Research and Practice on Training Mode Reform of Applied Talents in Environmental Engineering Technology under Industry-Teaching Integration Training Base

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Abstract. It is an effective way to promote the in-depth development of school-enterprise cooperation to build a high-level professional training base integrating industry and education with radiation-leading effect [1]. It is an important measure to reform the training mode of talents and improve the training ability of talents with technical skills. Through the research on the construction and teaching reform of the industry-teaching integration training base for environmental engineering technology major in Chongqing vocational college of resources and environmental protection, adopt the "four-in-one" teaching reform mode of "Internet + teaching + project +X certificate" [2], carry out reform and practice of application-oriented talent training mode based on industry-teaching integration training base. Implement the curriculum teaching design that emphasizes vocational competence [3], analyze the results and experience, put forward the problems existing in the process of educational reform and the effective operation thinking of sustainable development, to study and explore a new path for the training of environmental engineering talents under the background of industry-education integration training base [4], continuously enhance the ability of environmental engineering technology specialty to accurately serve regional development needs.

Keywords: Industry-teaching integration training base, teaching reform, applied talent training mode, environmental engineering technology.

1. Introduction

The State Council's "Notice on the Issuance of the National Implementation Plan for Vocational Education Reform" document Guo Fa [2019] No. 4 clearly states, "Enhance the enthusiasm of enterprises to participate in vocational education, train tens of thousands of enterprises that integrate industry and education, create a number of excellent vocational education and training evaluation organizations, and promote the construction of 300 high-level specialized training bases that integrate industry and education with radiation and leadership [1]." The importance of building a training base for the industry-teaching integration in vocational institutions has been raised from the national level. School-enterprise cooperation training base is an important carrier to promote the industry-teaching integration, an effective way to promote the deep development of school-enterprise cooperation, and a necessary measure to realize the integration and utilization of school training base and enterprise or
park production resources. In the context of the reform of the industry-teaching integration in the training of talents, and based on the 8+3 plan in the Action Plan of Chongqing Municipality for the Promotion of Science and Education and the Strengthening of Talents, the environmental engineering technology major of our university has gradually established a training base (hereinafter referred to as "dual-base") which has the dual functions of teaching and production, and the in-depth cooperation between the school and the enterprise to train talents with technical skills [5], build a talent training mode that meets the needs of the market, realize the double qualified teacher and mutual employment, double certificate training and integration, and promote the seamless connection between talent training and enterprise demand In the education chain, talent chain and industrial chain, innovation chain organic link [6], improve the ability of technical personnel training, enhance the ability of environmental engineering technology to serve the local economic and social development.

2. The connotation of the industry-teaching integration training base

The dual-bases of higher vocational education based on the integration of industry and teaching are the integration and utilization of the practical training bases of schools and production resources of enterprises or parks through the cooperation between schools and superior enterprises, and the in-depth cooperation between schools and enterprises to train talents with technical skills; it is a collaborative education training base which integrates practical teaching, real production, skill training, skill appraisal, teacher training, entrepreneurship incubation, professional quality and social service, and meets the needs of industry development. [7]

(i) Joint construction major
Making full use of the construction of dual-bases, schools and enterprises jointly build majors, jointly determine talent training standards, formulate talent training programs, participate in professional planning, textbook development, teaching design and curriculum setting, improve the professional (group) practical teaching system, optimize practical training programs and contents, promote project teaching, case teaching, scenario teaching and work process-oriented teaching, and maximize the integration of enterprise needs into talent training links.

(ii) Joint training of "double qualified" teachers
Make full use of the construction of dual-bases, schools and enterprises jointly train "double qualified" teachers, schools and enterprises jointly establish a mechanism for mutual employment of employees, support professional teachers of schools to study and work in dual-bases on a regular basis, and integrate "double qualified" teacher training bases and dual-bases as one. Encourage schools to set up special positions for industrial teachers (tutors), and employ experienced enterprise experts, engineering and technical personnel, skilled artisan as part-time teachers.

