A Joint Cultivation Plan Exploration on Applied Talents Oriented Environmental Engineering Students Based on the Cooperation of Industry and College Under One Frame

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Abstract. As of the applied talents oriented cultivation process of college students majored in environmental engineering presently concerned, many attempts such as “3+1”, special cooperation order-oriented and joint practice base outside the college were adopted, and the effects and problems arisen need more efforts to pay and solve. In this article, a new jointed cultivation mode was developed and tested, which pay more attention to the quality requirements and the development potential of personal engineer and characterized by college predomination structure. In this system, college plays the dominant role and responsibility for the applied oriented talents training, and the industry was introduced and fused into the college’s educational structure as a cooperation between college and industry. A short period test-run shows positive results of the mechanism than the present one in the respect s of enhanced cultivation quality, resource efficiency and motivated participants of industry, college and students, which implies a suitable alternative in resolving out-of-touch status between the college and industry on applied oriented talents cultivation.

Introduction

At present, more than 200 colleges have participated the "A Plan for Educating and Training Outstanding Engineer" Since the Ministry of Education of P. R. China implemented in 2010, as an educational support for national strategic transfer of development, which paid more attention to the applied oriented talents cultivation for higher education, and gained valuable experience and great achievements. Among this, joined cultivation of industry and college was proved to be the most effective mode, it would be manifested as “3+1” mode, “special cooperation order-oriented” mode and “jointed practice base outside the college” mode and were adopted and accepted widely for colleges and universities for some obvious advantages, such as students be easy to obtain employment, enterprises could pay off immediately (for a saving of the long and expensive training process) etc., but at the same time, it also exposes some shortcomings, mainly as the mechanism be unsustainable, be lack of motivation in participating, be lack of development potential for students, prone to vocational training as a special workshop. With the intensification of international competition, the adjustment and transfer of development mode, the industry has changed significantly and still under changing, this requires that the cultivation of applied oriented talents should not only meet the present needs of the industry society, but also provide a good foundation for future development and innovation of students and industry, that is to say, the optimal cultivation mode for applied oriented talents should take many factors into consideration, which should include and not limited to the essence of the profession related, the present status and development of the related industry, the position and condition of the participants and regional economic development strategies, comprehensive exploration and dynamic adjustment should be taken in the mechanism design, rather than simply follow the pattern of success.
Specific Features of Environmental Engineering in Existent College-enterprise Cooperation

The environmental engineering specialty is relatively very young as comparing some traditional industries, such as machinery industry, petrol-chemical industry and miner and metallurgy industry, there are so many long established large enterprises in these fields, with stable structure both in the routine operation, but in the employees’ recruitment, training and development, the cultivation in college has a relative clear and stable standard to follow. But for the environmental engineering, the corresponding ones are very small enterprise with a typical faculty numbers below 50, they survived through intense competition and few of them could last more than 5 years. In this situation, the cultivation of applied oriented talents from colleges has no as clear and stable the aim as the traditional industry, more emphasis should be put in the building of students' ability and development potential, enhancing its adaptability and innovation ability for serving the whole industry, from this point of view, the “special cooperation order-oriented” mode cannot simply apply and a new mechanism needed.

