Study of Cultivation Pattern of Applied Undergraduates in Environmental Engineering Specialty

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\textbf{Abstract.} With year-by-year rising social demand for applied talents, it’s imperative for environmental engineering specialty in applied universities to transit into application type, where the most important work is to cultivate undergraduates’ abilities in coordinated development of engineering theories and technology application. Taking undergraduate cultivation in applied environmental engineering as study object, this paper analyzes current situation of applied undergraduate cultivation in environmental engineering specialty and main existing problems. Based on special requirements for talent cultivation in this specialty, the cultivation idea depending on scientific and technological innovation team and university-enterprise collaborative innovation center is proposed, and applied engineering talent cultivation pattern and its security system are established on this basis.

\textbf{Introduction}

Under rapid socio-economic development trend in China, environmental problems like water pollution and atmospheric pollution have become increasingly prominent\cite{1, 2}. Rapid development of environmental protection industry driven by this will certainly drive heavy demand for applied environmental protection talents\cite{3}. China's Medium- and Long-Term Talent Development Plan (2010-2020) defines environmental protection talents as specialized talents in short and in urgent need in key social development fields\cite{4}. Rightly because of demands for economic and social development, higher education in environmental engineering specialty has gradually transited from “elite education” into “mass education” and demand for applied talents is abruptly increasing \cite{1, 2}. Therefore, studying cultivation pattern of applied talents has become the focus in educational reform. At present problem of seriously insufficient students’ innovation consciousness and innovation abilities exists in undergraduate education in environmental engineering specialty, especially cultivation of applied innovative talents is inadequate; teaching model and means of applied talents are relatively backward, teaching fails to be closely combined with scientific research and practice, most colleges and universities have teachers with strong engineering practice abilities while having defective relation with enterprises \cite{5}, while professional abilities which enterprises hope from graduates are mainly abilities of environmental engineering design and operations management, application ability of pollutant control technology and environmental monitoring and assessment ability\cite{6}. Hence, disciplinary orientation of environmental engineering specialty should be at applied engineering technical personnel facing grass roots and the forefront of production, and talent cultivation objective should be applied senior professional technical talents having comprehensive development of morality, intelligence, physique and aesthetics, having basic knowledge in aspects of pollution control, environmental monitoring and assessment like water, air, solid waste and physical pollution, having professional abilities of design and operations management of pollution control engineering, environmental planning and environmental assessment as well as environmental
monitoring, and being able to be occupied in work in aspects of planning, design, operation, management and evaluation, etc.

**Current Situation and Existing Problems of Applied Talent Cultivation in Environmental Engineering Specialty**

Environmental engineering is an interdisciplinary involving natural science, technical science and social science, but there are partially more research-based teachers in the realistic teaching staff who have insufficient engineering experience and emphasize theories while neglecting practice, and main problems existing in applied undergraduate talent cultivation in environmental engineering specialty are the following four [7,9]:

**School-running Orientation is Ambiguous and Curriculum Structure is Unreasonable**

Environmental engineering specialty in some colleges and universities in China has been established based on specialties like chemical engineering and material engineering, so a large number of chemical engineering and material curriculums have been set up during curriculum setting in talent cultivation plan while environmental-type curriculums like sewage treatment, atmospheric control, solid waste treatment and reclamation are insufficiently established, and consequently, students have unreasonable knowledge structure and what they learn doesn’t fit their application in the future.

**Allocation of Practical Teaching Materials is Inadequate**

After some applied universities expand enrollment in environmental engineering specialty, they fail to timely supplement teaching hardware configuration, and then practical teaching equipment level lags behind technological development within the industry and can’t meet teachers’ requirements for practical teaching. Class hours of practical and training subjects occupy a small proportion in overall hours, practical training effects lacks effective testing and rating system, and as a result, students’ operational abilities can’t reach the “application” goal and teaching quality can’t be guaranteed.

**Lack of Effective Cultivation and Assessment Method of Applied Talents**

Single scoring method is commonly used in traditional teaching assessment to evaluate students’ learning quality and its disadvantage is that it can’t comprehensively demonstrate students’ abilities. It’s already difficult for single course assessment method to adapt to diverse talent cultivation requirements under the new situation, especially to assessment method of applied talent cultivation.

**Cultivation Plan Reform of Applied Engineering Talents**

Orienting at economic construction and social development, the universities should be devoted to the goal of cultivating applied talents adapting to local economic construction and facing industrial enterprises. In cultivation contents, “knowledge instruction” should be transformed into “improve abilities and quality”, and emphasis should be laid on autonomous learning ability, practical ability and innovative ability of students; relying on scientific and technological innovation teams, the government should carry out teaching reform practice in aspects of theoretical teaching, practical teaching links, assessment mode and teaching management, etc.

