

The Construction and Practice of Multi-Dimensional Innovation and Entrepreneurship Competence System for Engineering Specialty

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Abstract: In order to stimulate the improvement of innovation and entrepreneurship competence of engineering specialty and improve students' innovation and practice ability, this paper discusses the construction of multi-dimensional innovation and entrepreneurship competence training system of engineering majors from four aspects of training mode, teaching means, practice platform and management mode. Through the practice and improvement of the system, a training mode suitable for innovation and entrepreneurship talents of engineering specialty is gradually established. According to the characteristics of engineering talents focusing on the cultivation of engineering ability, starting from the four student-centered dimensions, this paper adopts innovative thinking to improve teaching methods and students' ability to analyze and solve practical problems, focused on cultivating students' team spirit in the teaching process, in order to better cultivate students' engineering practice ability and engineer concept.

Keywords: multi-dimensional, engineering, innovation and entrepreneurship, competence enhancement

1. Introduction

With the development of society and the progress of the times, how to do a good job in the cultivation of engineering students' innovation and entrepreneurship competence is the top priority of talent cultivation. According to the needs of enterprises and industries, it is required to constantly innovate the education mode, improve students' innovation and entrepreneurship practice ability, and improve students' pioneering and innovative thinking, which is of critical importance for engineering students. In the practical project teaching process of engineering specialty, the key to improve the innovation ability is to cultivate the scientific research ability and quality of college students by using innovative thinking, to explore a good teaching mode, and to use appropriate methods. The main purpose is to enable college students to apply the knowledge in books to solve practical problems in social science and social activities, and to improve students' ability to analyze problems. It is necessary to broaden the students' mind set, change the existing thinking of the team, and train their ability to solve problems.

In daily teaching, revolving the topic of how to use innovative thinking, explain various project cases and modeling cases, improve students' interest in learning and learning effect, some reforms of teaching method are gradually under way. By utilizing innovative thinking, some practical project teaching reforms have been conducted, which enable students to take a more active part in learning and active thinking. In order to comprehensively improve the innovation and entrepreneurship competence of students from engineering speciality, it is imperative to constantly explore and practice in the aspects such as training system, management mode, practice platform and comprehensive application. This paper proposes a multi-dimensional innovation and entrepreneurship training mode of engineering majors, which divides the innovation and entrepreneurship training of college students into four aspects: "interest, creativity, innovation and entrepreneurship", and generally divides it into two levels. The first level is "interest", which indicates that teaching project and teaching mode can arouse students' interest in active learning; the second level is "creativity", which can germinate and cultivate students' innovative consciousness, as well as enhance their practical ability of science and technology innovation; the third level is "innovation" and "entrepreneurship", which can gather the previous training foundation to further improve students' innovative and entrepreneurial literacy. Combined with

the first classroom and the second classroom education, the specific work is carried out from the four dimensions of "interest guidance, creative training, innovation promotion, entrepreneurship guidance and training". The four dimensions are interrelated and carried out in parallel, so as to form a "two-tier and four-dimensional" innovation and entrepreneurship training system, which can better stimulate students' active participation enthusiasm, systematically and continuously exercise students' innovation and entrepreneurship ability, cultivate talents with innovative and entrepreneurial talents, constantly improve the ability of engineering practice, and improve the concept of engineers.

Engineering major is an important supporting major for social and economic development. How to cultivate students' innovation and practice ability is an important subject of major construction. In order to meet the needs of society and industry for students, from four aspects (i.e. practice teaching mode, learning autonomy, teaching methods and teaching team), this paper explores, practices, establishes and improves the training system of innovative practice talents, as well as constantly improves students' innovative practice ability.

2. Construction of Multi-Dimensional Innovative Practice Teaching Mode

The cultivation of engineering professionals should meet the needs of industry development, reflect industry characteristics, rely on national engineering practice center and large-scale engineering projects, vigorously enhance innovative practice ability, and build innovative practice training mode with engineering ability and engineering concept as the core, as shown in the figure below:

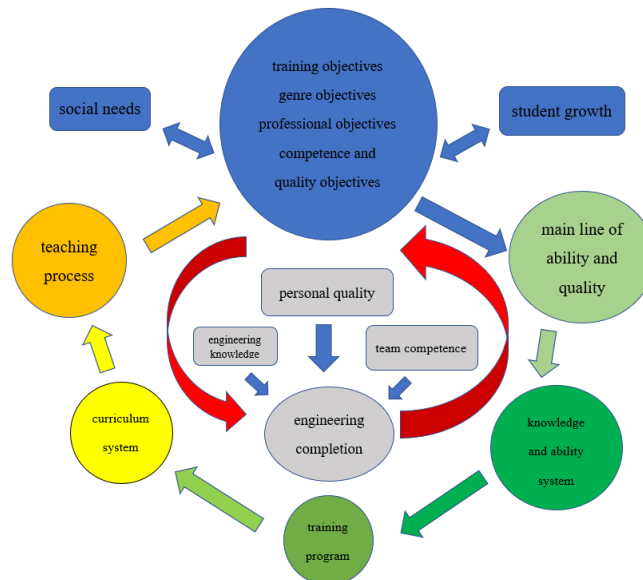


Figure 1 Training mode of integrated industry capacity demand.

