

## Research Article

# Research on Engineering Education Mode Based on CDIO Concept: Take Food Machinery Major as an Example

Lihua Wang, Xiaoqiang Wu and Li Li

College of Mechanical Engineering, Inner Mongolia University for the Nationalities, Tongliao, Inner Mongolia 028000, China

**Abstract:** For cultivating the high quality engineering and technical personnel, all the countries in the world are vigorously promote the reform of engineering education, make oneself keep a favorable position in the international competition, the concept of CDIO teaching for the reform of engineering education provides an important way, has become the focus of attention of the education field. In order to solve the problem of the existing engineering education of our country is the lack of creativity, team cooperation, put forward a partnership model of engineering education based on CDIO and from the curriculum, teaching, laboratory and evaluation four aspects of the model are discussed in detail; at the same time, take Inner Mongolia University for the Nationalities food machinery major engineering education model for example, effectiveness of the proposed method is proved to provide reference for engineering education reform.

**Keywords:** CDIO, engineering education, food machinery

## INTRODUCTION

The engineering and technical personnel have the irreplaceable function to the economic and social development, the quality of the engineering technology talents directly decides the core competitiveness of a country (Temple, 2005). At present, all the countries in the world especially developed countries are vigorously promote the reform and development of engineering education, in order to cultivate more high quality engineering and technical personnel, make oneself keep a favorable position in international competition.

China's engineering education model is not perfect, there are still many shortcomings: First, education heavy theory, light practice, teachers generally lack experience in the industry; second, the stiff curriculum, lack of knowledge integration and cross, lack of innovation education; third, the lack of interest in Engineering Science and technology and innovation culture, lack of professional ability and professional morality education (Xie and Cao, 2015). This situation leads to the lack of innovation ability of engineering personnel, lack of ability to think and solve problems, teamwork consciousness and interpersonal communication skills are not strong. Therefore, the renewal education idea is the current engineering education reform the first important business.

CDIO as the international forefront of philosophy of engineering education, which emphasizes students

actively, practice, course the organic connection between the learning ways to obtain engineering capability, concerned about the students engineering basic knowledge, personal ability, interpersonal skills and team systems engineering capability of coordinated development. CDIO Engineering Education Model in China will become China's culture is an effective way for innovative engineering talents, provides a good framework and idea for us, it is worth our in-depth exploration and research. This study based on the advanced the concept of CDIO Engineering Education, in view of the current our country actual engineering education proposed partnership model of engineering education based on CDIO and from the curriculum, teaching, laboratory and evaluation four aspects of the model are detailed analysis and to Inner Mongolia University for the Nationalities engineering education mode for example further said based on CDIO engineering cooperation education mode of the implementation of the process.

## ANALYSIS OF ENGINEERING EDUCATION IDEA

**Collaboration of production science:** Production and learning cooperation, a school and industry or enterprise in the process of teaching, production work together to foster talent education model. It makes full use of the resources of schools and enterprises, complementary

**Corresponding Author:** Lihua Wang, College of Mechanical Engineering, Inner Mongolia University for the Nationalities, Tongliao, Inner Mongolia 028000, China

This work is licensed under a Creative Commons Attribution 4.0 International License (URL: <http://creativecommons.org/licenses/by/4.0/>).

advantages, mutual benefit and win-win together for social and enterprises to train a large number of high skilled personnel. The cooperation of production and education is an important way to promote the combination of education and production practice and it is the inevitable trend of the development of modern higher vocational education (Hu and Ren, 2010). Production study combination for higher vocational colleges to deepen reform of education and teaching, to improve the level of talent of professional skills and strengthen the construction of teacher's team, to solve the problem of employment of students, to enhance the service ability of the society, has important theoretical value:

- The cooperation of production and science is advantageous to improving the quality of the running of higher vocational colleges. The education of higher vocational colleges is different from the education of the higher school, which emphasizes the cultivation of students' practical skills. Through the cooperation of production and learning so that students have the opportunity to practice more and improve their skill level and industry university cooperation can also so that the combination of theory and practice, improve the employment rate of higher vocational colleges, greatly improve the quality and level of vocational school.
- The cooperation of industry and science is advantageous to the enterprise to the talented person. Due to the enterprises to participate in the talent training plan formulation, curriculum development and teaching practice guidance, assessment, etc. a series of activities, so the students in Higher Vocational Colleges and universities to cultivate more in line with the enterprise standard, to meet the enterprise demand for talents.
- The cooperation of industry and universities is beneficial to the construction of teachers in higher vocational colleges. Production cooperation so that teachers have more opportunities to the enterprise to post exercise, to understand the actual production process, production process and production technology level, to help teachers grow into the combination of theoretical knowledge and practical skills in the "double teacher type" teachers.