**Theoretical Teaching Reform of Applied Engineering Talent Cultivation**

Traditional “teacher-centered” classroom teaching evaluation system should be broken, and a new-type one with students being subjects and teachers giving theoretical and thinking guidance should be established. According to enterprises’ requirements for talent knowledge system, overall curriculum system should be set into three major modules respectively being: liberal education knowledge module, professional basic knowledge module and professional knowledge module. Compulsory courses occupy 71% of total class hours and optional courses occupy 29% of total class
hours; internship and practical training credit hours occupy 31% of total credits, being 43 weeks. Credit hours of internship and practical training are lengthened while class hours of theoretical courses are shortened, but this doesn’t mean that theoretical teaching is neglected. During teaching process, starting from explanation of practical engineering projects and enterprise cases, teachers should integrate contents like professional terms, abstract concepts and environmental engineering design standards, etc, and then the current situation with excessively strong theoretical property and hard to be accepted by students will be improved; the method combining multimedia technology and traditional teaching should be used to improve teaching efficiency and guarantee course contents; information literacy education should be embedded to improve students’ self-learning ability, exert their autonomous learning ability and reasonably extend classroom teaching.

**Embedding Literature Review Tasks**

Looking up document literatures to extract useful information is an essential skill for students to smoothly finish school and make achievements in future cause. Endlessly emerging environmental pollution problems are seriously affecting people’s living quality, for instance, development speed of detection of air pollutants, new testing means and instruments and equipments have far exceeded teaching contents. Therefore, teachers should consciously guide students to use modern information technologies and let students collect new technologies and new equipment data for air pollutant detection at present as literature review tasks of students, and in this way, students’ abilities of initiatively learning new knowledge can be cultivated.

**Reform and Assessment Method and Teaching Management of Applied Engineering Talent Cultivation**

Overall-process assessment should be carried out from curriculums to curriculum completion, and assessment on students should involve aspects of class participation, feedback of social practice, homework completion, investigation and survey abilities shown in experiments and scientific research projects as well as participation degree in regular class group discussion, etc. Curriculum assessment methods can be written examination, oral test, open reply, thesis and actual operational ability assessment or can be a combination of these forms. Fractional accumulation method can be adopted for assessment and evaluation, contents of all aspects can be evaluated comprehensively according to certain proportions so that single index will be avoided. Evaluation of students should be diversified, proportions during assessment process should be relatively average, proportion of exam results is adjusted from previous 70% to 50% so as to urge students to study hard during the whole learning process, but not acquiring good scores through rote memorization in the last two or three days before the final examination.

Based on scientific research and practice platform jointly established by universities and enterprises and centering on scientific innovation team of colleges, key problems in engineering project design and scientific and technological projects should be tackled to reach win-win pattern.

Universities should establish long-term stable cooperative relationship and let enterprises participate in student cultivation such as ‘outstanding engineer’ cultivation in environmental engineering specialty in which cultivation pattern is ‘3 + 1’ university-enterprise co-cultivation, and experienced engineers are recruited as enterprise tutors to participate in professional teaching, guide students in internship and graduation design, etc. Yearly industry-university-research conference on environmental engineering specialty will invite enterprises to participate in formulation of training plan and revision of training program so as to realize advancing with the times according to enterprises’ demand for talents. These are all optional practice patterns.

Theoretical knowledge will be organically integrated with engineering cases in teaching approach, and teaching mode of classroom discussion should be used to guide students in initiative thinking, motivate their innovative thinking and lay the emphasis on cultivating students’ engineering ethics; in aspect of teaching staff construction, “bring in and go out” pattern should be used, namely requiring
that new teachers should be exercised for one to two years in enterprises to comprehensively improve engineering abilities of teaching staff; as for university-enterprise fusion, “outstanding engineer” cultivation program should be carried out for students, and students are required to get the internship for one year in enterprises while teachers should serve enterprises, cooperate with enterprises in subject projects and realize transition of scientific research results into productivity, and concepts should draw attention are as follows: practice and innovation are mutually complementary, laying a good knowledge foundation and cultivating thinking ability are innovative fountain and foundation of improving practical skills; in terms of management system, various rules and regulations of universities should be strictly implemented, and second-level colleges should carry out overall-process management of practical teaching for students. Applied talent cultivation in environmental engineering specialty in Fujian University of Technology will always orient at talents demanded by the society, and serving local economic development is the root of university development.

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