Exploration of Cultivating Mechanical Innovation Talents under the Background of New Engineering— A Case Study of College of Mechanical and Electrical Engineering of Qiqihar University

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Abstract: To keep pace with the era and cultivate a new type of talents with comprehensive quality, higher education in our country must change the original traditional teaching and training ideas. In view of the shortcomings in the talent training of engineering related majors under the background of new engineering, this paper puts forward new training ideas and implementation ways in the aspects of curriculum system, training methods and practical projects, taking the School of Mechanical and Electrical Engineering of Qiqihar University as an example. Practice shows that innovation in teaching methods, courses and teaching platforms can effectively improve students' comprehensive quality.

Keywords: Innovation, New Engineering, Talent Training

1. Introduction

In the report to the Party's 20th National Congress, president pointed out that education, science and technology, and human resources are the basic and strategic support for comprehensively building a modern socialist country. Science and technology is the primary productive force, talent is the primary resource, and innovation is the primary driving force. Under the background of new engineering, application-oriented undergraduate universities are the main positions for cultivating innovative technical talents of mechanical majors. Innovative talents of mechanical majors should not only have a solid theoretical foundation, but also have rich practical operation ability, and should establish engineering thinking, system thinking, scientific thinking and innovative thinking. The talent training mode of application-oriented undergraduate universities should not be based on traditional classroom teaching, but should carry out comprehensive reform and innovation in training objectives, training content, training methods, major and curriculum Settings, supporting resources and environment. Therefore, exploring new teaching has become the primary problem to solve.

2. Problems Existing in the Current Training of Engineering Students in China

2.1. Insufficient emphasis on practical ability

For many years, there has been a problem in the training of engineering students in China's higher education, emphasizing theory over practice, engineering students lack real experience in enterprises, and some schools even have no internship after graduation. Many school students practice for 3 to 8 weeks, practical teaching time is seriously short. In recent years, higher education has always emphasized the cultivation of vivid skills in engineering, introduced advanced western teaching models, and vigorously carried out the combination of university and enterprise. However, most schools still stay at the research level, and there is little time for training engineering students. This does not improve the current dilemma of engineering students "talking on paper", and students still stay at the theoretical level of knowledge. Students lack the flexibility to apply knowledge in practice [1].

2.2. The innovation curriculum is not perfect

At present, most of the engineering courses in ordinary universities still take books as the main reference and infuse teaching as the leading method. In the course setting, emphasis is placed on the teaching of basic knowledge, while the guidance of students' innovation is ignored. The teacher simply instills the book knowledge to the students in the teaching, and does not care about the acceptance of the students. The establishment of professional courses lacks innovative courses. In addition, the current advanced technology is often disconnected from university courses, and the courses students learn are old and cannot meet the development needs of society's advanced manufacturing industry[2].

2.3. The purpose of cultivation is not clear enough

In the teaching of most local universities, there is a lack of new content and development of disciplines, and the vertical or horizontal connection between disciplines is insufficient. Moreover, due to the lack of relevant innovation experiment facilities and the weak construction of innovation practice bases, there is a serious disconnect between innovation theory teaching and innovation practice in teaching, and the learning model proposed under the background of new engineering has not been well developed[3].

The following article will take the College of Mechanical and Electrical Engineering as an example, how to integrate innovative elements in teaching, in order to achieve the purpose of cultivating innovative talents.

3. New Teaching Methods

In terms of cultivating and training students' innovative thinking ability, college teachers should pay attention to the cultivation of thinking modes and learning methods." Teach a man to fish better than give him fish"[4]. The knowledge of engineering discipline is becoming more and more abundant and more and more novel, and it is very unrealistic for educators to teach students all the knowledge. Only by inspiring, inducing and prompting, stimulating students' interest and enthusiasm for the major, and cultivating students' awareness and ability of independent thinking can they develop better and better in the future[5]. Second, avoid explaining the contents of each chapter in isolation. By summarizing and comparing the contents of each part, teachers can make knowledge become an organic whole, which is easier for students to grasp and consolidate; Third, introduce some innovative thinking, encourage students to reduce the "constraint" of thinking, increase the "freedom" of thinking, and combine imparting knowledge with cultivating excellent engineering thinking. Fourth, educators keep up with the development direction of modern machinery, pay attention to new hot spots at any time, constantly enrich and enrich teaching content, find new ideas and new things that stimulate students' interest, and develop students' innovative ideas.