**CDIO teaching idea:** CDIO stands for the conception, design, implementation and operation, which concept includes the definition of demand and technology, consider the strategy, rules and regulations, development concept framework and business case; design main concern to create a design, which describes the implementation is draft plan and operational rules; refers to the design phase of the plan to transform it into a real product, including manufacturing, compile, test and verify; operation is refers to the use of product

realization to the desired value, including maintenance and disposal system.

CDIO Engineering Education model is the latest achievements of international engineering education reform in recent years, is a practice and theory education combining the education idea, it is the whole life cycle of products, processes and systems for background of the philosophy of education as the carrier, the CDIO syllabus and standard based, lets the student to the organic connection between the active and practical courses to study engineering. CDIO training outline of engineering graduate capability is divided into engineering basic knowledge, personal ability, interpersonal skills and team systems engineering capability four level, the requirements of the outline comprehensive training to enable students in the four aspects to achieve the intended target.

### THE EDUCATION MODE OF THE COOPERATIVE ENGINEERING BASED ON CDIO

Based on CDIO concept learning partnership model of engineering education to outstanding school and enterprise talent curriculum setup, training target, process management and result evaluation, participation, help the students to get engaged in the engineering profession the technical. The mode of education from the four aspects of the curriculum, teaching, laboratory and storytelling on the life cycles of products, systems engineering and CDIO each link to strengthen the industry participation, play the industry in the aspect of educational practice guidance advantages, so as to achieve a win-win situation and business schools, engineering education has a positive role in promoting (Wang and Cheng, 2009; Shen and Smith, 2009). Figure 1 shows the learning assessment process for the teaching mode of the CDIO concept.

**Course:** Carry on the reform to the course: first, in the course of increase the design and construction of the project; the second modify the teaching contents and methods, in order to achieve the goal of learning of students; third, create the challenging experiment, let the students to design, construction and operation of a system.

**Teaching:** In the new mode of education, teachers mainly by teachers in Colleges and universities and enterprises engineers, seminar style teaching method into the project based courses and lectures for the form of curriculum, let the students try different engineering roles in different learning environments.

**Laboratory:** The laboratory is provided by the co investment of the students in the laboratory or the enterprise is individually provided and provided to the students in the environment of the study and operation in the experiment. The activities in the laboratory can

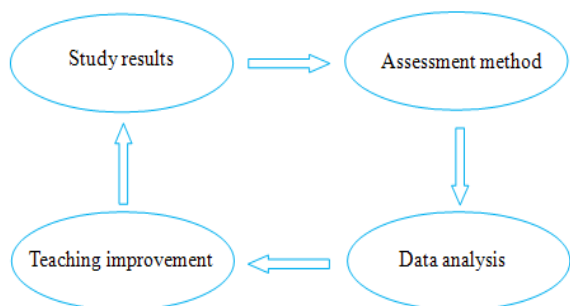


Fig. 1: The study and evaluation of the teaching mode of CDIO concept

promote the students to "design a realization" skills and then promote their learning for subject knowledge, encourage students to find and test. The existence of the laboratory made the engineering education use the new method possible and enhanced the students' enthusiasm for study and expanded the interactive communication between the teachers and students.

**Assessment:** Learning outcome assessment by the school and industry participation, mainly including four aspects: a detailed description of the learning outcomes; list and curriculum evaluation method, learning outcomes and teaching methods, use a variety of assessment methods on students' performance evaluation, according to the final evaluation results to improve the curriculum and teaching methods, until the improved the learning environment.

### CASE ANALYSIS

Take Inner Mongolia University for the Nationalities food machinery professional engineering education model for example: the school with oneself is actual, reference CDIO philosophy of engineering education, with the industry standard as an engineer training direction, adopt the cooperation of production and learning as the main way to cultivate education mode. The prominent to "learning by doing" as the main means of teaching, in the conception, design, implementation, operation of the four key links of reinforcement emphasis on professional learning and

quality education, theory and practice, learning to combine the cultivation of thinking ability and innovation, focus on improving the student's skills and ability, judgment and attitude. In the teaching content, taking into account the ability to cultivate and subject knowledge, modular curriculum, to expand the knowledge and deepen the professional ability to provide different options for students. The educational model is shown in Fig. 2.