(iii) Jointly carry out technical skills training
Make full use of the construction of dual-bases, integrating vocational and technical training centres and dual-bases to provide vocational training and qualification training for the community, industry and students. It actively undertakes and develops social service projects, carries out multiform education and training, lifelong education services, poverty alleviation and development, and labour transfer training, and strives to enhance the service capacity and contribution of the base. Achieving a "dual certification" rate of over 90% for students in majors aligned with the National Vocational Qualifications Catalogue through the construction of dual-bases [5].

3. The construction mode of industry-teaching integration practical training base of environmental engineering technology

In accordance with the principle of "jointly building the hard platform of the on-campus and off-campus training bases, jointly managing the soft platform of the operation and management system of the training bases, and jointly training and sharing the talents with technical skills that meet the job requirements", the two sides of the school and the enterprise [8-9]. In order to achieve the innovation of talent training mode, double qualified teacher training and mutual recruitment, dual certification training and integration, to build a practical teaching team, to improve the technical skills training
ability, to combine the national environmental protection industry policies and the actual development of environmental protection enterprises, and to build a dual-base of teaching and practice for environmental engineering technology majors closely around the theme of school-enterprise cooperation [10].

(i) Establishment of a hard platform for the training base

Clarify the responsibilities of the dual subjects and cooperate with schools and enterprises to build dual-bases. Relying on the "dual-base" construction project of environmental engineering technology vocational education, the major aims to build three modules of on-campus training bases, including environmental monitoring, sewage (waste) water treatment and solid waste treatment and disposal.

(1) The module of environmental monitoring has built an environmental monitoring training room on campus, and has attracted enterprises to the school - the Dazu District Ecological and Environmental Monitoring Station, which has a strong social influence, has been moved to our university, and has signed an agreement of 7.4 million yuan to enter the school; and relying on the strong testing strength of Chongqing Jiusheng Testing Technology Co., Ltd. to complete the construction and listing of off-campus environmental monitoring training base, environmental engineering technology students can regularly rotate to the enterprise for job shadowing, on-the-job internship, which can train more than 50 times per year.

(2) The module of sewage (waste) water treatment has built a sewage and waste water pre-treatment training room and a domestic sewage treatment simulation training room on campus, and the off-campus training base has been built by Dazu Drainage Company, which specializes in waste water treatment, and has now hung the plaque of talent training base and internship base on each other. The enterprise is close to the school, so students can go to the enterprise for cognitive internship since freshman year, professional internship in sophomore year, and job shadowing and on-the-job internship in junior year, which realizes resource sharing and talent training between school and enterprise. At the same time, it also provides a training platform for national and municipal level skill competitions.

(3) Solid waste treatment and disposal module has been built on campus solid waste treatment and disposal training room, off-campus training base relying on solid waste treatment technology advanced Chongqing Huanchuang Solid Waste Treatment and Disposal Co., Ltd.

Two-way entry and school-enterprise integration to foster a dual-base. The university and enterprises work together to build a high-level training base involving the integration of various needs such as professional setting, education and teaching reform, internship training, order training, technology development, science and technology research and development. Realize the integration and utilization of school training bases and enterprise resources, and create a double-base platform that integrates practical teaching, social training, real production and technical services for in-depth school-enterprise cooperation in training talents with technical skills.

(ii) Build a soft platform for the training base

(1) Team Building

The dual-bases of vocational education in environmental engineering technology need to be equipped with a certain number of teams of practical teachers with front-line working experience in enterprises, who are responsible for guiding and managing students to carry out internship and practical training. The practical teachers should be mainly tutors from enterprises, supplemented by teachers from schools, to form a "double qualified tutors" teaching team. A team of experienced and sufficient number of practical teachers is the fundamental guarantee of effective practical training for students [11].

Therefore, our university actively implements the mutual employment of dual teachers and school-enterprise exchanges to collaboratively nurture talents. We will focus on the construction of excellent professional teaching team, take the construction of professional leaders and professional backbone teachers as the core, select young teachers of professional courses to cooperate with enterprises for on-the-job practice or teaching every year, hire enterprise engineers and technicians, skilled craftsmen as part-time teachers, the number of double qualified teachers has reached more than 70%, and initially
build a teaching concept advanced, reasonable structure, combined with professional and high-quality "double qualified teacher" practice teaching team [12].