2.1. Construction of Ability Training System with Engineering Ability as the Main Line

In accordance with the needs of industry and social development, with improving the engineering ability as the goal, build the characteristic knowledge system, the ability demand should be analyzed and refined, the ability system should be built from the aspects of technology, economy, management, team and social responsibility, and the ability training system should be built from the perspective of ability training.

2.2. Practice Curriculum System Reflecting Ability Elements

Integrate professional basic courses and professional courses, form a course group with engineering ability as the core, and build the knowledge system which embody engineering design, construction and management, with petrochemical equipment operation and maintenance ability. Under the guidance of engineering practice ability, the practical teaching curriculum system is formulated, highlighting professional practice ability. From simple to complex, it can be divided into three categories: the first

category is curriculum projects, the second category is projects including a group of related core courses and ability requirements, and the third category is projects including the main core courses and ability requirements of the major, forming a spiral practical teaching system of basic experiment-comprehensive application skill-training technology application-innovation ability.

2.3. Innovative Design Teaching Methods

It is very crucial to adopt the teaching method suitable for students, reform the practice teaching content, plan different levels of design, research, innovation and comprehensive for practice projects, and strengthen the training of engineering practice ability.

In teaching, teachers should actively advocate optional and collaborative experiments; combined with the process of engineering practice and scientific research, teaching methods should be introduced, involving such as interest, inquiry, case, problem, task-driven. Under the professional guidance of teachers and business mentors, as the main body, students can complete the conception, design, implementation and operation of multiple professional skills project practice, and carry out multiple projects. In the process of practical training, students' engineering application ability is improved spirally.

Based on the Internet platform to share excellent teaching resources, including multimedia courseware, network classroom, engineering project video and so on, aiming at the common problems in students' practice, the students can learn selectively and repeatedly, and the practical effect is good. Through learning and teachers' guidance, students can solve the problems encountered in all kinds of learning and practice in real time, and break through the limitations of traditional classroom teaching methods, which can expand the ways of students' self creation and training, as well as ensure the implementation of the full coverage training system.

3. Stimulating Students' Interest in Inquiry

To build a student-centered teaching mode, good teaching methods are adopted to help students take the initiative to participate. For example, in the activity of "how many paper clips can a cup full of water hold", students will find that there is a big difference between the actual number of paper clips and the conjecture. Teachers should seize the opportunity to guide students to raise a series of questions beginning with "why". For example, "why can a cup full of water hold many paper clips without water overflowing", "why the number of paper clips put in different groups is different", "why the number of paper clips put in different cups is different". Students will develop a profound interest in such questions, and at the same time, students have been actively thinking, laying a good foundation for in-depth exploration.

Teachers can also reasonably lead out the problems that students cannot solve at present and may think about by learning knowledge through analogy and other methods, and guide them to contemplate, in order to stimulate students' cognitive needs. We should respect the academic spirit and cognitive process, actively guide and encourage students to question the textbooks and teachers' teaching contents, as well as pay attention to every question raised by every student. Teachers should stand in the position of students to approach the problem, to allow students to have wishful or even whimsical thinking. Even if the questions put forward by students are ridiculous, teachers should try to actively obtain the value of students' questions from those seemingly unrelated problems, instead of sneering at them, in order to protect students' enthusiasm and interest in learning.

Teachers of engineering majors should correctly grasp the characteristics of practical courses, make full use of and tap all kinds of project resources, improve teaching methods, organically combine the cultivation of ability and self inquiry learning, and constantly stimulate students' interest in self-learning.

4. Improving the Ability of Innovation and Practice

4.1. Aspects Needed to Be Improved

The current focus is the theoretical education of engineering talents, and the cultivation of practical ability is relatively insufficient. In the current new social background, the industry has higher requirements for students' practical ability, and the following aspects need to be improved:

(1) The proportion of students' participation in various industries and government competitions is relatively low, despite the large number of the relevant competitions. Meanwhile, the proportion of subject competitions is relatively large. Therefore, it is difficult to meet the needs of improving the innovation and entrepreneurship competence of most students;

(2) There are many kinds of projects of innovation and practice ability, most of which are laboratory based teaching methods. Without making full use of high-quality engineering project resources, it is difficult to realize the whole process education of innovation and practice for the majority of students;

(3) The teacher-dominated passive innovation and training management mode can not fully stimulate the vitality of students' independent innovation, and it is difficult to achieve a high level of innovation and entrepreneurship.

4.2. Constructing Multi-Level Practice Teaching System and Developing Progressive Practice Teaching

According to the characteristics of engineering specialty, fully combined with teaching, scientific research, engineering and other links, knowledge teaching, ability training, quality improvement can be effectively achieved. To examine the connotation of practice project from the engineering perspective, through the organic combination of professional direction platform and practice innovation teaching system in the innovative practice curriculum system, the discipline professional knowledge can be consolidated, the cultivation of engineering practice ability should be highlighted, and the innovation of the curriculum system should be placed emphasis on. The improvement of humanities and science quality and the cultivation of teamwork spirit can promote the coordinated development of knowledge, ability and quality, and solve the problems of students' engineering ability training.