As for the prevalent “3+1” case, it has many advantages for the enterprises associated have the ideal environment and resource for student’s practicing and learning, with the engineering vocation which they will take when graduated, this is true for many traditional industries but not applicable for environmental engineering students, the reason lies in 5 aspects mainly: First of all, environmental engineering is an interdisciplinary, contains a wide range of subjects, more than water and wastewater, air pollution and solid waste three traditional fields, the corresponding small businesses generally erected upon certain technology or equipment in a special narrow aspect, which belongs to only a small area of the whole environmental engineering discipline, when the engineer training of a junior college student conducted in this enterprise, only a small fraction of special practice could be picked, and on the turn the professional student graduated, it’s very likely that he has no chance to take this kind of job, so the practice process make very limited build-up to his/her wide special knowledge structure; Second, the small company has limited project undertaking capacity, in general, only about 1~3 project are conducted at random for one year, that means they have a relatively non-regular working schedule, most likely, they have no new project and stayed in the office most of the year while at a certain period, all out at the site. The extreme and unpredictable status of small company will bring the engineer training process out of control, when the professional student’s training schedule and the free time of small company overlaps to some extents, that is probably the most likely case, the effect and efficiency of practice training would be discounted dramatically; Third, the small business erected and existed for its high efficiency and organized in project groups generally, the group members had devoted all their efforts to the responsibilities distributed to them, forbidding no mistakes for it will pay their surviving salary. Who would take the risk of training the students through their vital ongoing project? The most thing the students do is office trivial and errands as an outsider of the project, if the college students have a normal self-learning ability, then the poor achievements they could make, unfortunately this is the most case; Fourth, small company has no such a complete human resource structure and redundancy as the traditional large enterprises, which need to cover the whole environmental engineering fields, it is difficult to form a higher level or more standardized professional atmosphere, the most needed engineering training could be missed or misled easily under such a casual circumstance; Finally, because the industry is private sector and not responsible for the results of professional student’s training, so they only offer necessary training to the students they want to recruit in the future, but on the other hand, the small company recruited extremely limited employee.

A cultivation of engineer or applied oriented talent need both the complete professional fundamental structure and it’s applying ability as an engineer in the industry, which the college and industry focused and did well separately, so a close and effective cooperation is necessary in the cultivation process but be subjected to exploration to meet the individual requirement.
The Alternative Structure in College-Enterprise Cooperation

In the cultivation process of apply oriented talents, there are 3 participants, college, enterprise and students involved, a single dominant and decisive role is needed to manipulate the resource and be responsible to the cultivation results, this is one of the most sustainable and effective management structure, from this perspective, the responsible subject is in transition during the enterprise’s practicing period for “3+1” mode, an anarchic state with irresponsibility and low efficiency would be firmly deduced, on such occasion, one would turn to the government or industry association, but this is still useless for these institution are not established for this responsibility and cannot afford the overwhelming affairs at the same time. In student’s education and cultivation, college will no doubt be the most sophisticated and effective institution ever erected, so our college-enterprise cooperation platform for apply oriented talents’ training was established under the complete domination of college, engineers form cooperation companies were invited and employed as a project teacher, students could conduct their preliminary engineering training in an artificial platform which provided by the college and be near the actual engineering environment, under the tutoring of engineer. The strongpoint is that the college could design the overall planning of the training process which will benefit the establishment of the professional knowledge structure of the students while carry out a comprehensive and efficient practice of professional training.

Through integrating the existent, separated professional laboratories, we built Joint cultivation hardware platform of industry and college, which consist of 4 sections as computer simulation section, pollutants measurement section, environmental engineering reactor and lab-scale equipment section and treatment process integration sand table section. Engineering training could be practiced including pollutant measurement, process numerical simulation and design, unit and system performance testing, unit research, system integration and other functions covering the whole conventional environmental engineering aspects: ecology, water and wastewater, air pollution and solid waste. The platform was equipped with widely used professional lab-scale units and new structures in the corresponding case could be fabricated and updated from both sides of the industry and college, this could provide an up-to-date, systematic and realistic engineering environment.

The engineer training curriculum was co-designed by professional teachers and engineers, which formed a practice teaching, of the training framework the professional teachers predominated, to cover the whole environmental discipline, but in the specific contents the engineer will lead, to reflect the application and practicality of the training. The result was the "problem - Test - Design - validation" training model, it is transferred from the science structure in college to the problem or project oriented structure with which the professional engineer faced, it began with project or problem analysis and followed by plan optimization, process simulation, key-point verification, engineering design(process, building and construction, equipment and pipeline, control and automation), lab-scale process construction, system commission and verification at last, nearly the whole, real process conducted in the industry would be manifested and experienced in the training, so reasonable foundation could obtained effectively in the platform and would be partially suitable to the whole industry.

