Construction Training System of Engineering Innovative Talents in Industry-University-Research Cooperation Based on CDIO

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Abstract: Based on the CDIO engineering education concept, the industry-university-research cooperation will build a training system for engineering and innovative talents in mechanical engineering and materials engineering in local engineering colleges. Strengthen and highlight the engineering design as the main teaching content to improve the engineering innovation ability of talent training programs, innovative the talents training model, establish an engineering innovation practice platform and build up a “double-skilled” teaching team to focus on strengthening students' engineering practice and the ability of designing and innovation.

Introduction

In the construction of an innovative country, the engineering of local undergraduate college shoulder a heavy responsibility of cultivating engineering application-oriented innovative talents for enterprises. Affected by many factors such as the history of education traditional culture and engineering education and the education management system in China for a long time, there is a problem that the engineering weakening can’t be ignored in higher engineering education, which leads to the lack of engineering innovation ability of college students. This problem is manifested in the lack of engineering skills and engineering innovation ability of college students assigned to enterprises. Improving the engineering ability of college students has become a key issue that needs to be solved in local higher engineering colleges[1]. In order to modernize higher engineering education, it must be oriented to engineering, return to engineering, and strengthen engineering innovation ability education. For this reason, the ministry of education launched a timely “Education and Training Program of Excellent Engineer” guided by the demands of industry enterprises, as the background, with the engineering practice in engineering technology as the main line, through close cooperation colleges and universities and industry enterprises, to develop the talent training standards, reform of the personnel training mode, construction of high level engineering education faculty, expanding opening to the outside world, to improve students' engineering quality, engineering design and engineering practice and engineering innovation ability.

CDIO (Conceive- Design-Implement- Operate) engineering education is based on product life cycle from product development to product operation, which has become the mainstream of modern university students' engineering innovation ability[2-4]. This model allows students to learn engineering in an organic way that is initiative, active, and effective.
According to the modern "engineering" education concept, constructing the engineering innovation talent training system and embodying the CDIO engineering education concept and putting it into practice in the talent training program is the primary problem of constructing the engineering innovation talent training system and cultivating the engineering innovation ability. This requires timely construction of the objectives, tasks and implementation plans of Higher Engineering Education in accordance with the characteristics and new trends of modern engineering development. We should improve the engineering innovation ability training to an important position, and study effective ways and methods to achieve the goal. In order to solve the problem of the lack of students' engineering ability and engineering innovation ability in the current higher engineering education, we should design a talent training program and a teaching curriculum system suitable for engineering development, and optimize the teaching content.

Based on the concept of modern engineering education and facing the needs of modern industrial development and economic construction, local engineering colleges should explore the use of industry-university-research cooperation and build an engineering innovation talent training system, which is an important subject for advanced engineering education. This requires us to innovate the talent training model, reorganize the teaching content and links, and strengthen the cultivation of engineering innovation ability. Based on the CDIO engineering education concept, this paper takes the implementation of the education and training plan of the National Excellent Engineers in Machinery and Materials as the opportunity, the industry-university-research cooperation, study and research, and the innovative talent training mode to strengthen and highlight the engineering design, implementation and operation as the main content design talent training program. Reorganize teaching content and links, build a platform for engineering innovation practice, set up a "double-skilled" teaching team, build a training system for engineering innovation talents in local engineering colleges, and focus on cultivating students' engineering practice, design and innovation capabilities, and specializing in local engineering colleges. Talent cultivation provides demonstration and reference.

Teaching Reform Initiatives

Based on the CDIO engineering education concept and the main line of strengthening the professional engineering innovation ability education, we will implement the talent training program based on the implementation of the National Excellent Engineer Education and Training Program for mechanical engineering, materials forming and control engineering, and metal materials engineering, engineering innovation practice platform, teaching team "three constructions", strengthen cooperation between industry, universities and research institutes, innovative talent training mode, focus on achieving "three enhancements" in engineering practice, engineering application and engineering innovation ability. The emphasis is on solving the outstanding problems such as the lack of engineering innovation ability and engineering innovation ability of the students majoring in machinery and materials in local engineering colleges and universities. Implement major teaching reform initiatives:

Optimizing Talent Training Programs and Reorganizing Teaching Content and Links

Based on the CDIO engineering education concept, centering on the main line of strengthening engineering innovation ability education, it focuses on strengthening engineering innovation practice teaching content and simultaneously expanding engineering
theory teaching content. On the basis of investigation and research, we will optimize the training program for professional talents, innovate the talent training model, reorganize the teaching content and links, and strengthen the cultivation of engineering innovation capabilities. Focusing on improving the ability of engineering innovation and implementing the “3+1” talent training model, we need to strengthen the engineering design, implementation and operation of teaching links, optimize the talent training program, and reorganize the teaching content and links, which can be summarized as “one strength and one extension”.