(2) Institutional development
The university attaches great importance to the construction of the dual-base project of industry-education integration and has set up a special leading group for the construction of the dual-base of environmental engineering technology. According to the requirements of dual-bases construction and the experience of enterprise management, six management systems have been formulated, including "Measures for Construction and Management of Higher Vocational Education dual-bases", "Work Guarantee Mechanism of Vocational Education "dual-bases" Project", "Measures for Inspection and Evaluation of School-Enterprise Cooperation Project Promotion", "Measures for Use and Management of Special Funds for School-Enterprise Cooperation", "Measures for Management of Double Qualified Teacher Training Base" and "Review System of Professional Setting". These management mechanisms regulate the processes of dual-base construction, double qualified teacher team construction, special fund management, student internship and practical training operation and management, and clarify the responsibilities of schools, enterprises, students, teachers and other parties, as well as the operation mechanism and evaluation methods for each project.

(3) Cultural construction
Schools should make full use of the dual-base construction platform as a window of communication between schools and enterprises to strengthen cultural exchanges with them. Firstly, it can enhance the social influence and visibility of the university and improve the competitiveness of employment for students; secondly, it can introduce new ideas, concepts, methods and technologies from enterprises into school education and teaching to achieve a deeper level of industry-teaching integration. Third, it can enhance students' awareness of their profession and their sense of belonging to the company. Through long-term submersion, school-enterprise friendship rendezvous, enterprise culture gallery, college students enterprise tour and other forms of campus cultural activities, so that students can personally experience the enterprise production process and cultural atmosphere [13]. Realize the integration of enterprise culture and campus culture, form a unique teaching model and cultural construction, and inject continuous vitality and power into school-enterprise cooperation and industry-teaching integration.

4. Research and practice on training mode reform of applied talents in environmental engineering technology
Environmental engineering technology industry-teaching integration training base is the basis of talent training and curriculum system reform, the main carrier of professional course practice and job skills training effective docking, is an important way to train students' job skills. A fully functional dual-base for VET builds realistic vocational environments and training scenarios for students [14]. Based on the dual-bases, our university has carried out in-depth curriculum development and teaching mode reform, mainly adopting the "four-in-one" teaching reform model of "Internet + teaching + project + X certificate" [2]. In addition, we implement a curriculum teaching design that highlights vocational competence. [3] The teaching is carried out in accordance with the actual job requirements.

(i) Determine the objectives of talent training in accordance with the needs of vocational positions
According to the vocational positions and typical work tasks identified in the market research report, organize seminars for industry and enterprise experts as well as professional key teachers to understand the changes in market demand and the specific requirements for talent specifications, conduct vocational ability demand analysis, analyze the vocational ability needs of specific vocational positions (groups), and accurately position professional talent training objectives in response to enterprise demand [15]. To adjust the professional training objectives to the needs of enterprises, in order to ensure that the training of talents in our university meets the needs of local economic construction and social development, and to deliver a large number of qualified talents to society.

(ii) Study of vocational qualification standards and development of professional core curriculum
After determining the training objectives and training standards that are compatible with the vocational positions with the enterprises, a vocational competence-based job curriculum system is established with the training of job competencies and skills as the main line and the strengthening of practical, social, innovative and vocational literacy as the core. To adjust and set up professional core courses, optimize the course structure, and reform the curriculum system and course standards in a targeted manner in accordance with the requirements of technical fields and vocational positions (groups) and with reference to relevant vocational qualification standards [16]. Incorporating enterprise standards into the curriculum standards, formulating curriculum standards that highlight the training of vocational abilities, requiring graduates to have the comprehensive abilities and vocational job competencies required for competent job qualifications, and realizing the "industry-teaching integration" talent training model.