The training curriculum was divided into two modules, which were compulsory and selective, the compulsory for everyone ensured the training and building of basic professional foundation and structure while the selective provided a higher level of practice for further improvement. The engineering training platform tried a dynamic management of students, at the end of the 6th semester, all students were required to start the engineering training courses of compulsory module, when finished and passed the exam, they can go to the industry for further professional practice or participated in the selective module in the training platform, all on their own wishes. at the same time, the engineering training platform also accepted the students back from enterprise practice, which was due to various reasons including completing their graduation thesis, no suitable project in the company, special enhancement as well as their innovation and entrepreneurship research purpose.

The joint cultivation platform of industry and college was under the college’s management, more than 60% of the tutors were invited from industry according to the schedule of the engineer training,
the training project could be existent project in industry, typical treatment process, hot subject in environmental engineering or the ongoing project under research. A finishing exam was set and the work performance was evaluated in two aspects, one was theoretical, facial quality, and the other was practical measurement of their constructed lab-scale system per their engineering design. The evaluation was preferred to the practical part and dominated by the engineer from the industry, this could reach a compromise that the students could practice the latest, enterprise based project, which the engineer was most familiar with, and at the same time the performance of students could reach or be close to a standard of their own companies or the industry, the students could easily access the get involved into the ongoing project in the industry for they can reach the common accepted standard.

A Short Test-run and Discussion
As a reform, we re-designed our whole curriculum system into a progressive practice cultivation plan, which was peaked and ended with the industry and college cooperation engineer training platform. The platform was founded through integrating existent separate professional laboratories financed by national project, and comprised biology, water and wastewater, air pollution and solid waste modules of the environmental engineering. Based on the course of Foundation of Environmental Engineering Design, we extended it a profound training program including the above 4 modules, students participated in the form of groups as different project members and tutored by 10 teachers, among them, 6 engineers came from the existing professional practice enterprises and 4 teachers from inside the college. Students from two classes of Grade 2014 attended the program as the first try, it started from the 6th short semester and lasted 10~12 weeks according the per project they taken. During the whole program, no o strict class time was set except a fixed routine discussion time every day, till the acceptance of the project students undertaken.

For a return and sustainable attempt, college awarded professional reputation and paid wages to the engineers from industry for this period of guidance, and at the same time, they have the priority in selecting excellent graduates in the successive practice in enterprise or as their employee, the laboratories of college provide open access to the participating enterprises for partly free services as for composition measurement, product or process development. The platform also provides space for the products of industry as advertisement, research, endowment and trial.

After a short turn test-run of the joint cultivation platform of industry and college, positive and unpredicted feedbacks are the characteristics for different participants, and they used pain, achievement and joyous as the key words to generalize the process. Great change and improvement were attained by the students, as from the beginning, they became confused at the project and could not start the working until several lectures, then they learn to look up the textbook, database and articles for directions and method, especially during the lab-scale model construction, they worked over and over again, cared for this and lost that…, but when looked back at the end of the project, they would be moved by the progress and achievement they not dared to imagine at the beginning, they became well understood the professional knowledge they learn before in the textbook and could applied this in the future in industry; as for the participated enterprises, they need pay more attention and time(not the facility) to the platform, they noticed the performance of students under their own guidelines and standard, so they were more readily to give their professional work to the students for a further training, and more readily participated the joint cultivation platform as a smooth joint between the industry and college; college and teachers may be the most “suffered”, college provided the expensive platform and teachers, of which the teachers faced greater pressure for them: irregular worktime, huge knowledge system, unpredictable workload and the most of all, the ability to accurately predict and judge the resultant of the method they tutored right now, but when they noticed the active efforts of students they never saw in the class, it would be worthwhile for all the hard work.

Summary and Prospect
Based on the single responsible subject, we pay more emphasis on the law of growth for applied
talents, and explored an innovative mode of joint cultivation as a joint and smooth transition from the college to the industry. Students focused growth, improvement and industry oriented training brings about some positive results, but many uncovered problems imply more impending exploration should be taken in the mechanism innovation and industry-college merging.

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References