Education Discussion on the Undergraduates in Major of Process Equipment & Control Engineering under the Background of New Engineering Disciplines

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Abstract. The undergraduates in major of Process Equipment & Control Engineering should possess better professional quality to meet the development requirement under the new industry era. According to the development trend and talent requirement of process industry, we discussed the construction route of the curriculum plan system under the background of new engineering disciplines, provided the reforming contents of the curriculum, and proposed some education measures on strengthening the creative abilities and the intelligent consciousness of the students.

Introduction

Engineering education is closely linked to industrial development and they are supported each other. The concept of “New Engineering Disciplines” [1] was first proposed in 2016 in order to actively respond to the new scientific revolution and industrial transformation, support the service innovation and development, and sustain the series of national strategies such as "Made in China 2025" plan; This concept is continuously promoted and is promising in colleges and universities in China through two years of theoretical deduction and practice test. The connotation of New Engineering Disciplines is based on China's engineering education reform objectives which include the new requirements of national strategic development, the new situation of international competition, and the new requirements of moral education [2]. So, New Engineering Disciplines construction is guided by the macro-aim of coping with change and shaping the future; and its main construction methods contain inheritance and innovation, cross and integration, coordination and sharing; Its practice objective is to cultivate diversified and innovative outstanding engineering talents for the future; And its construction contents have the characteristics of strategic, innovative, systematic and open. New Engineering Disciplines construction will advance in gradual steps, and it is necessary to focus on three tasks of learning and teaching, practice and innovation, localization and internationalization. The development of the emerging industries and new economies need the high-quality composite talents with strong engineering practice ability, strong innovation ability and international competitiveness. Promoting the construction of New Engineering Disciplines in China is an inevitable requirement as to implement the innovation-driven development strategy, promote the supply-side structural reform, and realize the transformation and upgrading of the industrial structure. It also provides a rare historical opportunity for the universities to explore new application-oriented talent training models, and promote the integration of production and education during the stages of the transformation and development.

Process Equipment & Control Engineering is a major with Chinese characteristics. The learning area of the undergraduates in this major is very extensive including the basic theories of chemical engineering, mechanical engineering and control engineering. The students should master the basic concepts, basic theories and basic methods of process equipment design, and have the basic qualities of working in process industry; they can use basic theories for research, development, manufacturing, and production organization management. The graduates are expected to become high-quality talents in the process industries including petroleum, chemical, steel, nonferrous metals, and building.
Under the background of new engineering era, the Process Equipment & Control Engineering college students should have higher professional quality to adapt to the development of the industry. Therefore, the specialty educators should deeply analyze the industry development and professional talent requirements in the new era, explore the curriculum system construction route, and propose curriculum content reform and innovation measures.

**Industry Development Trends and Talent Requirements in the New Industrial Era**

With the rapid development of science and technology, especially the new progress of the information technology, higher requirements have been set on traditional manufacturing technologies. The internet technology has strong cross-border penetration capability and also provides a superior information technology platform for industry transformation and innovation.

China has been the largest process industry manufacturing country in the world, but there is still a big gap compared with the international advanced level in the overall efficiency of manufacturing. It is the overall trend that the development of the process industry should be further coordinated with environment, energy and resources.

In recent years, the traditional process manufacturing industries such as petrochemical and steel industries have been facing bottlenecks of upgrading and transformation. The existing manufacturing models have some problems that need to be solved urgently. In summary, the efficiency of integration and regulation in the fund flow, material flow, energy flow and information flow should be improved. In the actual operation level, it corresponds to the information perception, management decision, production operation, energy efficiency security and other links.

The advancement of process industry manufacturing in the engineering technology level is to achieve digital, intelligent, network and automation; and in the enterprise production and manufacturing level, it is to achieve agility, efficiency, green and security.

At present, innovation has been the main driving force for the development of global economy. Engineering and technical personnel need to have certain comprehensive innovation capabilities, and have the potential to apply technologies unknown, and to solve the new problems. The talents engaged in the process manufacturing industry should establish the intelligence consciousness in addition to the engineering, system, economic, quality, environment, and safety consciousness.

The intelligent consciousness showed in the professional jobs of research, design, development and management, is to understand the modern information technology, such as big data, cloud computing, mobile network communication and human-computer interaction. The professional Engineers can apply modern information technology to optimize the objective and meet the overall requirements of the process industry with high efficiency, green and intelligent, and maximize the economic and social benefits of the enterprise.

**The Construction Route of the Curriculum System for Process Equipment & Control Engineering under the Background of “New Engineering Disciplines”**

The teaching reform of the current curriculum system should be carried out, in order to meet the training requirements of talents in the new engineering background. And the educators should optimize, transform, and upgrade the traditional curriculum system, and focus on the interdisciplinary integration.

