

# Exploration and Practice of Environmental Engineering Major Construction Based on the Integration of Science, Industry and Education Model

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**Abstract:** In the construction of the Environmental Engineering major in the School of Environmental and Chemical Engineering at Zhaoqing University, a problem oriented approach has been taken. Through reform practices such as the integration of theory and practice, science and education, and industry education, a talent training mechanism has been formed under the integration of science, industry, and education. This model is being explored for application in professional construction. Practice has shown that this model has achieved good construction results in terms of talent cultivation quality, faculty team, and education platform, and the environmental engineering major has entered the provincial-level first-class professional construction point. At the same time, extract innovative aspects in talent cultivation concepts, training models, disciplinary specialties, and engineering practices.

**Keywords:** Integration of Science and Education; Integration of Industry and Education; Professional Construction; Practical Teaching Base; Pattern Innovation

## 1. Introduction

The Environmental engineering major of the School of Environmental and Chemical Engineering of Zhaoqing University is a traditional engineering major. In the long-term construction of the major, it has been faced with a series of problems, such as the lack of close connection between theory and practice, insufficient support of scientific research for teaching, limited practical teaching conditions, disconnection between engineering education and production practice, and lack of practical

ability of teachers.

In the face of the above problems, the integration of industry and education and the integration of science and education have always been the research hotspot to solve the problem [1,2]. The integration of industry and education refers to the mutual cooperation between social enterprises and institutions of higher learning on the basis of their respective development needs, the establishment of a mutual interest community of supply and demand docking, resource sharing, and complementary advantages, the promotion of the cooperative relationship and education mechanism of enterprise production and university education integration, and the organic connection of school-enterprise cooperative education chain, supply and demand talent chain, social industrial chain, innovation and entrepreneurship chain. In the undergraduate education of environmental engineering, many schools have also conducted a discussion on the aspects of teaching subject production [3,4].

Adhering to the position of building an applied research-oriented university, Zhaoqing University has always attached importance to the integration of industry and education and the integration of science and education. In 2024, Zhaoqing University has obtained the master's degree in resources and environment, which has unique conditions in the integration of science and education. Over the years, the school has adhered to the integration of production and education and the integration of science and education in professional construction, and actively promoted the reform of the school education system and mechanism. Deepen the integration of industry and education, deepen school-enterprise cooperation, improve the level of professional

group construction, and promote the organic connection of education chain, talent chain, industrial chain and innovation chain [5]. As the integration of industry and education moves from "integration" to "integration", the integration of industry and education is constantly promoted to a new stage in professional construction [6,7]. The practical connotation of constructing the major by integrating production and education includes three aspects: the integration of discipline and specialty construction, the integration of system and mechanism, and the sharing of integrated resources [8]. The environmental engineering major of the school where the author works also actively promotes the sharing of resources and teachers. In the face of a new round of scientific and technological revolution and industrial change, the traditional environmental engineering major needs to solve several key problems restricting professional development in order to achieve conformal development, and train high-quality talents needed by the industry [9].

This paper summarizes the exploration of the professional construction mode in the model of teaching-discipline-production integration and its application effect in the author's school.

## **2. Exploration of Professional Construction Mode of Integration of Teaching, Science and Production**

In response to the problems in the cultivation of environmental engineering professionals, in accordance with the OBE talent cultivation concept of engineering education certification, a curriculum system is constructed to deepen the reform of the curriculum system and teaching content, and a reform plan for the construction of environmental engineering undergraduate majors based on the integration of education, science, and industry is formed. After practical testing, significant results have been achieved [10].

### **2.1 Integration of Theory and Practice**

Adhere to the problem-oriented, enrich the teaching mode, consolidate the theoretical foundation of students, and strengthen the training of practical ability of light industry engineering, so as to achieve a closer connection between theory and practice. Aiming at the problem of disconnection between theory and reality in teaching, this

paper innovates teaching methods and constructs a new blended teaching model of classroom, network and mobile terminal. Strengthen innovation and entrepreneurship education, improve the four-wheel drive teaching system of "creativity - innovation - creation - entrepreneurship", and promote the organic combination of "learning, research and innovation".

