The Thinking of CDIO Engineering Education Mode

LI Huai, HE Wenting
Hebei University of Engineering, Handan, P.R.China, 056038
hblihuai@yahoo.com.cn

Abstract: CDIO model is a kind of new educational model of higher engineering education at present, whose goal is to train international engineers. The CDIO model is not only a kind of implementation programs of engineering education, but also a philosophy of engineering education. We can refer to CDIO model in China's higher engineering education practice, but also we must combine with the characteristics of our society, every school and each specialized subject. Step up to explore both in theory and practice, build effective new model of engineering education

Keywords: CDIO, higher engineering education, major engineering idea, comprehensive quality, experiential Learning

1 Introduction

With the rapid development of industrial property and science and technology, more and more countries in the world pay attention to engineering education. But China's current higher engineering education model in large part have the problem of emphasizing the theory but lighting practice, emphasizing on individual academic ability but ignoring the spirit of team work and attentioniong to knowledge learning but ignoring capacity-building of innovation. There is still widespread gap between the engineering education and capacity requirements for engineers of industry. Since October 2000, education reform and research team of engineering education which composed of four Universities, including Massachusetts Institute of Technology of United States and Swedish Royal Institute of Technology, sustainable development and advocacy of the new CDIO idea, that is engineering education idea (Conceive --- Design --- Implement --- Operate), and CDIO idea with the goal of capacity-building. And in 2004, the CDIO international cooperative organization was established. At present, there are already more than 50 universities have joined the CDIO co-operation program, including Denmark, Finland, France, South Africa, Singapore, China and other countries, and jointly continue to develop and improve the CDIO teaching. CDIO approach focuses on integrated innovation ability, and coordinated development with social environment; at the same time, more concerned with engineering practice to enhance practical ability of students. It has an important instructive significance in China's current reform exploration of higher engineering education.

2 The Characteristics of CDIO Engineering Education Model

2.1 The concept of large engineering.
CDIO model interprets engineering from a broad perspective. In this perspective, engineering no longer limited with technology, engineering combined closely with social development, market discipline, management model, history and culture, values, psychological, aesthetic and so on. CDIO model constructs the curriculum system based on such a large engineering concept. The CDIO model is not just to train technical experts, but also to train engineers who can engaged in system development of product under the modern organization and management models and market operation mechanism, but also the founder of engineering talent with a sense of social responsibility whose purpose is based on human well-being and social civilization. CDIO model is training engineering talent from a system macro perspective. The training objectives, the curriculum system and teaching mode are all under the command of such concept.

2.2 Focus on training the overall quality.
CDIO model is researched and perfected through surveys and practice for enterprise and stakeholder by
MIT for a few years. According to social and industrial needs, MIT has developed an integrated system of CDIO training objectives. CDIO focus not only on professional knowledge and practical ability, but also pay attention to social ability such as co-operation, and other comprehensive ability such as problem solving, critical innovation, systems thinking, planning and so on, as well as self-strengthening ability such as lifelong learning, etc., professional attitude such as a good professional ethics. CDIO provides students with a learning experience and context so that students can develop personal abilities, interpersonal skills, as well as system concept, design, implementation, operational abilities of product while learning academic knowledge.

2.3 Close ties with industry.
CDIO education model is lead by industry demand, its teaching contents and methods are synchronized with industrial development, and its theory and practice are combined with each other. Its goal is to cultivate qualified engineering talent who adapt to industrial development. CDIO Standard refer to the needs of the industrial sector directly. Its 4 links: conceive, design, implementation, operation, is a product development process of the business in a real social environment. CDIO model calls for students to have the ability of developing system of product through this four links. And it also requires students to carry out two or more design practice, one for primary, one for high-level, project-oriented, to enable students to combine academic knowledge with real development practice of the product. At the same time CDIO model requires teachers to have a good engineering practice ability to pace the basis of technical innovation and constantly updated engineering capabilities. DIO model is the engineering education mode which fused with industrial development and synchronized with industrial development.

2.4 Systematical reformation of engineering education.
CDIO education is a systematical reform of engineering education. There are 12 standard to assess CDIO educational model, is integrate system reform of engineering education covering engineering education concept, training objectives, curriculum system, teaching model, experimental and training conditions, teacher standards, student assessment methods, professional assessment and other factors. Implementation of the CDIO education model needs school, society and industry cooperate closely, we need all aspects and all various departments of the school to support the model actively, and need a series of specific links from program to the implementation and evaluation, it is a complex system project.

3 Thoughts of CDIO Higher Engineering Education Reform in China

CDIO model has good inspiration and reference for engineering education in China, and has created a great response for engineering education in China, in recent years, Shantou University, Tsinghua University and other colleges and universities take the lead on the CDIO engineering education reform, and achieved good results. Learn from CDIO engineering education reform model, our colleges and universities can refer to CDIO model in practice, but also must implement engineering education combine with the characteristics of our society and the different characteristics of each school.

