

Research and Practice on the Cultivation Mode of Civil Engineering Professionals in Characteristic Application-Oriented Colleges under the Background of Professional Certification

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Abstract:

The professional certification of engineering cultivation is a kind of specialized certification in the field of higher cultivation, which aims to improve the cultivation quality of engineering talents in colleges. Based on professional certification, this paper analyzes the problems existing in the cultivation of civil engineering majors in characteristic application-oriented colleges, and studies and optimizes the talent cultivation mode of civil engineering majors in characteristic application-oriented colleges. This paper puts forward the talent cultivation plan and core competence cultivation scheme of civil engineering specialty, studies the construction of cultivation staff, and puts forward the effective methods of cultivating students' innovative consciousness. A cultivation quality monitoring and guarantee system is constructed to ensure that the cultivation of civil engineering majors in characteristic application-oriented colleges can meet the standards of engineering cultivation certification and meet the needs of national, social and industry development.

Keywords: Professional certification, Characteristic application-oriented universities, Civil engineering professionals, Cultivation mode, Research, Practice

I. INTRODUCTION

Engineering education professional certification is a kind of specialized certification carried out in the field of higher education, which aims to improve the training quality of engineering talents in colleges and universities. The professional certification of engineering education can realize the docking of engineering education with industry and enterprises, and it is an effective way to improve the training quality of engineering talents. Colleges and universities actively carry out professional certification of engineering education, and at present, thousands of majors have passed professional certification. The concept of engineering certification can be summarized into three aspects: student-centered, achievement-oriented and continuous improvement, and results-oriented education is its dominant idea [1]. Combined with

engineering certification, civil engineering majors in characteristic application-oriented colleges and universities should highlight the characteristics of running a school, establish the orientation of the development of applied schools and the training path of applied talents, and aim at cultivating compound applied and technical skilled talents [2]. Take the integration of industry and education, the integration of science and education, collaborative education as a breakthrough, according to the needs of the development of the region and industry, find the right cut-in point, innovation, growth point, and strive to be first-class in the discipline. The civil engineering major in characteristic application-oriented colleges and universities should rely on industrial enterprises, take ability training as the core, realize the training goal, meet the graduation requirements and curriculum objectives as the main line, and create an innovative mode of cultivating talents, and cultivate applied talents who meet the international engineering certification standards.

II. PROBLEMS AND CAUSES IN THE TRAINING OF CIVIL ENGINEERING PROFESSIONALS IN CHARACTERISTIC APPLICATION-ORIENTED UNIVERSITIES

participation from industries and enterprises; the curriculum is lack of coherence, curriculum standards need to be improved, and engineering practical skills are lacking; teaching methods are too traditional and formal innovation is restricted; lack of reasonable evaluation on training objectives, graduation requirements and curriculum objectives; unreasonable structure of teachers, and lack of matching between teaching staff and professional certification system. There are many problems, such as lack of engineering practice skills, decoupling between practice and engineering practice, insufficient investment in graduation design, neglect of the cultivation of students' innovative consciousness and interest diversity, single form of school-enterprise cooperation, weak quality control system and so on [3]. The causes of the above problems are as follows: the school's understanding of the standards of professional certification and personnel training is not in place; the school is restricted by traditional ideas, and the school is too utilitarian; the curriculum is confused, and the degree of cooperation between schools and enterprises is low; the school management mechanism lags behind. Teacher assessment is not perfect and so on.

III. OPTIMAL DESIGN OF TRAINING MODE FOR CIVIL ENGINEERING MAJORS IN CHARACTERISTIC APPLICATION-ORIENTED UNIVERSITIES

3.1 Clarify the Requirements of Professional Certification for the Training of Civil Engineering Professionals

The major of civil engineering should have a clear orientation and a high degree of achievement of training objectives; the teaching plan should meet the training standards of engineering talents, and the curriculum should meet the requirements of engineering; teachers should have rich experience in engineering practice, and teaching resources should support engineering practice activities; professional teaching management system is complete, and adheres to quality evaluation and continuous improvement. Training goals should be clear, measurable and supported by graduation requirements, which must cover the 12 requirements of the Washington Accord [4].

3.2 Constructing the Training Program of Civil Engineering Professionals in Characteristic Application-Oriented Universities

The formulation of the training goal of civil engineering professionals in characteristic application-oriented colleges and universities should take talent training and discipline construction as the main line to meet the needs of national and local economic construction and social development. According to the school orientation and the requirements of engineering education, we should cultivate applied senior professionals who can meet the needs of national modernization and economic development, all-round development morally, intellectually, physically and aesthetically, with the concept of sustainable development, good professional quality, innovative spirit, practical ability, employment and entrepreneurial ability.