(iii) Reform of teaching mode in environmental engineering technology

The dual-bases of environmental engineering technology vocational education in our university are divided into three modules for teaching: environmental monitoring, sewage (waste) water treatment and solid waste treatment and disposal, each module corresponds to two professional core courses: first, the environmental monitoring training base corresponds to the courses of Environmental Monitoring and Practical Skills for Practitioners of Socialized Environmental Testing Agencies; second, the sewage (waste) water treatment training base corresponds to the courses of Water Pollution Control Engineering and Operation and Management of Municipal Water Treatment Systems; third, the solid waste treatment and disposal training base corresponds to the courses of Solid Waste Treatment and Disposal and Three Waste Treatment and Circular Economy. The enterprise and the university jointly develop the syllabus and practical teaching system of the above six professional core courses, and at the same time, the cooperative enterprise provides the place for environmental engineering technology students to observe, operate, follow the work and top-up internship, gradually forming the "three-stage" internship training mode of "cognitive internship in the first year, professional internship in the second-year and specific-job training in the third year" with the objective of practical combat. Taking the combination of engineering as an important entry point for the reform of talent training mode, the project-based curriculum teaching mode focusing on environmental monitoring, sewage (waste) water treatment and solid waste treatment and disposal is formed around the training objectives of environmental engineering technology majors. To enable students to integrate theory and practice more closely, and strive to achieve a zero match between students' professional skills and the employment needs of enterprises.

Corresponding to the content of the three modules, teachers of environmental engineering technology and industry experts jointly compiled "Environmental Monitoring Practical Training Course", "Water Pollution Control Technology Practical Training Course" and "Solid Waste Treatment and Disposal Practical Training Course", forming a project-oriented practical training course system with the work tasks of environmental monitoring, sewage (waste) water treatment, solid waste treatment and disposal as the guide, and environmental monitoring, sewage treatment, solid waste treatment and other work processes as the main line, reflecting the integrated characteristics of "teaching, learning and doing". Update the teaching philosophy and teaching methods, adhere to the "action-oriented" teaching concept, combining the "instruction first" and "construction first" teaching methods; strive to practice the integration of "teaching, learning and doing"; students actively participate in the teaching process, and the teaching objectives are effectively completed.

(iv) Deepen the reform of the training mode of composite talents with technical skills and jointly train dual-certification talents

In accordance with the requirements of aligning practical training projects with industrial needs, learning contents with vocational standards (evaluation norms) and practical processes with production processes [17], the university relies on the three construction modules of the dual-base of vocational education of environmental engineering technology, our university has set up three types of national vocational skill appraisal jobs, namely, science and engineering of water production department, industrial wastewater treatment and solid waste treatment and disposal. Our university
actively promotes the "1+X" certificate system of the State Council, deepens the reform of the training mode of compound technical skill talents, consolidates the foundation of students' sustainable development on the basis of academic education, provides students with channels to promote multiple types of vocational skill level certificates, and expands their employment and entrepreneurial skills. The university has now achieved an annual training capacity of 1,000 national vocational skills identification, with a pass rate of more than 70%, playing a model leading role in the city's environmental protection industry.

(v) Mutual recruitment of teachers and joint training of "double qualified" teachers

The university has formulated the Interim Measures on the Management of Teachers' Specific-Job Practice (trial) to encourage teachers to participate in enterprise training, technology research and development and other activities to enhance their practical teaching ability. Make full use of the dual-bases of environmental engineering technology vocational education, and industry-education integration enterprises to conduct targeted training for professional teachers, to train a large number of teachers to adapt to the needs of "double position", so that teachers can master the "two podiums" of schools and enterprises. At the same time, the school has developed a system of independent appointment of part-time teachers from enterprises, and regularly employs model workers, skilled craftsmen, technical talents from enterprises and highly skilled personnel as part-time teachers and internship instructors to undertake training tasks [18]. Relying on the dual-bases, a fully functional, well-equipped, flexible, resource-sharing, and relatively stable training base that integrates teaching, training, production, and technical services in the cooperation between schools and enterprises to train "double qualified" teachers is built. To build a teaching team with advanced teaching concept, reasonable structure, combination of both specialties and high-quality "double qualified teachers", now the number of double qualified teachers in environmental engineering technology reaches more than 70%.