3.1 Advocacy of the CDIO concept of engineering education.
China's colleges and universities should make "concept - design - implementation - operation" as the background of higher engineering education, and train engineering students with knowledge, ability and quality of surviving and growing in the modern engineering environment; try to make "project implementation" as the organizing principle of engineering practice education and develop students communication skills and control awareness and capacity of multi-disciplinary and large-scale systems; make the relationship between teachers and students from leaning knowledge from teachers extended to interactive learning of teachers and students which based on problem-solving, guide the students from mainly succeed knowledge to active learning of exploring the unknown. CDIO-based personnel training of engineering education determines the three overall objectives: Engineering education should always
emphasis on the foundation of technology; train students to have the capabilities of taking the lead in the creation and operation of new products, new processes and new system; train students to understand the importance, strategic as well as the impact on society of science and technology development.

3.2 Plan and adjustment the subject curriculum based on the modern engineering environment.
Planning and integration of various courses, build a new curriculum system based on the CDIO and arounded the subject to organize. According to training objectives, try to design and plan training programs, curriculum and teaching requirements learn from CD IO standards. In revised undergraduate training programs, using the discipline of system-based, incorporating the needs of the professional system, engineering subject education of students will be placed in the context of modern engineering in the respect of theory education and practice education, the cultivation of modern engineers will be combined with students’ professional basic knowledge learning, and bring theory curriculum and experiment curriculum into education construction. Through curriculum adjustments of the basic courses, professional basic courses and specialized courses, combined teaching links such as experimental course, production internships, graduate internships and graduate design, focusing on teaching engineering technical knowledge principles and technical reasoning, lay a solid basis for students in professional knowledge; emphasis on introduction of modern engineering science and technological development, as well as introduction of multi-disciplinary engineering application knowledge, so that students can understand a wider basic principles of scientific; focus on introducing engineering products and life-cycle of systems, cultivate students’ capacity of "concept - design - implementation - operation". At the same time, streamlining the number of hours to ensure that students can have more self-study time; make students to become more involved in research projects of university students, seminar courses of university students, and scientific and technological activities, learning, pay attention to guiding students to develop ability of active learning, team communication collaboration and system control.

3.3 The establishment of teaching and learning environment of experiential learning.
To create engineering practice theories and experimental courses, set up project plan of "Students Technology Innovation Fund" declared with the form of student group, organize study and discussions activities under the relaxed and happy atmosphere, create theoretical and practical guide courses related to scientific and technological innovation activities of university students, create all kinds of training seminars of science and technology competition, organize teams of students to participate in all kinds of students at all levels of extra-curricular science and technology competitions, also provide display and communication environment for students’ learning and results. Through teaching and learning environment design of CDIO activities, we can guide students to experience the whole process of learning of developing products / systems "concept - design - implementation -- operation " through effective communication with others in the context of modern engineering activities and team collaboration, in order to cultivate students with team spirit and communication skills as well as awareness and ability of control new products, new processes and new systems in the modern engineering environment.

3.4 The implementation of new "teaching" and "learning" approach of active learning and comprehensive learning.
Education Research confirmed: active learning significantly increased students’ learning initiative, and encourage students to become more involved in the exchange of ideas and academic seminars and other activities, the students’ learning activity will be further stimulated. CDIO approach encourages students to active learning and integrated learning, to carry out academic research activities, to promote student to learn products, production processes and systems construction skills, and to learn skills of exchanges and cooperation with others. In this process, the instructor will adapt to a variety of active learning and integrated learning methods, lectures-type, engineering-type courses or experiential learning, such as learning, simulations and case studies based on project. Active learning and integrated learning will enable students to have the opportunity to take a variety of means acting on the increasing complexity of
learning, and also enable teachers to more effectively help students to learn academic knowledge, train students to think problem systemly in an atmosphere of engineering practice, reinforce the student's technical foundation, train learning ability of students and train students to get the experience of learning experiences and interpersonal relations in teamwork, share the fun of learning with peers to meet the needs of educating people of engineering.

3.5 Implementation of non-traditional methods of learning evaluation.
Many teachers used to evaluate student learning in traditional methods, namely, teaching test, is by a rational way making some kind of test function, such as test basic knowledge, basic steps (procedures), to produce evaluation proficiency of a certain part of the course knowledge. However, whether students can really master a wide variety of complex knowledge and skills, whether it can reach a level, which for engineering students, are very important. CDIO ideas promote the "real judge". because the engineering education needs to imitate the real world, but this world which is the students will be facing after leaving the educational courses, many modern engineering environment required a high level of awareness, it can not be tested or predicted only in the traditional Teaching test methods. Traditional learning evaluation method is still important, combined with exploring non-traditional learning evaluation, including the use of students’ self-evaluation, peer evaluation, oral tests, learning records, display works, published papers and so on. Learning evaluation is not an isolated behavior, and learning evaluation results should be timely feedback, and used to adjust the curricula and teaching methods.

4. Conclusion
CDIO model itself is summed up through empirical research and practical exploration, it's worth more reflected in its ideology, philosophy and methods, different types of schools can draw inspiration from the CDIO model, but the CDIO model should not be fixed and immutable pattern, but to build a flexible and effective training model of CDIO based on the diverse needs of the community, the location and characteristics of schools, the characteristics of the students. CDIO model provides a good framework and philosophy for engineering education reform, we should make in-depth exploration both in theory and practice according to different social and cultural, the characteristics of industrial development, the characteristics of each school, and students in different situations, and build a new model for engineering education with Chinese characteristics.

References