The revision and improvement of talent training programs is the premise and basis for the implementation of certification and results-oriented teaching. The formulation and improvement of civil engineering training plan in characteristic application-oriented colleges and universities should carry out reverse design, clarify three pairs of relations, and grasp five key steps. Reverse design means that teachers carry out reverse curriculum design from the ultimate goal in order to prepare for the corresponding teaching activities. The positive implementation of the reverse design derived from the final learning results ensures that all the final learning achievements can adapt to teaching. Teaching should take the final learning achievements as the starting point. Clarifying the three pairs of relationships refers to clarifying the relationship between training objectives and graduation requirements, graduation requirements and teaching links, graduation requirements and curriculum content. Grasping the "five keys" refers to the following five aspects: carrying out demand survey, defining talent training objectives, clarifying talent training standards, figuring out students' graduation requirements, and straightening out curriculum structure support. Based on the new concept of OBE, a talent training program is designed to meet the needs of continuous improvement, as shown in Fig 1 [5].

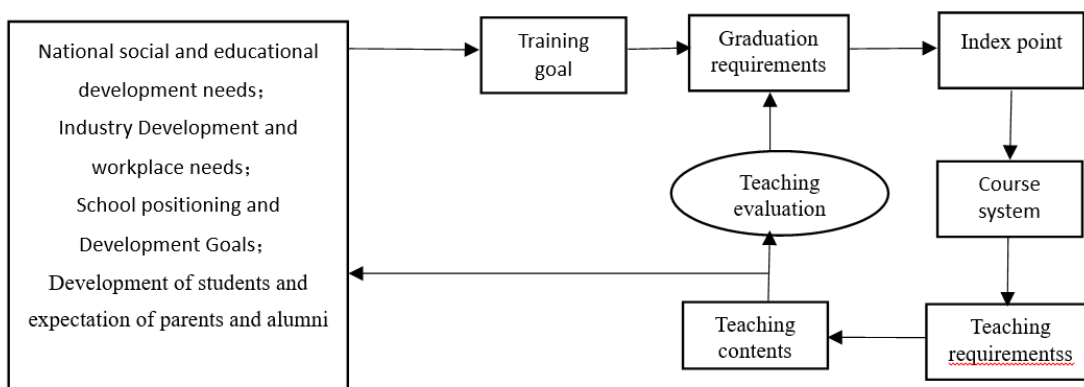


Fig 1: design of talent training program and continuous improvement mechanism

On this basis, aiming at the characteristic application-oriented undergraduate universities, sort out the corresponding relationship between engineering certification standards and civil engineering professional

evaluation standards, decompose and refine the training objectives of civil engineering professionals, and clarify the graduation requirements, form a correlation matrix between training objectives and graduation requirements, optimize the curriculum system, and form a supporting relationship with training objectives.

3.3 Constructing the Training Program of Core Competence of Civil Engineering Specialty in Characteristic Application-Oriented Universities

Result-oriented education is based on students' output, setting clear professional training goals and core competencies that students should possess and master when they graduate. The core competence and goal weight that graduates of this major should possess are shown in TABLE I, and the core competence indicators of this major are further decomposed and analyzed according to the actual situation [6]. In the society, there are higher requirements for the practical operation skills that students of this major should master, so it is very important to cultivate students' practical ability.

TABLE I. ANALYSIS ON THE COMPOSITION, GOAL WEIGHT AND ACHIEVEMENT OF GRADUATES' CORE COMPETENCE

SERIAL NUMBER	PROFESSIONAL CORE COMPETENCE	GOAL WEIGHT%	ACHIEVEMENT ANALYSIS
1	Ability to apply relevant knowledge of mathematics, science and civil engineering	25	Strengthen the study of 71 courses such as higher mathematics and structural mechanics. Implement a number of measures to strengthen the basic ability of undergraduates and ensure the realization of core competence. Use a variety of examinations and evaluation methods to understand the learning status of undergraduates and their mastery of the curriculum, so that they can acquire and master the most basic core competencies.
2	Ability to design and perform civil engineering experiments, analyze and interpret data	20	Set up 16 experimental courses, such as engineering survey experiment, material mechanics test, structure test and so on. Students are required to operate by hand, master the operation methods and skills of the instrument, and improve their practical ability.
3	Have the necessary technology, skills and use to carry out civil engineering practice.	10	It provides 59 courses, such as professional computing, to meet the needs of students to acquire practical skills in this field. Undergraduate students are required to master various technologies and practical skills commonly used in this major, such as civil engineering construction. Students are required to use the commonly used software such as CAD and PKPM structural calculation of Tianzheng Building skillfully. Through the above training, students can acquire the ability to use

