Research and Practice on the Engineering Talents Cultivation System between College and Locality

Wang Rongde, Wang Zhiqun, Li Fengyun

Qiuzhen College, Huzhou University, Huzhou, Zhejiang Province, 313000, China

Keywords: Independent College; new engineering construction; post competence; engineering practice and innovation ability cultivation system

Abstract: Confronting the obvious issues with the engineering students in Independent College who are generally weak in engineering practice and innovation ability, we have seized the new opportunity of cultivating engineering talents for Independent College based upon the newly-built engineering specialty together with the new requirements of cultivating engineering talents with the characteristic development of Independent College itself, and have clarified the cultivation goal of engineering practice and innovation ability with the consideration that we should regard post competence as focus based upon the investigation of over 200 enterprises, as result, the "135"engineering practice and innovation ability cultivation system in Independent College has been formulated in an innovative manner. Here, "1" indicates the core of post competence together with the cultivation program of engineering practice and innovation ability containing knowledge requirement, skill requirement, role requirement and quality requirement. "3" refers to three stages of progressive development of engineering basic skill cultivation, engineering project skill cultivation and engineering post skill cultivation. "5" denotes the five implementation systems of theoretical teaching, practice teaching, comprehensive training, science and technology activities and competence assessment. In the "135"cultivation system, "1" takes a lead as dominance, "3" is the progression of time vertically, "5" is the expansion in space horizontally. By far, we have carried out the "135"cultivation system in Qiuzhen College, Huzhou University and, with the computer major as an example, have achieved positive results.

1. Introduction

Higher engineering education in China has developed rapidly since 40 years of reform and opening up, and has been now ranked first in scale in the world. However, the scale is large, but not strong, the unbalanced and insufficient development among various colleges and various disciplines and majors within different colleges are still very prominent, especially in Independent Colleges. Independent Colleges in China have had a relatively short running time, the hardware and software such as teachers and experimental facilities are limited to some extent. Engineering students' engineering practice innovation ability is generally weak, which affects their employment development. Therefore, this has become an important part of engineering education reform in Independent College.

Therefore, we have seized the new opportunity of new engineering construction for Independent College to cultivate engineering talents, taken the enhancement of post competence as focus in cultivating engineering practice innovation ability in Independent College with new requirements of characteristic development, constructed "135" engineering practice innovation ability cultivation system in Independent College. "1" cultivation program of engineering practice innovation ability consists of role requirement, knowledge requirement, skill requirement and quality requirement. "3" cultivation stages of engineering practice innovation skill are composed of basic skill cultivation, project skill cultivation and post skill cultivation. "5" cultivation implementation systems of engineering practice innovation ability are made up of theoretical teaching system, practice teaching system, comprehensive training system, science and technology activities system and competence assessment system. After several years of implementing the "135" engineering practice innovation ability cultivation in our Independent College, positive results of students' practice innovation

  DOI: 10.25236/icecbn.2019.015

ability have been achieved.

2. Theoretical thinking

In view of the problem that higher engineering education in our country is big, but not strong, the Ministry of Education, engineering field, higher education field and various colleges and universities have carried out active reforms in engineering education, for example, in recent years the “Excellent Engineer Program” and “New Engineering Construction” have led the reform of higher engineering education in the new era of our country.

2.1 New engineering construction providing new opportunity for independent college to cultivate engineering talents

As a matter of fact, it is an inevitable requirement for China to promote the construction of new engineering projects in order to implement the strategy of innovation-driven development [1], promote the supply-side structural reform and realize the transformation and upgrading of industrial structure. Higher requirements for engineering talents have been put forward with the vigorous development of the new economy represented by new technology, new forms of business, new models and new industry. The implementation of the strategic plan named “Made in China 2025” urgently needs a large number of modern engineering talents [2]. Thus, the State Council has issued the “Development Plan of a New Generation of Artificial Intelligence”, and the Ministry of Education has issued the “Action Plan for the Innovation of Artificial Intelligence in Colleges and Universities”. It is estimated that the talent gap of artificial intelligence in China is of 5 million people, accordingly, Higher Education should adapt to the new needs in new era, accelerating the cultivation and research of modern engineering technical talents, providing service for the cultivation of high-level talents as well as the expansion and improvement of the skill-oriented talents. As for Independent College, it should seize the opportunity and carry out the new engineering construction according to the local conditions.

