching materials and the guidance of graduate papers (design). Enterprise engineers are regularly invited to give lectures and lectures to undergraduates to introduce the development trends and technological frontiers of the construction industry and promote engineering education to keep pace with the times.

### 3 Three Education

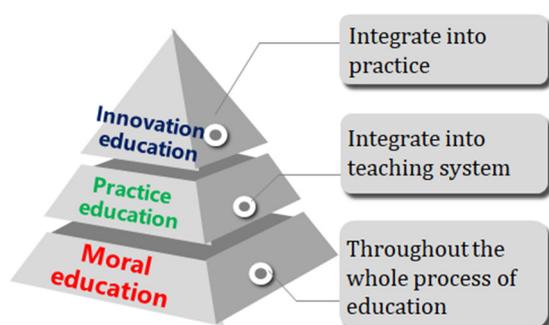


Fig 2. “Three-Dimensional ecological education” model

#### 3.1 Moral education

First, the branch leads. A national excellent party building model branch was built, playing the leading role of party building education to guide teachers to focus on teaching, care about the growth of students, improve the ability and level of education. We also changed the passive education to the active education, and form an educator group and a set of educational forces with the intention, emotion and elements of education. Pay attention to pioneer to lead,

give play to the advantages of branch organization. Actively playing the vanguard exemplary role of outstanding party members, branch collective was hired as the college “Green building plan” entrepreneurship and innovation tutor, “Lu Ban Innovation practice class” student tutor, implementing of the “three complete education” responsibility. A contract was signed In Hangzhou Xiasha Meida community to establish a volunteer service base. Education and guidance branch party members in the daily teaching and research life show the identity of party members, set up an advanced standard, set up a pioneer image. Many experts and professors of the branch actively participate in the provincial “ten thousand items” squatting guidance service action, spending summer vacation, weekend time into the frontline. The laboratory, office was moved to the construction site in order to help solve the Pujiang County Tongji Bridge reservoir comprehensive renovation project, Tongji Bridge irrigation project and other engineering construction technology.

Second, model worker demonstrates. Based on the first-class discipline core team of the university a “model worker” training studio was build up, centering on the model party branch of the University of the Province, and aiming at comprehensive education. Aiming at the development of science, Innovation and technology, revitalization of industry and promotion of culture, and facing the great strategic needs in the field of civil engineering in the Yangtze River Delta region and the urgent need for industrial transformation and upgrading, we lead the teaching and Research Staff, industry leading enterprise experts, and student innovation practice team to carry out innovation and research, and strive to promote technical progress in construction engineering. The application research of soft soil foundation and reclamation engineering technology, green building and structural engineering, water engineering heritage protection and utilization and other fields were carried out systematically centering on the development direction of prefabricated building industrialization, BIM technology, sea reclamation engineering technology, and water engineering heritage protection and utilization. Participating in the formulation of several national and industrial standards in the field of civil engineering played a positive role in the industry.

#### 3.2 Practice education

First, build a practical education system. According to the laws of the experimental teaching and talents growth law of civil engineering experiment teaching center in close connection with the development of civil engineering industry trends, starting from the experimental teaching idea, the establishment and organic combination of theory teaching, combining knowledge with practical ability and innovative thinking training in experimental teaching system, the “1244” experiment teaching system was developed, namely “one core, two combinations, four levels, four patterns”. “One core” is to cultivate students’ civil engineering practice ability and innovative spirit as the core. “Two combination” means that the experimental

teaching project is closely combined with the engineering practice project, and experimental teaching projects are closely combined with teachers' scientific research projects and college students' innovation projects. The "four levels" are to cultivate students' basic skills of professional experiment, professional experimental application ability, comprehensive innovation spirit and engineering practice ability. The "four modes" of experimental teaching include basic experimental teaching, open experimental teaching, research and exploration experimental teaching, and engineering practice experimental teaching.

Second, expand the method of practice education. In addition to the traditional teaching method, it also vigorously advocates and promotes the project system teaching, and adopts the characteristic experimental teaching methods such as engineering experiential teaching, scientific research experiential teaching, science and technology competition-oriented teaching, research and exploration teaching, virtual simulation teaching and online real experience teaching.

- **Engineering experience-based practice education.** Relying on the center at all levels of production platform, according to the students' professional direction and personal interests, "double type" teachers were arranged to guide students to actively participate in test, design, construction, supervision of engineering projects, to help students to improve their hands-on ability and ability to analyze and solve practical engineering problems, get familiar with enterprise project management processes and methods in advance. Figure 3 shows the photo of students participating in engineering practice projects.



**Fig 3.** Students participating in engineering practice projects

- **Experiential and scientific research-based practice education.** Change the traditional one-way input teaching mode, create a teaching environment and atmosphere for scientific research, guide students to study, think and experiment actively, find, analyze and solve problems autonomously, so as to achieve the teaching objectives of accumulating knowledge, cultivating ability and improving quality. Encourage students to choose their own topic according to their interests. Promote experimental teaching and improve the quality of experimental teaching with high-level scientific research projects. To attract students to participate in teachers' scientific research projects, receive high-level scientific research training, deepen the understanding of engineering design, testing and

scientific research, understand the latest trends of science, deeply understand theoretical knowledge, and integrate with engineering practice. In recent three years, students have participated in engineering practice and obtained 7 provincial engineering laws of Zhejiang province and over 60 patents. Students no longer act as an operator, but feel, understand and participate in the process of exploration, and cultivate the ability to acquire new knowledge, analyze and solve problems. Experimental teaching has obvious effects.