			modern tools skillfully.
4	Own basic design of structures, roads and bridges and other related projects, as well as construction, operation and maintenance capabilities of civil engineering projects	10	Set up 57 courses such as road survey and design, steel structure and so on. Students are required to be familiar with the methods and skills of curriculum design and graduation design, to improve their basic ability of engineering design, so that students can get started quickly when facing practical engineering projects in this professional field, and make them operate normally and effectively.
5	Ability of civil engineering project management, effective communication and teamwork	10	Students' core competence is cultivated through 42 courses, such as engineering surveying practice, graduation practice, concrete structure basic principle, steel structure principle and so on. Students are required to interact well with colleagues in experiment, practice and practical training. Improve students' communication ability and teamwork ability.
6	Have the ability to explore, analyze and apply civil engineering research results and deal with complex engineering problems	15	Experiment, curriculum design, cognitive practice, production practice, graduation design and other forms are used to cultivate students' core competence. Students are encouraged to bravely explore and use the existing research results in this field, constantly absorb mature engineering experience, and have the ability to effectively analyze and deal with difficult problems in engineering practice. Relevant measures are adopted to encourage students to actively participate in a variety of extracurricular competitions such as drawing competitions, surveying competitions and structural design competitions.
7	Ability to learn continuously, update knowledge and recognize current issues, understand the environmental, social and global impact of engineering technology, and cultivate	5	Provide students with various professional lectures and academic reports, regularly carry out industry-school research seminars and industry mentors interactive exchange meetings, host postgraduate entrance examination forums and alumni forums to guide students' learning career. Students are encouraged to consult relevant materials through various channels, to be familiar with the rules, norms and construction methods of this major, and to apply them effectively in various course design and practice. Cultivate students' good study habits and make them form the ability of lifelong learning. Guide the students to continue their studies. Encourage students to actively participate in engineering practice, actively obtain various

	innovative thinking		professional certificates, and cultivate their own innovative ability and innovative thinking. Students are required to constantly update their knowledge, understand current affairs and policies, grasp the pulse of national, social and times development, and pay attention to natural and sustainable development. Provide career development and career guidance courses for students, and provide planning and scientific guidance for students' career development.
8	Have the ability to understand and follow civil engineering professional ethics,5 recognize social responsibility and respect multiple viewpoints		Offer 43 courses such as situation and policy, project bidding, building code, etc. In class, professional teachers emphasize to students the responsibility of future civil engineers to the country, society and nature. Encourage students to build a variety of social practice teams, so that students can be based on local economic construction, use professional expertise to serve the grass-roots level, approach rural areas, experience national conditions, receive education, and increase their own talents in practice.

From the point of view of the realization of professional training objectives, construct a training plan for the core competence of civil engineering majors in characteristic application-oriented universities, in order to achieve the ultimate effect of core competence training through certain training and evaluation methods.

3.4 Research on the Cultivation of Innovation Consciousness of Civil Engineering Majors in characteristic Application-Oriented Universities

3.4.1 Existing problems

The school attaches importance to knowledge education, does not attach importance to the cultivation of students' innovative consciousness and interest diversity, de-engineering is serious, engineering characteristics are not prominent; students' learning purpose is not clear, learning attitude is not correct, lack of courage and perseverance to explore freely, the driving force of competition is weak,. The students cannot experience the fun of innovation, lack of a sense of achievement, and cannot form a virtuous circle [7].

3.4.2 Training way

Optimize the curriculum system, form a growth environment for cultivating students' innovative consciousness, realize the reform of teaching methods to improve students' innovative consciousness, promote the reform of practical teaching and strengthen the combination of students with engineering practice, create conditions for the cultivation of students' innovative consciousness, and open up

three-level classrooms according to the requirements of professional certification standards for innovative consciousness [8].