2.2 New requirements for cultivating engineering talents with the characteristic development of Independent college

Independent College belongs to the teaching type of higher undergraduate education running entity. According to the level of running the college, the characteristics of students and the successful experience obtained by Independent College [3], the cultivation mode of engineering talents of Independent College is positioned as application-oriented undergraduate engineering professionals in accordance with the needs of local economy and social development, which indicates that we should take students’ practical application ability, post skills and overall quality as the main characteristics [4]. Moreover, this type of talent cultivation mode is ability-centered, the goal is to meet the needs of society, the main line is to cultivate students’ technical application ability, the focus is the future development potential of students according to which we could design the knowledge structure, ability structure and quality structure of talent cultivation. Therefore, we must attach great importance to the cultivation of students’ practical ability, innovative ability and application ability so as to form the talent cultivation characteristics of Independent College.

2.3 Taking enhancement of post competence as focus in cultivating engineering practice innovation ability in independent college

Under the guidance of “Excellent Engineer Program” and “New Engineering Construction”, we have organized the field investigation in more than 200 enterprises and employing units, listening to the requirements from enterprises about engineering talents, finally, our college and enterprises have worked together to draw a conclusion that the post competence should be treated as focus [5]. The term “competence” has first proposed by professor David McClelland of Harvard University, from the perspective of education and cultivation, competence refers to whether a student can be qualified for a particular job after graduation which includes his professional knowledge, skill and value required to the job when he works independently. In other words, the work competence com

As for the engineering major in Qiuzhen College of our university, we have conducted the detailed research on post competence of electronic and electrical category, mechanical category and computer category together with the industry and enterprises through the co-education between our college and locality.

2.4 Constructing "135" engineering practice innovation ability cultivation system in independent college

From what have been discussed above, we have worked out a "135" engineering practice innovation ability cultivation system in Independent College in an innovative manner. Here, "1" indicates the core of post competence together with the cultivation program of engineering practice and innovation ability containing knowledge requirement, skill requirement, role requirement and quality requirement. "3" refers to three stages of progressive development of engineering basic skill cultivation, engineering project skill cultivation and engineering post skill cultivation. "5" denotes the five implementation systems of theoretical teaching, practice teaching, comprehensive training, science and technology activities and competence assessment, thus, forming a "one key link, three verticals and five horizontals" engineering practice innovation ability cultivation system in which "1" takes a lead as dominance, "3" is the progression of time vertically, "5" is the expansion in space horizontally. In the "135" system, time and space are interlaced, as a result, the development can be carried forward with integration.

3. Exploration of practice

Now let us take computer science and technology major as an example to illustrate the specific practice of "135" engineering practice innovation ability cultivation system.

3.1 "1" Cultivation program of engineering practice innovation ability

Guided by the "Excellent Engineer Program" and the "New Engineering Construction", we have formed the role requirement, knowledge requirement, skill requirement and quality requirement of the computer science and technology major according to the computer science and technology professional post demand survey with which the computer science and technology professional cultivation program has been improved.

Role requirement: Students are required to be able to serve as, after graduation, software development engineer, computer hardware engineer, test engineer, computer educator, database engineer, network engineer, system maintenance engineer, technical support engineer, etc. moreover, they can play the roles of individual, team member or head in a multidisciplinary team [6].

Knowledge requirement: Students are required to possess the knowledge of mathematics (including advanced engineering mathematics, probability and mathematical statistics, discrete structure, etc.) and physics (including mechanics, electromagnetism, optics and modern physics, etc.)the natural science knowledge, besides, they should also be armed with the basic engineering and professional knowledge (including programming, data structure, computer composition, operating system, computer network, software engineering, etc.) and the professional core knowledge.

Skill Requirement：Students are required to have the capability to identify, express, research and analyze complex engineering problems of computer system by applying the basic principles of mathematics, natural science and engineering science, in the meantime, obtain effective conclusions. In addition, ability should be possessed by them to design, implement, or deploy application system based on computational principles, supported by hardware, software, and computer network. Furthermore, they should have the ability to effectively communicate with industry peers and the public on complex engineering problems of computer system, even possessing certain international perspective, being able to communicate in a cross-cultural context.

Quality requirement: Students are required to have the humanity and social science accomplishment, the social responsibility, can understand and abide by the engineering professional

ethics and the practice request in engineering practice, meanwhile, perform their responsibility.

3.2 “3” Cultivation stages of engineering practice innovation skill

According to the cultivation program and requirement of computer science and technology specialty, the cultivation of engineering practical skill has been carried out in three stages step by step，it is described below.