Qiqihar University relies on the Collaborative Innovation Center of Intelligent Manufacturing Equipment Industrialization of Heilongjiang Provincial Department of Education and Qiqihar Science and Technology Innovation Platform, and through the establishment of graduate joint training base, the university organically combines the respective advantages of the university and the enterprise, forming a new model of graduate training featuring complementary advantages, resource sharing and win-win benefits. In the field of industrial design, our Institute has employed five enterprise tutors including Jiang Hui from Qiqihar QiZhong Numerical Control Equipment Co., Ltd. in 2019, and established a "dual" training model from the aspects of graduate double selection and practice. Graduate students who choose enterprise tutors are also equipped with on-campus tutors, and enterprise tutors give graduate students topics according to actual projects in production. Scientific research platform and experimental conditions are provided, and the school tutors provide students with scientific research guidance from the aspects of theoretical knowledge and thesis framework construction. The purpose of universityenterprise joint training of graduate students is to break through the constraints of universities themselves, take the industry demand as the guidance, and improve the quality of applied talents. Relying on scientific research projects, the university improves the teaching mode of university-enterprise cooperation, takes the scientific research projects cooperated by enterprises and schools as the specific carrier for cultivating master students, combines theoretical teaching with enterprise projects, sets up the teaching curriculum system with "engineering application and innovation ability" as the core and focuses on the engineering practice, and actively gives play to the platform advantages of the cooperative enterprise-Qihui numerical

control. This mode realizes the practical teaching mode of "docking inside and outside the class, linkage inside and outside the school", and builds the school-enterprise coordination docking mode to drive teaching.

4. New Curriculum System

According to the practical teaching characteristics of professional basic courses and the needs of students' practical ability training, the college has constructed a new practical teaching system of "three levels and six categories", as shown in Figure 1. The system consists of three modules: basic skills training, design and comprehensive skills and system engineering ability training, and innovation ability training. There are three levels in the practical teaching system. The first level is basic skill training, which consists of metalworking practice, electrical and electronic practice, and basic experiment. The second level is the cultivation of comprehensive ability of design, which consists of several course design and comprehensive system design. The third level is the cultivation of engineering practice innovation ability. By guiding students to enter the laboratory or college students' science and technology innovation practice base according to their own hobbies, they can study their own proposed topics and student innovation fund projects. Students can also participate in faculty research projects, participate in science and technology competitions such as "College Student Mechanical Innovation Design Competition" and "3D Digital Innovation Design Competition (3D Competition)" to promote students' engineering practice ability and innovation ability.



Figure 1: "Three levels, six categories" innovation ability training system.

5. New Teaching Platform

The college has also built a new training system for innovative applied talents in mechanical majors, which is composed of theoretical teaching platform and practical teaching platform, as shown in Figure 2. Theoretical curriculum innovation teaching platform is committed to building a thick foundation, wide caliber and multi-direction curriculum system. In the curriculum system, pay attention to the infiltration of arts and sciences, and lay a broad foundation. General education courses and compulsory courses for humanities quality should be added to general education elective courses. The professional basic course emphasizes the cultivation and training of students' scientific thinking method, and sets up the interdisciplinary general theory guide course; The elective course of the major direction should meet the needs of the society, condense the characteristics and avoid complexity; Professional optional courses and public optional courses build platforms according to subject categories, reflecting the frontier of disciplines, interdisciplinary and interdisciplinary integration, broadening students' horizons and enhancing adaptability. The practical teaching platform includes three parts: experiment innovation teaching platform, practice link innovation teaching platform and engineering training innovation teaching platform.

The experimental curriculum innovation teaching platform mainly cultivates students' innovative consciousness and comprehensive experimental ability. The school has systematically integrated experimental teaching, established a mechanical and electrical engineering experimental teaching center, and made overall planning for the teaching of all mechanical and electrical experiments. Professional teachers break through the original discipline and curriculum boundaries, adopt a modular structure for hierarchical teaching, separate courses, separate credits, so that mechanical experiments form a unified system. At the same time, comprehensive, design and innovative experiments are increased, and the experimental center is open to students in all aspects.

Build an innovative teaching platform of practice to cultivate students' practical ability in all aspects. Through strengthening the practice of curriculum design and vigorously developing extracurricular science and technology competitions, students' innovative consciousness can be cultivated in many ways.

Through setting innovation credits and comprehensive practice credits, students' comprehensive quality can be improved. The excellent quality of the students is cultivated in the general labor practice and social investigation practice.

The innovative teaching platform of engineering training has been built to improve students' engineering practice ability and comprehensive engineering quality. The engineering training center includes modern machining training center, electrical and electronic training center, innovation practice training center and process equipment and control training center. The center integrates basic training, comprehensive training, extension training and innovative practice training, and becomes a practical teaching base for the purpose of cultivating students' engineering practice ability, cooperative spirit and innovative consciousness.