### **2.2 Integration of Science and Education**

Adhere to the goal of improving students' quality, strengthen the combination of scientific research and teaching, transform "scientific research density" into "teaching quality", and achieve strong support from scientific research for teaching. After expanding its scale, the school embarked on an era of integrating science and education, transforming high-quality scientific research resources into educational advantages. Implement the three-step approach of "teacher student discussion student exploration", promote research-based teaching, support teachers to introduce the latest scientific research achievements into undergraduate courses, and cultivate students' innovative thinking ability.

### **2.3 Integration of Production and Education**

Adhere to the unified orientation of industrial needs and educational goals, cooperate deeply with enterprises in the light industry to improve students' comprehensive quality and adaptability, realize the deep integration of production and education to meet industrial needs, deepen the reform of teaching content and curriculum system with the OBE-CDIO engineering education concept, and integrate the results of industrial development into the classroom; On the basis of the training of environmental engineering talents, the connotation of light industry should be expanded, and new media technology and new engineering major should be established. Build a practical teaching platform linking the campus practice base with the off-campus practice and training base to promote the development of school-enterprise cooperation. Through "Please come in, go out", a "double teacher" team has been built.

## **3 Application of Professional Construction Mode of Integration of Teaching, Science and Production**

### **3.1 Strengthen the Construction of the Management System and Cooperation Mechanism for the Integration of Industry and Education**

The deep and long-term integration of industry and education in the cultivation of new engineering talents cannot be achieved without a sound management system and cooperation mechanism. Based on the characteristics of the integration of industry and education in the cultivation of new engineering talents, establishing a sound multi-party cooperation mechanism is conducive to the rational allocation of responsibilities and rights among universities, enterprises, and governments. The government takes the lead in establishing a practice base for the integration of industry and education, and the construction committee and professional construction committee jointly participate in major decisions such as base construction and professional development. The government provides policy support and tax incentives to enterprises participating in the integration of industry and education, and establishes supporting management and operation mechanisms, interest incentive mechanisms, and risk supervision mechanisms for the continuous operation of the industry education integration platform, forming a system guarantee for the common interests of multiple parties.

### **3.2 With Students as the Main Body and Teaching Reform as the Means, Innovative Teaching Mode and Method**

Strengthen the cultivation of students' practical ability. Establish the academic tutorial system, teach students according to their aptitude, and carry out individualized personnel training. School and enterprise experts form a mentor group to jointly guide and carry out real engineering project training. Make full use of virtual simulation, smart classroom, mobile APP and other information technology means, classroom, network, mobile terminal trinity, to promote the reform of teaching methods. In the form of "Student master" studio, improve students' awareness and ability of "creativity - innovation - creation - entrepreneurship". Students have won the "Creative youth", "Internet +", "Challenge Cup" and other innovation and entrepreneurship competition awards, as well as outstanding college

entrepreneurs and other honorary titles.

### **3.3 Promote the Integration of Scientific Research Resources into Curriculum Teaching, and Collaborate with Science and Education to Educate People**

Relying on the existing Guangdong Key laboratory and other platforms, integrating teaching and scientific research resources, teachers will apply high-quality scientific research results to classroom teaching and talent training. Effective construction of "teacher-teacher-student-discussion-student research" three-step promoting teaching model. Guide students to participate in scientific research activities, strengthen the cultivation of innovation consciousness and innovation ability. Support students to join scientific research teams and encourage students to conduct independent and innovative learning. The proportion of students who started to participate in scientific research projects in the laboratory exceeded 43% in the sophomore year. In the past five years, students have won more than 50 innovative and entrepreneurial projects of various kinds and published more than 30 scientific research papers.

### **3.4 Deepen the Integration of Production and Education, Co-Build and Share High-Quality Production and Education Resources, and Build a "Double-Teacher" Teaching Team**

First, establish a mechanism for improving teachers' quality and ability. The school requires all full-time teachers to train their personal curriculum teaching content and core vocational skills, and to take temporary positions in enterprises for no less than 6 months in a three-year cycle. Relying on the practice base platform, full-time teachers have extensively participated in enterprise production management and technology research and development activities, and their scientific research and production practice abilities have been significantly improved. Teachers continue to provide intellectual services for enterprises, and continue to integrate new technology and new technology into the curriculum teaching content, and the teaching reform has achieved remarkable results.