(1) First stage: Basic skill cultivation which includes three aspects: the professional basic theoretical knowledge and skill, practical knowledge and skill, and general knowledge and skill. The cultivation has lasted throughout the first year of students’ academic year, and some have to continue into the first semester of the second year.

(2) The second stage: Project skill cultivation which includes three aspects: the cultivation of comprehensive professional design skill, the cultivation of comprehensive discipline competition skill and the cultivation of comprehensive innovative design skill. This stage of project skill cultivation will continue throughout the second and third academic years.

(3) The third stage: Post skill cultivation which includes three aspects: internship in enterprise, comprehensive skill of graduation design and business skill of innovation and entrepreneurship. This stage of post skill cultivation will continue throughout the fourth academic year.

3.3 “5” Cultivation implementation systems of engineering practice innovation ability

During the above thee stages of cultivation for computer science and technology majors, “5” cultivation implementation systems of engineering practice innovation ability (namely theoretical teaching system, experimental teaching system, comprehensive practical training system, scientific and educational activity system and ability assessment system) support and guarantee the actual operation of the three stages, therefore, the cultivation of talents’ practical ability can be carried out smoothly.

(1) Theoretical teaching system. It consists of general course, basic course, major course and elective course. The general course is composed of two parts: general compulsory course and general elective course in which the general elective course must get 8 credits. The major basic course is made up of high-level language programming, linear algebra and university physics. The major course is constituted with discrete mathematics, data structure, database principle, computer network, computer composition, operating system, software engineering, algorithm design and analysis, among them, the data structure, database principle, computer network and operating system are the degree courses. The professional elective course offers three modules for students to choose: security of network and information, big data processing and mobile Internet.

(2) Experimental teaching system. It consists of in-class experiments, curriculum design, cognitive practice, professional internship and summer 3+X activities etc. The goal for the training of experimental teaching system is to improve students' basic skill and professional skill. We have cooperated closely with enterprises to set up the experimental teaching system and have jointly applied for the industry-college cooperation and collaborative education project of the Ministry of Education.

(3) Comprehensive training system. It consists of comprehensive curriculum design, graduation design, graduation practice, military training and innovative practical training. The goal for the comprehensive training system training is to improve the comprehensive quality of students. In order to further improve the comprehensive training ability of students, we have established the demonstration base of industry-college-research cooperation with enterprises. At the same time, we have invited experts from enterprises to our college, introducing to students the development of the whole project in detail, so that students’ comprehensive quality as well as their graduation design level have been greatly enhanced.

(4) System of science and education activity. It consists of provincial college students' innovation and entrepreneurship training program, college students' programming competition, service outsourcing competition and other competition activities. This system also contains computer association activity, key laboratory scientific research practice, public welfare activity and

various innovation and entrepreneurship activities. Through this science and education activity system training, students' comprehensive quality has been further improved.

(5) Ability assessment system. It consists of all kinds of professional qualification examination (such as computer maintenance worker, computer rank examination, professional qualification examination of computer programmer, etc.), post skill training, paper and patent examination, etc. The goal of the ability assessment system training is to improve students' post competence and competitiveness.

4. Positive results

After several years of implementing the "135" engineering practice innovation ability cultivation in our Independent College, preliminary results of students' practice innovation ability have been achieved. Students have actively participated in various competitions, so far, they have won 5 national prizes, 27 provincial prizes, obtained 2 software copyrights, and 8 students have got the utility model patents. The employment rate of students has reached 98%, among which the entrepreneurship rate is 5%. At present, in Qiuzhen College, there are 10 engineering majors, including mechanical design manufacturing and automation, mechanical and electronic engineering, electrical engineering and automation, computer science and technology, among which the electronic information engineering, electrical engineering and automation, material chemistry, photoelectric information science and engineering have been rated as the new characteristic majors in Zhejiang colleges and universities.

5. Conclusion

The Independent College has been born and grown up in the local place, so that it is inextricably linked with the local place, therefore, it is of great significance to intensify the cooperation with the local place and make full use of the local resources. From what have been explored above, we can realize the greatest fit of combination between industry and education, between collaborative education and the cultivation of application-oriented talents, hence, in close combination with social needs and application-oriented transformation, we can form a development community of co-education between university and locality, reconstruct the curriculum system, build a practice platform, implement the dual-tutors system between university and locality, thus, collaboratively cultivate modern engineering talents.

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