Figure 2: Innovative talent training system.

In addition, the School of Mechanical and Electrical Engineering of Qiqihar University has also established the Education, Teaching and Practice Center, which has set up innovation research rooms and laboratories such as artificial intelligence, VR virtual simulation, 3D printing, Huiyu, and Explorer to provide comprehensive support for students to participate in scientific research and innovation and entrepreneurship training projects. With the joint efforts of teachers and students, the school has achieved remarkable results in innovation and entrepreneurship projects. More than 230 national, provincial, and school-level projects have been approved, and more than 600 students have presided over and participated in them, ranking in the forefront of the school in terms of quantity and quality.

Through the innovative talent training mode of "integration of industry and education and cooperation between school and enterprise", the School of Mechanical and Electrical Engineering of Qiqihar University actively explores cooperation with government and enterprise, industry and research institutes to build laboratories, practice bases and industrial colleges, and create joint training platforms. In 2019, Qiqihar University and Qizhong CNC Equipment Co., LTD., relying on the School of Mechanical and Electrical Engineering, prepared to establish the "Intelligent Equipment Industry College" jointly built by government, school and enterprise. The aim is to train innovative and application-oriented technical talents in the field of product and system design and manufacturing, technology development, engineering application, production management and technical service for the modernization, industrialization, and intelligent development of Longjiang equipment manufacturing industry, and constantly promote the transformation and upgrading and high-quality development of Longjiang equipment manufacturing industry. The innovative machinery talent training mode can make full use of social school-running resources, strengthen the integration of production and education, school-local cooperation, and improve the collaborative cooperation and co-construction mechanism. At the same time, relying on the regional development advantages of the old industrial base in Northeast China, with the goal of cultivating innovative skilled talents, the construction of "intelligent equipment industry College" can optimize the professional structure and enhance the vitality of running a school. We will improve the collaborative education system with the integration of production and education, promote the reform of the teaching status of "dual subjects" between schools and enterprises, and create a demonstration talent industry college integrating talent training, scientific research, and technological innovation.

6. New Practice Project

The results of teachers' scientific research projects are selected for appropriate content, modified and redeveloped, and experimental projects suitable for engineering students are established. How to transform the results of teachers' scientific research projects into operational experimental projects is a

difficult point in the field of experimental education. According to the content of scientific research and teaching practice, the teachers of the School of Mechanical and Electrical Engineering developed a new type of verification experiment for the static stiffness test of machine tools based on ANSYS. Through the experiment, the students understand the elastic system composed of machine tools - workpieces - tools, the displacement generated by external force and the corresponding test method, which can allow students to better understand the impact of machine tools and equipment on the quality of parts processing in the mechanical manufacturing process. In this project, students are required to master ANSYS analysis software, and carry out simulation analysis on the geometric accuracy of related machine tools. The analysis results are compared and verified with the experimental results. Through the practical operation and analysis of students, the experiment has achieved satisfactory results. Therefore, the research innovation experiment relates to college students' entrepreneurship and innovation plan, undergraduate graduation design and graduate training, and students are encouraged to propose project ideas according to innovative experiments, apply for college students' Innovation plan (SRIT plan) project, and complete their graduation design and thesis in their laboratory because of establishing a good interactive relationship with the instructor.

The actual results show that it is a particularly good direction for teachers to transform the results of scientific research projects into student experiments. The college makes use of the existing resources of the laboratory, establishes a new relevant management system, selects the corresponding scientific research content, integrates the two organically and well, develops a set of local practical and innovative training program for science and engineering students, and trains high-quality science and engineering talents.

7. Conclusion

In the practice of cultivating innovative talents in the new era, the School of Mechanical and Electrical Engineering of Qiqihar University constantly explores and integrates innovative elements into the teaching methods and curriculum systems for students, and cultivates innovative applied talents that are different from traditional teaching. With the major of mechanical design and automation as the educational pilot object, the college has carried out all-round reforms in the personnel training system, curriculum system, teaching methods and means, and students' extracurricular scientific and technological activities. The module of professional knowledge and innovation ability in the talent training program consists of public compulsory course platform, professional basic compulsory course platform, professional module (professional or professional courses), practice link (internship, course design, graduation project, extracurricular science, and technology activities), etc. It mainly cultivates senior applied talents who master mechanical automation and related technologies, master basic theory, basic knowledge and basic methods of analysis and design, and have pioneering and innovative spirit. Through the survey of graduates, most of them could find and solve problems in practical work. In the feedback of actual employers, the satisfaction of graduates reached 98%, and the quality has been significantly improved, as shown in Figure 3.



Figure 3: Overall quality of graduates.

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