Second, establish the incentive mechanism of practical guidance teachers. The college signed

a cooperation agreement with Guangdong Xijiang Environmental Protection Co., LTD. The company continues to select skilled craftsmen with good professional ethics, high theoretical level, strong teaching ability and skilled professional practice skills as part-time instructors. The college pays part-time instructors for their work in accordance with relevant agreements and personnel systems. The teaching quality training courses for backbone part-time teachers regularly set up by schools and enterprises cultivate the career interest of part-time teachers by sharing excellent course design and teaching methods, and effectively enhance the sense of responsibility of enterprise employees. The part-time teachers in the base guide at least one professional practice course every year to ensure the professionalism, continuity and stability of the practical teachers.

Third, the integration of production and education improves the technical service ability of teachers in the base. Relying on the practice base platform, both schools and enterprises make full use of talents and technical advantages to carry out a wide range of science and technology lectures, enterprise staff training, national training for higher vocational schools, and provincial companionship for secondary vocational schools, significantly improving the technical innovation and social service capabilities of teachers in the base. School-enterprise co-construction of Guangdong Province intelligent equipment manufacturing collaborative education platform 1, Guangdong Province college students practice teaching base 1, the joint implementation of equipment manufacturing "double master" backbone teacher professional skills training projects, remarkable results.

#### **4. The Innovation of the Construction Mode of Teaching and Producing Specialty**

##### **4.1 Training Mode Innovation**

The model of "integration of teaching, science and industry" in the construction of light industry has been created and applied, and remarkable results have been achieved. To meet the needs of the industry, OBE-CDIO engineering education concept, scientific planning, through the integration of science and practice, to consolidate the theoretical foundation of students and strengthen the

training of practical ability of light industry engineering; Through the integration of science and education, students' innovative thinking and innovative ability are cultivated, and high-quality personnel training is supported by high-level scientific research. Through the integration of production and education, the course system of light industry majors has been established in line with the certification standards of engineering education, a team of high-level teachers has been established, and a number of high-quality school-enterprise collaborative practice teaching platforms have been built. The environmental engineering major was selected as the construction point of "First-class undergraduate Major in Guangdong Province".

##### **4.2 Subject Specialty Innovation**

Establish master's degree in resources and environment, expand the connotation of environmental engineering, establish new engineering majors, and create a new pattern of construction of light industry majors. In 2024, the Master's Program in Resources and Environment will be established to focus on cultivating master's students. In order to meet the demand for compound talents in the transformation process of traditional industries, the Resource and Environmental science major was established by comprehensively utilizing the resources of education, science and production, expanding the connotation of light industry, and significantly increasing the professional influence of the discipline.

##### **4.3 Engineering Practice Innovation**

The "learning factory" practice teaching base of environmental engineering has been built, and the "learning factory" practice base of school-enterprise co-construction and sharing covers the industrial chain of packaging, printing and media. It is equipped with advanced equipment such as material testing, virtual simulation, environmental monitoring and virtual studio, providing students with an environment for practical teaching, course teaching and engineering research. It created a precedent in the construction of a "learning factory" practice base in the field of light industry.

#### **5. Conclusion**

Since the application of the professional

construction mode of integration of teaching, science and production, good results have been achieved in the quality of personnel training, the construction of teacher teams and the education platform group, which are embodied in the following aspects.

(1) The quality of personnel training has been improved year by year. In the past five years, students have won more than 30 awards at the provincial and ministerial level and above, published more than 40 papers and applied for patents. More than 300 applied talents are transported to the environmental engineering industry every year. According to third-party professional survey data, employers' satisfaction with graduates is more than 88%. In the Alumni Association ranking of environmental universities in 2021, my university ranks third.