“One strong” refers to the key content of strengthening professional engineering practice teaching, which mainly includes two aspects: professional engineering skills and comprehensive training professional engineering skills mainly include mechanical engineering training, professional comprehensive design experiments and curriculum design. The focus of professional engineering skills is to design and reorganize some design, application and innovation or comprehensive, design experiments and curriculum design that can reflect the major machinery and materials engineering and carry out research on related teaching content and teaching mode. Its purpose is to promote the overall improvement of students' engineering skills. The reorganized teaching content and links include mechanical engineering training, electronic training, professional skills comprehensive training, enterprise post practice and enterprise project design (molding process, equipment design). The comprehensive training mainly includes strengthening the core practical teaching links of professional teaching practice, scientific research training (graduation design (thesis)) and scientific and technological innovation (scientific and technological innovation competition) with the background of large projects. In combination with the "production- research" project, the focus is on the professional teaching practice, graduation project (thesis) and extracurricular science and technology innovation competition, such as the practical teaching content, teaching mode, organizational form, etc. to optimize the design practice, so as to achieve a comprehensive "learning" project to achieve and operational teaching purposes. The reorganized teaching content and links include corporate cognition and production practice, graduation project (thesis), and extracurricular quality.

"One extension" refers to expanding the content of professional engineering theory teaching. In accordance with the guiding ideology of engineering theory teaching, such as synchronous strengthening, highlighting engineering design, realization and operation. In the combination with the latest research results and typical cases of professional “production and research” engineering projects, reorganize and design the teaching content of professional core courses, including some school-enterprise courses, such as “professional introduction, modeling materials and quality control, casting process and casting mold design, foundry planning and design, plastic molding process and mold, plastic processing quality control, mold digital processing technology, arc welding and cutting, welding quality control and management, welding workshop and tooling design”. Research the corresponding teaching mode, compile characteristic teaching textbooks. The research on the relationship between "one strong" and "one extension" should be carried out, and the organic combination of professional engineering theory teaching and practice teaching should be strengthened.
Build an Engineering Innovation Practice Platform to Improve Engineering Innovation Capability

Luoyang is the national advanced equipment manufacturing base and a new material industry base. It has many large and medium-sized backbone enterprises and research institutes, for example, China YTO Group Corporation, CITIC Heavy Industry Machinery Company, China Shipping Heavy Industry 725 Research Institute, Luoyang Nonferrous Metal Processing and Design Research Institute. These companies and our university, has formed a "three kilometer engineering education circle". It is outstanding to carry out higher engineering education in cooperation with industries, universities and research institutes. In addition, the school's material science and engineering disciplines are national defense characteristic disciplines and Henan province's first level key disciplines. It has National United Engineering Laboratory for Advanced Bearing Tribology, National Joint Engineering Research Center for Abrasion Control and Molding of Metal Materials and Henan non-ferrous metal Common Technology Collaborative Innovation Center and other national and provincial key laboratories (engineer Center) etc. A platform for engineering education and scientific research with excellent disciplines has been constructed.

Depending on the advantages of professional disciplines base, scientific research platform and the outstanding characteristics of the cooperation between industries, universities and research institutes, the software and hardware platform of engineering innovation practice are built. Through excavating and optimizing professional disciplines bases, research platforms and relying on enterprise resources, we can meet the teaching needs of improving professional engineering innovation ability to the greatest extent, and increase the "engineering" training to improve professional engineering innovation ability. We construct the engineering innovation practice teaching classroom which combines inside and outside the class, explore the effective teaching mode and method, and highlight the cultivation of engineering innovation ability. According to the plan of optimizing talent training, taking professional discipline base, scientific research platform and relying on enterprises as the main support, the cooperation between industry-university-research, the construction of engineering innovation practice platform and the improvement of innovation ability can be summarized as "one dig one mention".