(vi) Social services

Relying on the "dual-bases" of higher vocational education, vocational training is being promoted in vocational colleges and universities to improve the quality of workers and vocational skills, and to enhance the ability of vocational education to serve development and promote employment and entrepreneurship. Our university gives full play to the advantages of environmental engineering and technology vocational education resources, using the dual-bases of government, industry, enterprise and school collaboration as a training platform, closely following the actual needs of the region, industry enterprises and personal development, ensuring the relevance and practicality of training, and carrying out large-scale, high-quality vocational training for workers in the social environmental protection industry. Adhere to the school-enterprise cooperation dual-base resource coordination, synergy, for local, industry, urban and rural environmental protection workers to provide skills training, skills identification, business incubation, teacher training and other services [19].

(vii) Explore the reform of talent training mode of "modern apprenticeship"

Clarify the responsibilities of the school-enterprise double-subject talent training, promote the construction of dual-base market-oriented operation mechanism, improve the "apprenticeship order class" school-enterprise management mechanism, and realize the integration of enrollment and recruitment. Selecting 25-30 students to form separate classes, the school and enterprises jointly develop the apprenticeship training program, set the curriculum according to the enterprise's demand for jobs, implement job-forming and job-specific teaching, and implement the 1.5+1.5 academic system. Clarify the dual identity of master as teacher, teacher as master, student as apprentice, and apprentice as student, and hold a ceremony to worship the master [20].

Determine the project-based teaching method oriented by working process, build the on-campus and off-campus experimental and practical training base, and form the "phased" practical teaching mode. For example, 1-4 theoretical classes in the morning and 5-8 classes in the afternoon will be conducted in the training room. Monday and Tuesday at school, Wednesday, Thursday and Friday at the company training. Explore the implementation of the "Internet plus teaching" model, integrate teaching resources through multiple channels, schools and enterprises jointly build a shared teaching
platform, through the introduction of digital teaching models such as MOOC, micro classes, online courses, mobile APP (application), online exams, etc. [21], combine online and offline learning to develop fragmentation, flexibility, real-time teaching; Implement "Enterprise School District", "mobile classroom" and other methods, put teaching in the factory area and workshop, take the position technical specifications as the standard, focus on technology and knowledge update adjustment, and improve students' technical skills and employment Entrepreneur ability [22].

Various teaching resources on campus are tilted to the order classes, and corporate culture is introduced to set corporate scholarships to enhance students' motivation and sense of honor in independent learning. Effectively realize the purpose of sharing the cost of school-enterprise education and jointly training technically applied talents. Students are required to obtain a vocational qualification certificate or a technical grade certificate at the same time as their diploma, and the current rate of students obtaining "dual certificates" is over 90%, thus achieving the goal of employment upon graduation.

5. The effectiveness and experience of dual-base talent training in environmental engineering technology

(i) Effective integration of school-enterprise experimental and practical training resources to build a dual-base for vocational education.

We work closely with Chongqing Jiusheng Testing Technology Co., Ltd. Dazu Ecological and Environmental Bureau, Dazu Drainage Company, and Chongqing Huanchuang Solid Waste Treatment and Disposal Company. We have jointly invested in the construction of the dual-base project, pooled our wisdom and the strengths of all schools, carried out the integrated design and construction of enterprise resources and school training bases, gave full play to our respective high-quality resources, empowered each other, promoted each other and enhanced each other, and have now built a dual-base for vocational education in environmental engineering technology. With the continuous optimization of the school-enterprise dual-base construction, the school-enterprise sides show a spiral upward development trend with good results.

(ii) Effective implementation of talent training model reform to enhance the quality of talent training

Our school analyzes the vocational positions related to environmental engineering technology, based on the competency needs of environmental monitor, environmental protection equipment technician, environmental engineering constructor and other positions, relying on the school's dual-bases of vocational education, effectively implements a training model based on the needs of environmental protection industry personnel, from basic theoretical knowledge learning to practical operation ability training to the progressive training law of job comprehensive ability enhancement, and works with cooperative enterprises to carry out "Internet+", "phased", "project-based", "digital" and other mixed teaching models. Examples of teaching models include the 3-day enterprise + 2-day school teaching model, the project-based teaching model for water quality monitoring in the Setts River, and the online open course. To make the teaching process of environmental engineering technology in our school highlight the characteristics of practicality, vocationalism, diversity, flexibility and openness, and multi-type teaching activities to continuously improve the quality of training talents with technical skills [23].