With the organic combination of "basic experiment, professional practice and engineering practice", it is essential to build a multi-level practice teaching system, carry out progressive practice teaching, set up basic verification type and comprehensive design type experiments for basic courses, strengthen professional basic skills, carry out task driven and innovative research type professional practice, cultivate students' practical ability and innovative consciousness, and continuously carry out engineering Project combat training to cultivate students' engineering application ability and professional quality.

5. Building a Multi-Disciplinary and Multi-Level Teaching and Learning Team

5.1. Building a Team of Innovative Practice Teachers with Strong Innovative Practice Ability

Teachers should constantly improve their innovative practice ability. Multi-dimensional engineering innovative practice requires teachers to have multidisciplinary, interdisciplinary and interdisciplinary knowledge, including engineering knowledge, innovative ability, knowledge application, team cooperation, engineer spirit, etc. From the perspective of talent ability training, the role of teachers is very important for students. Teachers need to guide, and solve problems for students. They should be good at grasping the application of knowledge at the system level, which is helpful for students to conduct in-depth study of innovation and practical problems.

As the instructor of innovation practice, the following experience is required:

(1) He/She has directly participated in large-scale engineering projects, engaged in technical management, project management, engineering budget and other work, with rich engineering practice experience;

(2) He/She has engaged in or directed a large-scale scientific and technological innovation competition and achieved excellent results;

(3) As a member of the technical innovation team, he/she has been engaged in the technical and management work of technical innovation, invention and creation;

(4) Members of the team come from different fields and have different technical, management and organizational experience.

The teaching of innovation and practice ability of multi-dimensional engineering specialty must be carried out in the form of team, to meet the needs of students with different interests for teaching, in order to better carry out teaching and guidance of students.

5.2. Forming a learning team based on interests

Interest is the best teacher, and the work of engineering innovation practice requires students to help each other in the form of team to achieve good learning effect. According to their own creative projects, students initiate project team recruitment information through the Internet platform. Students of different majors and grades can choose the projects they are interested in on the Internet platform based on their creative projects, while the initiators select the applicants who meet their own requirements to join the team. Through the interaction of students of different majors and grades on the Internet platform, they complement each other and form a multi-disciplinary and multi-level complementary innovative practice team, which can realize the integration of interdisciplinary students, and can also find partners with common interests in different classes and within the specialty.

6. Case Analysis

Aiming at the innovative practice teaching mode proposed in this paper, taking students of electrical engineering and automation major from Guangdong University of petrochemical technology as an example, according to the teaching results of the past two years, the electrical 2017-1 class and 2017-2 class are divided into two groups, and the teaching effect of traditional teaching and multi-dimensional innovative practice teaching in the "professional comprehensive practice" course is adopted. The course practice lasts two weeks. Group 1 (from Class 1) adopts the pure traditional innovative practice training mode; Group 2 (from Class 2) adopts the multi-dimensional innovative practice teaching mode. Table 1 shows the comparison of the two training modes:

Table 1 Traditional training and multidimensional innovation practice mode.

Traditional practice training		Multi-dimensional innovation practice mode	
Theory part	single discipline	Theory part	inquiry teaching method
	teaching centered		case teaching method
	homework practice		Problem-oriented discussion groups
Practice part	Traditional practice teaching laboratory	Practice part	Training center of Power Supply Bureau
	Electric Power Laboratory		Power supply office of Maoming Petrochemical Co., Ltd

The two groups were trained in the training method described in Table 1 and after two weeks of training, 7 students were randomly selected from each group, as shown in Table 2.

Table 2 Comparison of students in the two groups.

Students from Group 1	Average score (before)	Average score (after)	Students from Group 2	Average score (before)	Average score (after)
01107	60	70	01103	62	80
01109	87	85	01106	84	94
01115	93	95	01113	90	93
01138	91	93	01136	88	92
01139	84	84	01131	81	84
01141	80	84	01149	85	88
01142	85	88	01148	82	85
Awards: Group 1, none; Group 2, after training, the third prize of the 11 th National College Students' Social Practice and Science and Technology Competition					

Based on the above data, it can be seen that the students trained by the multi-dimensional innovative practice training mode tend to be better in both performance and ability.

7. Conclusion

The construction and practice of multi-dimensional innovation and practice ability system for engineering specialty is an exploration of college students' practice teaching system. The practice results demonstrate that students' innovation and practice ability have been comprehensively improved, with a better understanding of the concept of engineers. Furthermore, progressive training has been carried out from the dimensions of cultivating interest, respecting independent choice, inspiring creative thinking, guiding innovation and practice, so as to effectively achieve the cultivation of innovation and practice ability.

The system focuses on improving students' self design and self-improvement, teaching students a good learning method and innovative consciousness, strengthening students' comprehensive ability of innovative practice, comprehensively stimulating students' vitality of independent innovation, and realizing the leap from passive innovative practice to independent innovative practice.

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