3.5 The Mode of Deep Cooperation between Universities and Enterprises in the Training of Civil Engineering Professionals with Characteristics and Application-Oriented Undergraduates

3.5.1 Construction idea

The adoption of the two-complete and one-depth training mode specifically refers to a new type of school-enterprise cooperative training mode in which enterprises participate in the training of students in the whole process and in all directions in the training of civil engineering specialties. The traditional cooperative training has changed from two subjects to a unified whole training mode. This model has a systematic and brand-new model carried out by the school and one or more enterprises, enterprises and one or more universities at the same time. As shown in Fig 2 [9].

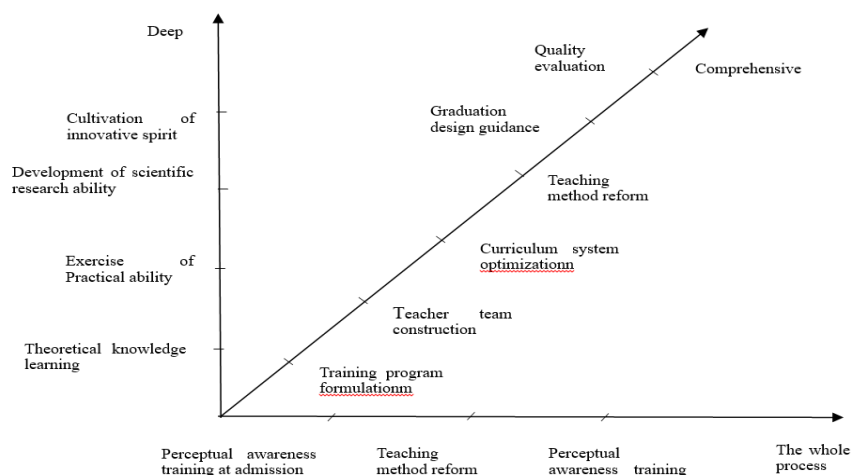


Fig 2: two-complete and one-depth training mode

3.5.2 Deep cooperation mode

Construct the school-enterprise training plan, accurately locate the school-enterprise training goal, scientifically formulate the school-enterprise training mode, and improve the school-enterprise training system. Both schools and enterprises explore deeply in the whole process of students' education and teaching. Centering on the cultivation of applied talents, according to the needs of the market and enterprises, they carry out reforms in the construction of practice and training bases, the training of teachers and the composition of cooperation mode. We can set up a professional guidance team, implement the project teaching method, strengthen the construction of teachers in schools and enterprises, adopt diversified training modes, and jointly build laboratories by schools and enterprises. There are many forms, such as the establishment of industry-university-research-application cooperation community between

universities and enterprises, the establishment of school-enterprise cooperation alliance, the support of students' innovation and entrepreneurship practice club, and the high-level forum of industry-university-research-application cooperation.

3.6 The Construction Plan of Teaching Staff for the Training of Civil Engineering Professionals in Characteristic Application-Oriented Universities

The all-round construction of teachers is the core project for application-oriented colleges and universities to realize the development and progress of teaching quality. The construction of the contingent of teachers must be closely combined with the goal of running a school, professional orientation, teaching characteristics and students' training mode, strengthen the reform, constantly improve the ability level of teachers, and strengthen the comprehensive quality of teachers. From the aspects of teachers' teaching, scientific research and innovation ability, we should constantly optimize teachers' comprehensive ability, cultivate more excellent applied and innovative talents, and promote the development of local construction and industry economy. Civil engineering majors in characteristic application-oriented colleges and universities can, by establishing a dual-track parallel training system of theoretical knowledge training and practical ability training, internally encourage young teachers to enter enterprises to enrich practical experience, externally hire part-time teachers in enterprises, and optimize teachers; strengthen the joint training of schools and enterprises to improve the quality of teachers; strengthen the introduction and training of senior talents; improve teachers' enthusiasm to study teaching and embody the guidance of achievements. Promote teaching through scientific research, cultivate teachers' double-division quality, pay attention to workplace training, improve the educational literacy of teachers in characteristic application-oriented colleges and universities, improve the personnel system, form the all-round development of teachers; strengthen the assessment of teachers in characteristic application-oriented colleges and universities to form a talent incentive mechanism.