“One digging" refers to excavating and optimizing existing professional discipline bases, scientific research platforms, relying on enterprise resources, maximizing the teaching needs of strengthening professional engineering innovation ability training from the aspects of software and hardware, and actually increasing "engineering" training and improving professionalism. For example, it is represented by large-scale key enterprises such as China YTO Group Corporation, and CITIC Heavy Industry Machinery Company, supplemented by national, provincial and ministerial key laboratories (engineering centers) and on-campus production and research bases. Focusing on the main lines of professional materials, techniques and equipment, breaking the boundaries of professional direction, and relying on rich internal and external teaching resources to achieve knowledge intersection and integration, forming analysis, design, process, manufacturing and testing, integration and development as the main line. The engineering education platform under the background of materials science and engineering, realize the direct service engineering education of production, scientific research and enterprise equipment, which make students understand and be familiar with modern production technology and equipment, production management, product quality control, testing, etc. Students' professional skills are significantly improved.
To cultivate students' engineering practice ability and improve engineering comprehensiveness, the proportion of design experiments, the improvement of graduation project (thesis), course design and other practical links from the proportion of engineering production: strengthen the teaching site, research on innovative engineering practice teaching mode; increase the openness of engineering innovation practice platform; build engineering and technical personnel to participate in the whole process of practice Effective teaching mechanism (such as engineers entering the campus): professional training and professional certification.

"One mention" refers to the construction of engineering innovation practice teaching classroom based on CDIO engineering education concept, which combines specialty with outside class, and explores effective teaching mode and method. To strengthen and highlight the cultivation of engineering innovation ability, and improves engineering teaching level in an all-round way. Such as bringing engineering innovation activities of college students into professional quality education credits, strengthening the construction of extracurricular engineering innovation laboratories for college students, encouraging college students to participate in SRTP engineering research projects and so on.

In recent years, it has jointly established the National Engineering Practice Education Center for Heavy Equipment and the National College Student Practice Education Base with CITIC Heavy Industry Machinery Co., LTD; carried out the engineering practice teaching reform in line with international standards, and started the international welding engineer for materials forming and control engineering (IWE) training, etc.; material molding and control engineering, metal materials engineering, national-level specialty major passed the engineering education professional certification; won the first prize of the National College Student Engineering Training Comprehensive Ability Competition, the National Welding University Student Innovation Competition, the Chinese University Student Casting Design Competition and other provinces 39 ministerial awards.

Improve Teachers' Engineering Innovation Ability and form a "Double-type" Teaching Team

Formulate a professional engineer construction plan based on the CDIO engineering education concept; adopt the "going out, please come in" approach, strengthen the teacher engineering innovation ability, and establish a "double-type" teaching team. On the one hand, formulate incentive policies, support and encourage young teachers to engage in engineering project development, technological transformation, and strengthen engineering skills training and on-the-job training; on the other hand, employ enterprise experts and technicians to train teachers on regular engineering theory and technical exchanges to form a long effective mechanism. In the past three years, young teachers have participated in engineering ability training, hired enterprise experts and technicians to conduct engineering theory training and technical exchanges. Two teachers obtained the provincial-level teaching masters and two teachers received the school-level teaching masters. Simultaneously carry out research on the teaching mode, methods and means of engineering innovation ability education, and adapt to the requirements of the era of engineering innovation education.
Teaching Reform Effectiveness

The research results of this project have been implemented in 18 classes of 576 people in the School of Material Molding and Control Engineering and Metal Materials Engineering, the main teaching reform results:

**Building a CDIO-based Engineering Innovation Talent Training System**

The research is based on CDIO's teaching organization form to improve engineering innovation ability, and builds CDIO-based engineering innovation talent training system for machinery and materials.

**A Large Platform for Engineering Education has been Set Up, and Students' Engineering Innovation Ability has been Significantly Improved.**

Cooperated with CITIC Heavy Industry Machinery Co., LTD. to build a national engineering practice education center and a national university student practice education base, built a large platform for engineering education, and improved the teaching operation management; Constructed professional four-level, eight-module engineering practice education system The ability to innovate has improved significantly.

**A Team of “Double-skilled” Teachers was Brought Together.**

The training of the "double-skilled" teaching team under the CDIO engineering education model has achieved outstanding results. one awarded the member of the Teaching Steering Committee of the Ministry of Education, two awarded provincial teachers, two awarded Central Plain scholars, two awarded special professors from Henan Province, There are four provincial education scholars and innovation team and Henan innovative science technology team.

**Conclusion**

Based on the CDIO engineering education concept, the industry-university-research institute cooperate to build a professional engineering innovation talent training system of local engineering institutes, reform the teaching content through innovative talent training mode, build an engineering innovation practice platform, and form a teaching team to comprehensively strengthen student engineering practice, design and innovation ability.

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