(2) The effect of teacher construction is obvious. Through the construction of the teaching staff under the "integration of education, science, and industry" model, a "dual teacher" teaching team with high theoretical level and rich practical experience has been established. By accelerating the construction of the teaching staff through practical models, we have successively won honorary titles such as "Teaching Master", "Teacher Ethics Model", and "Advanced Collective in Teacher Ethics Construction". In the past 5 years, we have won 2 provincial-level or above teaching achievement awards, undertaken more than 10 provincial-level or above teaching and research projects, published more than 20 teaching and research papers in domestic and foreign public journals, published 2 monographs and textbooks, and authorized more than 10 national invention patents.

(3) The education platform continues to improve. The Environmental Engineering and Resource Environmental Science major was established as the Guangdong Provincial Key Laboratory of Environmental Health and Resource Utilization in 2019. At present, more than 10 internship and training bases and joint laboratories have been established with well-known environmental protection enterprises in Guangdong Province. We have established nearly 10 exchange platforms with foreign research institutes such as the University of Leeds, Macau University of Science and Technology, and regularly select

teachers and students for learning and exchange. By implementing the professional construction model of integrating education, science, and industry, the environmental engineering major where the author works has made significant progress and achieved remarkable results. The environmental engineering major has been selected as a "first-class undergraduate major construction site in Guangdong Province". In the future professional construction, the author's team will continue to deeply study the integration model of science, industry, and education, and promote the development of professional construction.

### Acknowledgments

This work was supported by the 2024 Zhaoqing College Quality Engineering and teaching reform project "Zhaoqing College -- Guangzhou Heyuanda Environmental Protection Development Co., LTD. Science, Industry and Education Integration Practice Teaching Base" (number: zlgc 2024002); Notice on the List of Undergraduate Teaching Quality and Teaching Reform Project Construction Projects in Guangdong Province in 2021 (Guangdong Education Gao Han [2021]29) College Students' Social Practice Teaching Base Construction project "Zhaoqing University-Zhongrun Green Ecological Environment Group (Shenzhen) Collaborative Innovation Social Practice Teaching Base"; 2024 Zhaoqing University Quality Engineering and Teaching Reform Project "Exploration and Practice of Blended Teaching of Water Pollution Control Engineering Curriculum Design under Digital Background" (zlgc 2024092)

### References

- [1] Li Yihua, Ma Jie. Construction of off-campus practice teaching base in the process of transformation of local undergraduate universities. *Journal of Tianjin Academy of Education and Science*, 2019 (1): 21-25.
- [2] Liu Zhimin. Integration of industry and education: From "integration" to "integration". *China Higher Education*, 2018 (2): 24-25.
- [3] Chen Feng. Seize the opportunity, seize the momentum and push the integration of industry and education to a new stage. *Chinese Higher Education*, 2018 (2):

- 18-22.
- [4] Mou Yanlin, Li Kejun, Li Junjie. How applied undergraduate universities lead the construction of professional clusters by integrating production and education. *Higher Education Research*, 2019,41 (3): 42-50. (in Chinese)
- [5] Cao Rui. Problems and Path Analysis of off-campus practice teaching base Construction in local colleges and universities under the background of transformation and development. *Journal of Taiyuan City Vocational and Technical College*, 2018 (6): 143-144.
- [6] Xiang Meilai, Yi Weisong. New Engineering Construction Approach under the background of integration of industry and education: Revelation of North American Cooperative Education. *Science and Technology of Chinese Universities*. 2019(Z1): 80-84.
- [7] Qi Fugang, Peng Juan. Innovation and practice of training mode for engineering postgraduates. *Journal of Higher Education*, 2018 (3): 31-33.
- [8] Li P, Jia Yuzhuo, Song Chenhu. Research on the construction of postgraduate training base outside school. *Journal of Jilin Institute of Chemical Technology*, 2016, 33 (6): 104-106.
- [9] Liu Jinglei. Exploration and practice on the training mode of civil engineering postgraduates under the background of school-enterprise cooperation. *Scientific Consultation (Science and Technology Management)*, 2021 (7): 144-145.
- [10] Tang Weibing, Wen Hui, Peng Jianping. Mechanism Construction of Collaborative Education under the concept of "Integration of production and Education". *Chinese Higher Education*. 2018 (08): 14-16.