(iii) Effective implementation of the "double qualified teacher" training base and improvement of the overall level of the practical teaching team

Relying on the platform of "dual-bases" for vocational education, the school and the cooperating enterprises have jointly formulated the "Management Measures of Double Qualified Teacher Training Base", which has improved the overall professionalism, teaching level and practical guidance ability of the instructors of both schools and enterprises through the mutual employment of "dual-position" teachers, training and on-the-job training, and project development. In this way, a relatively stable team of "dual-teacher" teachers with excellent production capacity and strong practical guidance and
training ability can be formed to achieve a positive interaction between the improvement of practical teaching work in schools and the enhancement of productive practice in enterprises.

(iv) Effectively promote the "1+X" certificate system to enhance the comprehensive abilities and literacy of graduates

Making full use of the dual-base platform to effectively implement the "1+X" national vocational qualification system [1]. This course provides vocational skills identification training and intensive training of "single skills" in core courses, realizing the integration of courses and certificates, and training students' ability to complete their jobs independently. At the same time, students are organized to carry out various professional skills competition training and entrepreneurship training on the dual-base platform, so as to improve the quality of talent training and enhance the comprehensive ability and literacy of graduates by integrating the training of vocational literacy and comprehensive vocational ability throughout the teaching process. In 2019, our environmental engineering technology students will have a 100% employment rate and a business satisfaction rate of over 95%.

(v) Effectively undertake various social service projects and play a model and leading role

The faculty, facilities and equipment of the dual-base training platform for vocational education in environmental engineering technology of our university are widely used for training and exchange of various types of learners from enterprises, government and society, and provide environmental consulting services and project R&D services for government departments and industry enterprises. At present, it undertakes 1,000 vocational skills appraisals in environmental protection each year, provides environmental protection training for government and enterprise employees 500 times, and provides more than 500,000 yuan in environmental monitoring technical services for urban and rural streets and enterprises. It has improved the social value and influence of the twin bases, realized the productivity transformation of the twin bases, reached a win-win model of school-enterprise cooperation, promoted the sustainable development and healthy operation of the twin bases, and played its demonstration and leading role.

6. The problems existing in the teaching reform of environmental engineering technology and the effective operation of sustainable development

The industry-teaching integration is the connection between school education and enterprise production, a process that integrates practical teaching, production work, vocational literacy, skill enhancement, business management and social services. The key and difficulty to realize the deep integration of teaching and industry lies in the integration of technology. How to realize the integration of enterprise production link into teaching, and how to realize the school to provide enterprises with intelligence, human resources and other assistance are the difficulties in the industry-teaching integration. Through the "three-stage", "project" and "stage" teaching methods, this paper has preliminarily completed the industry-teaching integration of teaching and production technology. The authenticity, advancement and sharing (openness) of the training equipment are completely consistent with the equipment of the enterprise, and the training process is completely consistent with the production process. However, there is still a problem that the amount of project-based teaching practice hours is insufficient, so this paper introduces the "Internet + teaching + project + certificate" model, which can realize the teaching reform mode of students' self-study on the online platform after school hours and full participation in project practice in class to solve the problem. In the later stage, the school still needs to keep exploring practice and innovating teaching methods and models.

7. Conclusion

To sum up, it is conducive to improving the level of education and teaching in higher vocational colleges and universities, improving the quality of training of talents with technical skills and enhancing the social service level of vocational colleges and enterprises by coordinating various resources and building a number of high-level specialized industry-teaching integration training bases with radiation leading effect. In the context of industry-teaching integration, continuously deepen the educational and teaching reform of the dual-base of practical training, timely adjust the talent training
objectives, optimize the application-oriented talent training system, use modern information technology to improve teaching methods and approaches, and promote the construction and universal application of virtual simulation and other network learning spaces [24]. To provide strong talent support to precisely serve regional development needs.

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