3.7 Construction of Teaching Quality Monitoring and Guarantee System for Characteristic Application-Oriented Undergraduate Civil Engineering Specialty

Establish a teaching quality monitoring and guarantee system, realize the process control of teaching management, improve the quality of personnel training, and meet the needs of professional certification and personnel training. In order to strengthen periodic evaluation and normal quality monitoring, characteristic applied undergraduate civil engineering majors should construct teaching quality monitoring mechanism, tracking graduate feedback mechanism and social evaluation mechanism, so as to realize the scientific management of the whole teaching process. The teaching quality monitoring and guarantee system has the characteristics of three-in-one closure, that is, full staff participation, whole-process monitoring, comprehensive improvement and circular close. It consists of seven subsystems: teaching decision-making system, quality objective system, quality standard system, quality management system, condition support guarantee system, quality monitoring and evaluation system, quality feedback and improvement system [10]. Teaching decision-making system is the main part and core of system control, and it plays an important role in ensuring the implementation of teaching quality monitoring in schools.

The quality target system is the leader of the system. The key link to improve teaching quality is to draw up reasonable teaching quality standards, and the quality management system plays a role in standardizing teaching management. The conditional support system plays a basic and guarantee role to ensure the effective operation of the system. Quality monitoring and evaluation system as the core can ensure the effective operation of all teaching quality monitoring and guarantee system. Quality feedback and improvement system is the most critical link of the whole system. The system is a multi-dimensional, dynamic and long-term basic work, which needs continuous improvement to ensure the overall improvement of professional teaching quality and teaching effect. As shown in Fig 3.

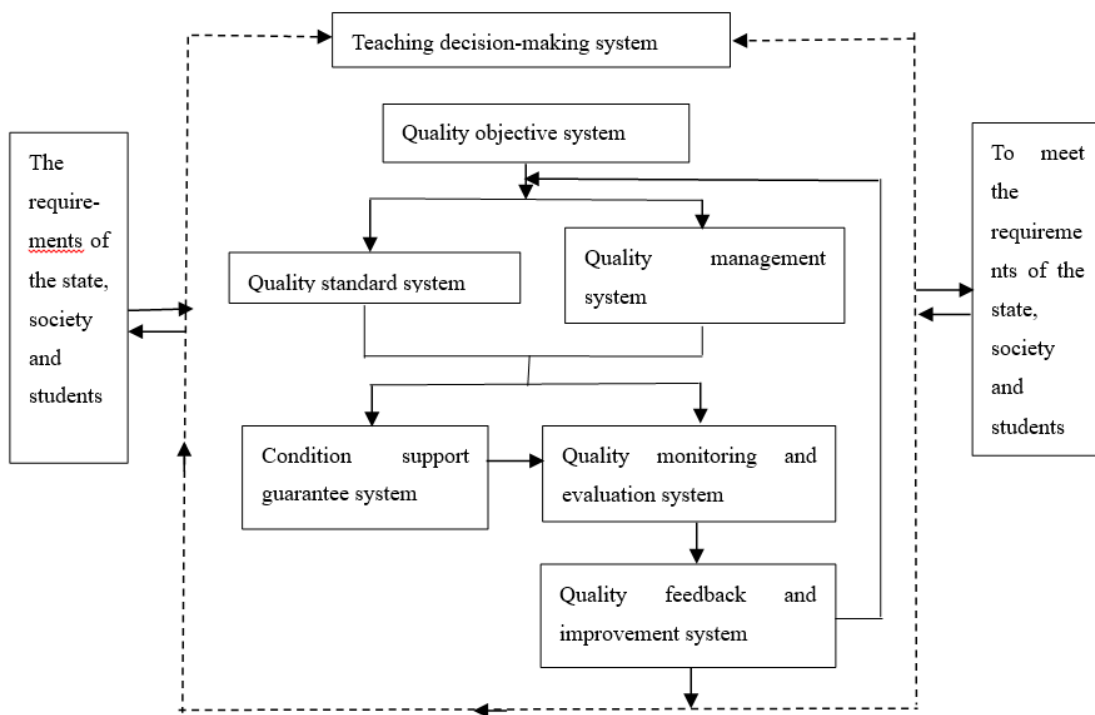


Fig 3: teaching quality monitoring guarantee system and operation mode

IV. CONCLUDING REMARKS

In a word, the characteristic application-oriented undergraduate civil engineering major should clearly recognize the essence of professional certification, and start from the aspects of constructing talent training plan, cultivating students' core competence and innovative consciousness, building a contingent of teachers and teaching quality monitoring and guarantee system, etc., construct the innovative mode of civil engineering specialty training in characteristic application-oriented colleges and universities, and improve the training quality of applied talents, meet the needs of national social and educational development, and adapt to the development of industries and the needs of the workplace.

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