

Research on the cultivation mode of engineering application-oriented innovative talents - Taking the major in Mechanical Design, Manufacturing & Automation as an example

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Abstract: In order to realize the cultivation objective of national engineering application-oriented innovative talents, the paper investigated the cultivation mode of engineering application-oriented innovative talents from the perspectives of theoretical teaching system and the practical teaching system. Taking the major in Mechanical Design, Manufacturing & Automation as an example, the construction of theoretical teaching system oriented by engineering ability cultivation mainly includes three aspects: talent training program improvement, specialized course adjustment and teaching method innovation. The practical teaching system is discussed from perspectives of teaching staff construction, collaborative education mode, scientific and technological innovation activities, aiming at the cultivation of the students' engineering application abilities and innovative abilities.

1. Introduction

With the increasing interests in engineering education reform, the cultivation of innovative, applied and skilled talents has become an inevitable requirement under the development trend of the times. Engineering application-oriented innovative talents, belonging to the category of applied talents, refer to the innovative talents with strong engineering application abilities and engineering application-oriented talents with strong innovation abilities. In recent years, a variety of researches have been carried out to investigate the cultivation mode and cultivation method of application-oriented innovative talents [1-6]. As one of the strategic goals of modern higher education, the cultivation of engineering application-oriented innovative talents concerns the development of national economic society and improvement of core competitiveness, which also has significant influences on the strategy realization of reinvigorating China through human resource development.

The major in Mechanical Design, Manufacturing & Automation in School of Qilu University of

Technology, is a national first-class undergraduate major, as well as the major passing the international engineering education professional certification. With the aim of improving the cultivation quality of engineering application-oriented innovative talents, comprehensive reform and innovation have been conducted on the theoretical teaching system and practical teaching system. The connotation of engineering application-oriented innovative talents, in combination with the university great merits of “Integration of Science Research and Higher Education, Collaborative Education”, has been taken into consideration during the reform and innovation process.

2. Construction of theoretical teaching system

2.1. Improvement of talent training program

The talent training program is adjusted in time in order to further adapt to the construction requirements of national first-class major and the training requirements of international engineering education professional certification. The talent training program of Mechanical Design, Manufacturing & Automation closely focuses on the development of national traditional equipment manufacturing and high-end equipment design, featuring the research and development of intelligent manufacturing and high-end light industrial equipment. The major has been committed to cultivating high-level engineering application-oriented innovative talents with solid basic theoretical knowledge and systematic professional skills. Furthermore, according to the internal and external evaluation results of talent training, ideological and political goals of professional talent training are supplemented in the professional talent training program in Edition 2020. The purpose is to fully implement the requirements of "Guidelines for Ideological and Political Construction of Colleges and Universities" issued by the Ministry of Education. Thus, the organic integration of knowledge teaching, value shaping and ability training is realized in the new talent training program which combines the knowledge structure system with the ideological and political system.

2.2. Adjustment of specialized course setting

Based on the professional knowledge structure of engineering application-oriented innovative talents, the curriculum group is established to achieve the adjustment, reform and innovation of curriculum system. Dynamic adjustment of specialized curriculum system can effectively solve the contradiction between the dynamic changes of market demand and the relative stability of the professional talent cultivation mode. In the curriculum system of Edition 2020, the practice credit proportion is increased to 30% by the following measures. First, “Thermal Engineering and Fluid Mechanics”, “Project Management”, “Enterprise Management” and other courses are added. Second, six characteristics course modules such as “Light Industry Machinery” are added. Third, three elective directions including mechanical manufacturing, mechatronics, process equipment and intelligent are added. Fourth, “Engineering Literacy Training” and another four practice courses are added. For example, based on the study on the course of “Project Management”, the students have the basic concept of market economy, master the analytical methods and analytical tools to solve practical economic problems. The students could compare and evaluate the engineering project and other practice work using the basic theoretical knowledge and rating methods of engineering economics, so that they are qualified with the basic accomplishment for engineering practice and technological innovation through course study.

2.3. Innovation of teaching method and medium

Teaching method and medium are reformed and innovated to improve the teaching quality. In

In addition to the traditional guiding and heuristic teaching methods, the students are encouraged to utilize the online learning platforms of MOOC national superior courses to conduct active learning after class. Teachers guide students to carry out project learning, simulation and case studies using lecture-based, engineering-based and experiential learning methods. The abilities of systematic thinking and solving engineering problems of students under engineering practice atmosphere are significantly improved during this process. Under the situation that the students are less exposed to engineering problems and do not know how to deal with engineering problems, teachers train the students to master the engineering research methods during the teaching of specialized courses. For example, simplified engineering problems are involved in the course learning of Thermal Engineering and Fluid Mechanics. Teachers organically connect the theoretical teaching contents with practical engineering problems, and emphasize the differences between practical engineering problems and theoretical analysis methods. Thus, the theoretical teaching is more integrated with engineering practice, and the engineering application characteristics of professional courses are strengthened.