**Course setting:** To the food packaging machine as a teaching platform, in the packaging machine design, production, assembly, operation process refines the conception, design, implementation, four processes are needed for the operation, based on engineering capability cultivation as a set of curriculum design. Set includes hydraulic transmission, hydraulic parts assembly, metal craft, electrical control, PLC design, mechanical drawing, 6 professional core courses, each course is divided into 3 levels of difficulty, to meet the needs of student development and enterprise talent reserve demand.

**Teaching and experiment:** In the course of teaching and experiment of each course, school and enterprise are the main purpose of improving students' key ability in CDIO four links. Specific steps are as follows:

- In the course of teaching, the students should provide the theoretical knowledge and the materials needed to improve the students' theoretical learning level.
- The ability of improving students' analysis and problem solving based on the teaching method of "dry middle school". Students are required to study the basic theory of the basis, to play imagination, independent design of the implementation of the task, to cultivate students with ideas, design and operation of the program.
- In the students after the completion of the design scheme, design scheme of teachers to students do evaluation, only students to check the design scheme is reliable, change traditional teaching in the process of excessive intervention, students do

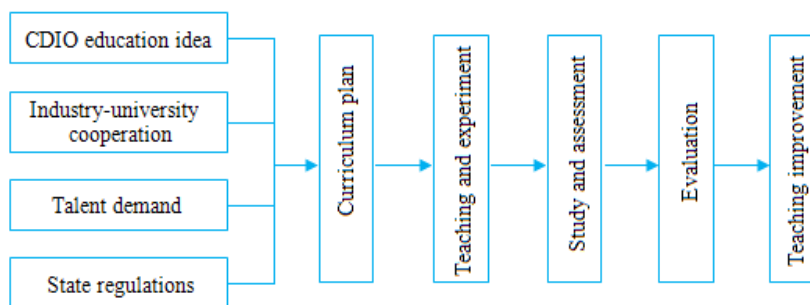


Fig. 2: Engineering education model of Inner Mongolia University for the nationalities

not have independent thinking power of teaching mode, students through practical operation has proved that the design scheme is feasible, in the operation process of accumulation of experience, forming ability.

**Assessment improvements:** In the assessment phase, the team of three stages of the production of cooperative teaching arrangements for the assessment of students learning outcomes:

- The assessment method and assessment of the learning outcomes and teaching methods for the course arrangement
- Phased assessment of the results of the students' learning and the teaching method of the teacher in accordance with the evaluation method
- Improving teaching based on the results of the assessment.

### CONCLUSION

CDIO provide a good framework and ideas for the reform of engineering education, through the study of CDIO philosophy of engineering education, finds out the problems existing in the engineering education reform in our country, put forward a partnership model of engineering education based on CDIO and from the curriculum, teaching, laboratory and evaluation four aspects were analyzed in detail. Finally, the effectiveness of the proposed model is demonstrated by examples to provide reference for engineering education reform in China.

### ACKNOWLEDGMENT

This study is supported by National machinery/foundation course teaching steering committee of Engineering training teaching steering committee/Education scientific research project (JJ-GX-jy201422) and the scientific research fund project of Inner Mongolia University for the Nationalities (NMDYB2013044) and Inner Mongolia University for the Nationalities (NMDPY1406) and Inner Mongolia University for the Nationalities for teaching and research topics (MDZD201510).

### REFERENCES

- Hu, Z. and S. Ren, 2010. Program optimization based on CDIO-CMM for undergraduate education in engineering [J]. *Res. High. Educ. Eng.*, 2010(4): 20-28.
- Shen, Y. and S. Smith, 2009. Product Redesign Using TRIZ and Contradictive Information from the Taguchi Method. In: Chou, S.Y., A. Trappey, J. Pokojski and S. Smith (Eds.), *Global Perspective for Competitive Enterprise, Economy and Ecology*. Springer London, London, pp: 487-497.
- Temple, J., 2005. Growth and wage inequality in a dual economy [J]. *B. Econ. Res.*, 57(2): 145-169.
- Wang, T. and W. Cheng, 2009. Study and practice on innovative engineering talent cultivation model based on CDIO [J]. *Res. High. Educ. Eng.*, 2009(11): 25-31.
- Xie, A.J. and J.Y. Cao, 2015. Construction of new teaching mode of "Five-in-one" in basic chemistry experiment based on the perspective of CDIO [J]. *Res. Teach.*, 38(1): 98-101.