- **Competition-oriented practice education.** Using the experimental teaching platform of Civil and Environmental Engineering Experimental Teaching Demonstration Center, all kinds of competition activities are taken as public optional courses for students, and students are actively organized to participate in various science and technology competitions, so that outstanding students can stand out, greatly improve the enthusiasm of students, and guide students to personalized learning and practice. For example, through organizing students to participate in various Challenge Cup competitions, various innovation skill competitions, students' scientific research quality and innovation spirit have been comprehensively cultivated.



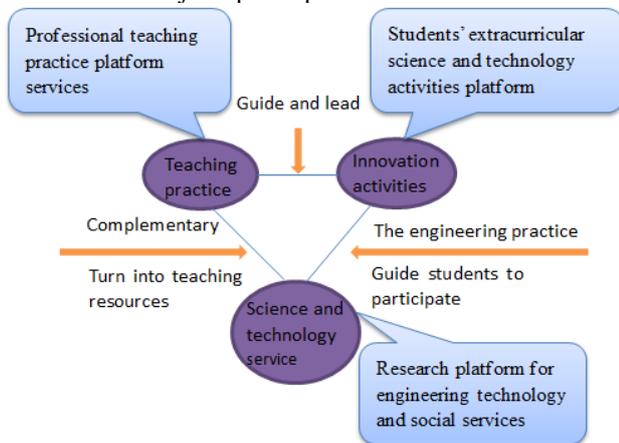
**Fig 4.** Real - time on - line system display for site construction

- **Online practice education.** Based on the experimental teaching platform of the center's online monitoring system and large numerical platforms such as Chenglong Group and Zhejiang Hualin, etc., real engineering teaching is carried out on campus. Figure 3 shows some photos of the industry-university cooperation contracts signed between our school and relevant units. The combination of network technology and real experimental environment and operation complement each other to stimulate students' interest in doing experiments and improve the teaching quality of civil engineering experiments. Practice shows that virtual simulation technology in civil engineering experiment teaching, online real experience, can fully inspire the students' creative thinking, greatly alleviate the experimental classes and the contradiction of the laboratory resources, constraints are solved such as time, space, traffic conditions and reduce the engineering safety problems brought by the scene teaching. It also enables students who are unable to use all kinds of large experimental equipment to

have a relatively vivid sensory understanding and understanding of modern analytical techniques and a deeper understanding of practical civil engineering problems. Figure 4 shows some photos of experimental teaching displayed in the real-time online system of construction site.

### 3.3 Innovation education

First, develop innovation education mechanism. Construct the teaching practice, the innovation activity, and the science and technology service trinity innovation education mechanism. Three platforms, namely, a scientific research platform for engineering technology and social service, a teaching practice innovation platform and a platform for students' extracurricular scientific and technological activities are built, as shown in Figure 5. The operation of the platform is realized by the guidance of teachers, the transformation of scientific and technological services and the joint participation of students.



**Fig 5.** Innovation education mechanism

Second, build an innovation team. Relying on the university civil Engineering Institute and Inventors Association and other organizations, and with the help of in-depth cooperative enterprise technical resources, we have successively established more than 20 cooperative innovation teams of integrated industry and learning, such as vertical greening, ecological block, ecological dredging, ecological slope protection, ecological river course, green construction, safety protection and sewage treatment. Teachers' innovation team, students' innovation team and school-enterprise cooperation team are organically integrated through the common innovation points selected by teachers and students

Third, carry out innovative projects. Carry out innovative projects in quality management, construction methods, norms, standards, patents, inventions, new technologies, new products and new methods.

## 4 Practical Achievements

### 4.1 Students benefit

The model has been widely used in civil engineering and has achieved fruitful results. In the last five years, the students won nearly 200 awards in the 4<sup>th</sup> "Internet +"

Competition for Innovation and Entrepreneurship among college students in Zhejiang Province, the 8th competition for Career Planning and Entrepreneurship among college students in Zhejiang Province, and the structural design competition for college students in Zhejiang Province, granted 259 patents, published more than 10 academic papers, and approved nearly 30 projects of National University Students Innovation and Entrepreneurship training program.

### 4.2 Teachers benefit

This model not only enables students to succeed, but also teachers to benefit a lot. In the process of innovation practice, the team teachers have 100% innovative achievements in patents, inventions and other aspects. They have successively won 1 excellent teacher of China Construction Association, 2 famous teachers of China Water Conservancy Education Association, 1 provincial excellent teacher, 2 advanced individuals of Provincial Three Education People and 3 "My favorite teachers" of the school. In the past three years, 3 were promoted to senior titles, 4 to associate senior titles, and 5 were included in various talent training programs.

### 4.3 Enterprises benefit

This mode emphasizes the integration of educational chain and industrial chain, which can improve the economic benefit and market competitiveness of enterprises. In the past three years, the company has obtained more than 150 authorized patents, 14 provincial and ministerial-level construction technology, and 3 municipal construction technology. The teams of teachers make use of the innovative achievements to give back to the society, and carry out innovative technology training for industries and enterprises. More than 30,000 engineering and technical personnel have benefited, covering industries and fields such as construction, municipal administration, water conservancy, and hydropower and highway transportation. The social benefits are very significant.

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