3. Construction of diversified practical teaching system

A series of practical teaching activities are carried out to improve the engineering ability of students majoring in Mechanical Design, Manufacturing & Automation, realizing the effective combination of theoretical knowledge and engineering practice. Teachers highlight the characteristics of engineering education in practical teaching, and conduct curriculum design, production practice, graduation thesis, other internship and practical training closely in combination with practical engineering problems encountered in Mechanical Design, Manufacturing & Automation. At present, the engineering practices generally encounter problems such as lack of engineering practice experience of teachers, limited internship enterprises, and insufficient operation training for students. Therefore, diversified practical activities are proposed to comprehensively improve the students' engineering application ability, scientific and technological innovation ability.

3.1. Improvement of the teaching ability

The major in Mechanical Design, Manufacturing & Automation has a professional teaching and research team with high education and strong academic ability. Currently, there are 25 full-time teachers, in which 20 teachers have doctoral degrees and 12 have overseas study experience. The teaching team closely follows the international development trend of Mechanical Design, Manufacturing & Automation major. In combination with the knowledge structure of specialized courses and their respective scientific research topics, they introduce relevant foreign engineering cases and academic frontier directions, to expand students' international vision and learn the discipline frontier. Teaching seminars on the innovation ability cultivation of college students are regularly hold to study the scientific and technological innovation projects related to the specialized courses. The purpose is to improve the level and quality of teachers to guide students to carry out scientific and technological innovation projects. In addition, most young teachers are lack of experience in practical teaching due to less corporation work experience after graduating with doctoral degrees. To solve this problem, young backbone teachers are encouraged to enter relevant enterprises for six-month follow-up practice exercises, improving the engineering knowledge level and engineering practice ability.

3.2. Establishment of Mechanical Collaborative Education Alliance

Department of Mechanical Engineering of Qilu University of Technology, in conjunction with the provincial key enterprise associations, established a Mechanical Professional Collaborative Education Alliance in 2019, forming a collaborative education model with features of “Integration of

Science Research and Higher Education” and “Integration of Industry and Education”. After three years of construction, the alliance has established 4 mechanical teaching demonstration centers, and 26 practice platforms acting as public training bases and China Light Industry Key Laboratories. Four textbooks and twelve lecture notes have been published with the actual enterprise cases as the engineering projects. Furthermore, 98 instructors from 76 companies are hired to participate in each teaching session, and the graduation projects come from the enterprises, which basically realizes the joint guidance of corporate mentors and university teachers in the graduation design process. The above measures focus on the cultivation of high-quality engineering application-oriented innovative talents, and achieve the two-wheel drive of “Integration of Science Research and Higher Education” and “Integration of Industry and Education”.

3.3. Promotion of scientific and technological innovation activities

The open type undergraduate scientific and technological innovation studio and practice platform are adopted to cultivate the students’ innovative thinking, scientific method, practical ability, scientific research literacy and teamwork spirit. Serving as the academic tutors, the specialized course teachers encourage students to participate in relevant competitions, such as China University Students Mechanical Engineering Innovation and Creativity Competition, National College Mechanical Innovation Competition, National University Student Social Practice and Science on Energy Saving & Emission Reduction, National College Student Innovation and Entrepreneurship Training Program. The major regularly holds scientific and technological innovation activities mobilization conferences and publicity sessions, and displays excellent scientific and technological innovation works in previous years. Students and teachers with rich experiences are invited to introduce their experiments in competition, which improves the students’ participation enthusiasm and innovation ability. During the design and competition processes, teachers guide the students to look up Chinese and English databases and documents. The students can continuously broaden their course knowledge and international perspective, which further improves the advanced nature and challenge of scientific and technological innovation activities.

4. Conclusion

Based on the current economic and social demands on engineering application-oriented innovative talents, this paper investigates how to improve the engineering application and innovation capabilities of students majoring in Mechanical Design, Manufacturing & Automation from the perspectives of theoretical teaching and practical teaching. According to the disciplinary development and social requirements, the professional talent training program, curriculum setting and course teaching methods are adjusted. In addition, a series of diversified practical teaching activities are proposed to cultivate high quality engineering application-oriented innovative talents.

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