We can integrate and reorganize the basic curriculum system to improve students' learning efficiency and effectiveness, and provide more cross-disciplinary elective courses to the students. We should pay more attention to enhancing the students' comprehensive qualities including critical thinking, design imagination, digital application, engineering management, engineering ethics, and cross-cultural communication. At the same time both of the professional and free combination courses can be allowed for the students to choose.

Benefiting from the teaching reform experiences such as “Top-notch Program”, we could explore more individualized cultivation mode, encourage students to display talent characteristics, institute the independent design training programs and self-professional procedures, and provide students
with necessary support conditions. Also we could provide the assurance mechanism which is based on the student evaluation for the teaching quality, and promote continuously improvement of the curriculum system and training program.

We can construct the special curriculum system, training mode and supporting system for the undergraduate linked to the graduate through in-depth analyze of the learning objectives and learning achievement evaluation in undergraduate, master, and doctor stage. So we can establish the mutual recognition mode of the undergraduate senior and postgraduate courses, and implement the independent and diversity training plan based on the corresponding admission conditions. The students are encouraged to choose their tutors and research interests during the leaning of professional basic courses, so that they can design and grow under the guidance of their tutors.

With the goal of training professional engineers, the practical teaching system can include four modules covering "engineering basic training, professional basic training, comprehensive application practice and realistic engineering scene simulation training". Also there are "six-in-one" contents in the system including in-class experiment, comprehensive experiment week, design linked to the curriculum, production practice, graduation thesis, and innovation project.

The Reform of Professional Curriculum Content Aimed to Cultivate the Abilities of the Innovative Thinking and Intelligent Awareness

In the process of transformation and upgrading of the process manufacturing industry, a large number of discoverers with innovative ideas, rather than followers, are needed. The cultivating goal of innovative ability is that students should have the spirit of finding problems and active exploration. In the "Process Equipment & Control Engineering" training procedures and methods, more attention should be paid to cultivating students' ability to ask questions, and to find problems. The educators can pay more attention to guiding students to explore their own cognition, enhance comprehension, doubt the knowns, and criticize the opinion, so that the students get the information and ability and can achieve some breakthroughs and creations.

The professional foundation courses for the "Process Equipment & Control Engineering" need to be continuously updated and adjusted according to the technical progress. Especially for the combination with intelligent technology, the related course contents can be supplemented by the cross-infiltration and application of intelligence technology.

For example, during the teaching content of "process equipment selection" in the professional basic course "engineering materials", we can supply the establishment of material expert data and intelligent application cases combined with Internet technology and intelligent technology; in the course "Process Fluid Machinery", we can add the introduction content about fault intelligent diagnosis application according to the technology developing. In the course "Process equipment control engineering", we can provide the basis of intelligent technology, combining with control process to implement strategy and practical application etc., In the professional course "Process Equipment Design", we can supplement the content of intelligent optimization design application cases.

Strengthening the Teaching Procedures Aimed to Cultivate Innovation Ability and Intelligent Consciousness

The cultivation of innovative thinking and intelligent awareness can be proceeded during the whole university training stage.

For example, we can organize the activities such as “Professor Day” in each semester to the students majored in "Process Equipment & Control Engineering", in order to induce the students understand the frontier issues of the discipline development; Through the series seminars about the innovation competition and achievement exhibitions, we can improve students' cognitive level to innovation. The innovation laboratory can be provided to the undergraduates, and the students are
encouraged to join the professional teacher-directed innovation team according to their own interests and participate in various innovation competitions. On summer vacation, we can organize students to visit advanced enterprises for engineering practice activities; through the activities, they may understand the advanced technology of modern process manufacturing, recognize the shortcomings of present technologies, expand their professional knowledge, open up the space for students’ thinking and imagination, and improve students' ability of innovation and practice.

During the practice teaching procedures, especially the professional teaching, curriculum design, and graduation design, we should strengthen the application of intelligent technology. For example, the laboratory can be adjusted and planned for the application of "Internet+" and intelligent technology, and the open and intelligent laboratory can be used by the students. Students can participate in some of the construction contents while the laboratory is building. The topics and contents of graduation design with combination of the production practice and scientific research are preferred. For some types of topics, the teachers are encouraged to combine modern intelligent technology to expand the graduation design content.

**Summary**

In order to meet the development needs of the process manufacturing industry, the professional talents cultivated by higher education institutions should keep up with the trend of the new era, and the educators should be not limited to the rigid teaching pattern, not fixed to the traditional teaching contents, and not limited to inflexible teaching strategy.

At the same time, the educators should constantly improve their own abilities, to help their students to obtain higher development, and to strive to cultivate more excellent talents for the new era.

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**References**


