Discussion on innovative talent cultivating mode Based on CDIO Concept

Gengyi Xiao

Department of Mathematics and Computer Technology, Guilin Normal College Guilin, China

xiao6169@126.com

Abstract

CDIO concept is new achievement in international engineering education reform in recent years. It advocates learning by doing, industry cooperation and internationalization, has strong guidance in engineering teaching reform. Many universities around the world implemented CDIO model and achieved remarkable results.In order to comply with the remarkable teacher training program requirement advanced by the Ministry of Education and train "Double Type" vocational teachers in both engineer and teaching mentor, the CDIO engineering education model has been introduced in Network Engineering Design and Management courses to improve ability, innovation and teamwork of students. This paper introduces the concept of CDIO engineering education and its application in teaching theory, practice and curriculum evaluation,providing a reference for application of the model to other courses.

Keywords

CDIO; Practical Teaching; Teaching reform.

1. Introduction

In recent years, in order to improve students' innovative ability and engineering practice ability,every country all over the world is busy with promoting engineering education reform and exploring the training model for the development of innovative engineering and technical professionals. CDIO engineering education model is first developed by the Massachusetts Institute of technology and a few Swedish Universities in 2004 with the support from the Wallenberg Foundation after four years of cross-national studies and tests, which represents one of the latest achievements in terms of international engineering education. The advance and feasibility of CDIO engineering education has been proved by education reform practice domestically and internationally, and such education has imposed a significantly positive role on the field of engineering education in China[1], and many scholars have published a number of valuable papers. The founder of CDIO, professor E.F. Crawley from the Massachusetts Institute of technology, carefully studied the curriculum of CDIO, and pointed out that the main value of CDIO course lies in that it serves as a model that could be widely promoted to engineering courses designed for any universities, with specific learning objectives satisfactorily met. Literature[3] mentioned that the application of education ideas related to CDIO and the use of its curriculum in the Department of Aeronautics and Astronautics, the Massachusetts Institute of technology, had promoted wide achievements. Literature summarized the good results when CDIO engineering education model has been successfully applied to courses such as "Innovations of Information and Communication Technology". In 2011, the Ministry of Education of the People's Republic of China approved the establishment of the project "The research and practice of CDIO engineering education model in China", and 39 colleges and universities became pilot schools. It

proposed a new NETWORK-CDIO engineering education philosophy, and advocated the use of engineering design as the guidance, and the cultivation of personal ability, group ability and system control ability as the major objectives. Also, the demonstration of ethics, integrity and professionalism was a must, and all trained engineers should be professional, honest and responsible. On the basis of CDIO, Dalian Neusoft University of Information reformed it with Chinese characteristics, creatively established eight TOPCARES-CDIO index systems that are used to assess eight abilities. Actually, every letter of TOPCARES represents a specific ability. For example, T refers to technical knowledge and reasoning, and CDIO refers to open thinking and innovation. Also, students were required to apply gained abilities onto different learning aspects of their college life. Literature discussed the application of CDIO model in order to train excellent and comprehensive network engineers. It could be concluded through our survey of domestic papers on CDIO model that the overall emphasis is on the training of excellent network engineers. However, studies that involve the training of these engineers' professional ability are still limited. Therefore, in addition to giving a brief introduction regarding the ideas of CDIO engineering education model, this present study provides a detailed description in term of its application in the course "Network engineering design and management" in aspects of theory teaching, practical teaching and curriculum evaluation, when the course is designed for students (normal) major in computer network technology.

2. Reform Ideas and Goals

According to CDIO engineering education concept, in network engineering discipline teaching, we should take the network development project as a background, combine the network engineering discipline knowledge, network's construction process with the CDIO education concept, explore and implement the NE-CDIO (Network Engineering-CDIO) cultivation mode, thus raise high quality network engineer in line with international standards and our national conditions. Therefore, we need to refer to CDIO engineering education outline and network engineering professional education to carry out one whole set of reform. It is meaning that we shall systematically plan and transform raising program, curriculum syllabi, teaching methods, practice teaching contents and system essential factors.

We carry out a new NE-CDIO program from 2015. We pay great attention to basic concept, as well as strengthen active learning, problem-based learnin，cooperative learning and exploratory learning. Reforming effort to improve the teaching level has been made as follow: Putting ""learning in doing" and "project task driven" into practice is a good method of strengthening theory and practice union and ability cultivation. Simultaneously， we carry on educational reform actively, improve teaching method unceasingly, update teaching contents, improve teaching conditions, strengthen teacher troop construction. At the same time, we use modern teaching means to develop CAI (Computer Aided Instruction) and audio-visual teaching actively, motivate students" active learning enthusiasm, develop teaching websites and CAI courseware, create students active learning supportive environment, and establish student productive practice bases.

In teaching idea renewal, we set up cultivating students' innovation consciousness, team cooperation spirit and style of theory and practice to the purpose. And we pay special attention to and strengthen engineering practice ability, synergy and professional skill comprehensive training. By introduction of advanced international CDIO teaching idea, we combined with the practice of network engineering specialized reality. The life cycle of network system development and deployment is determined as the network engineering education background，and network design project as carrier and trunk. The mode, project practice courses can drive learning of related core professional theory courses, develops attributes and skill training. Thus students will engage in active learning, exploratory learning and cooperative learning with practical problems. While their professional knowledge learning and knowledge application skills training will be more targeted and effective.

The mentality and localization of reform is that we refer to the advanced idea of the international CDIO higher engineering education, combine with our network engineering education practice, carry out educational reform comprehensively to the network engineering specialty, and propose NE-CDIO education pattern, an innovative network engineering teaching and learning mode. It takes occupational ethics and good faith as foundations, and combines features of network engineering education with the CDIO framework organically. The target is to cultivate high quality network engineers. The main content is that the point of network engineering education is the vocational ethics. Professional foundation is set up by the CDIO process. NE-CDIO lays more stress on cultivating project application ability, team cooperation communication ability, engineering technology studying independently and problem definition and solution capacity, as well as system regulation ability, self-learning abilities comprehensively in the science and technology, individual and specialized quality, interpersonal ability as well as system design and construction, etc. Thus we can raise high quality application network engineers with ability of lifelong learning at undergraduate level.

Guiding by network engineering professional demand, referencing to international advanced CDIO engineering education idea and standard, combining with our national conditions and network engineering education characteristics, we carry on the full-scale reform in talent training scheme, curriculum system, teaching modes and methods, teaching contents, teaching links, teacher training and use and so on. Through the teaching and learning reform and key specialty construction, network engineering specialty of Department of Mathematics and Computer Technology is becoming a distinctive fostering base for high quality network engineers.

3. NE -CDIO Cultivation Plan

NE-CDIO cultivation plan is the programmatic document, which embodies and implements the NE-CDIO teaching and learning mode. Its features manifest in training objectives, professional characteristics, and curriculum system and progress arrangement.

The training target of high quality network engineer is to cultivate a batch of network engineering technicians and managerial personnel who have abundant engineering science foundation, creativity and systematic thinking ability, multi-disciplinary backgrounds and international vision, outstanding management and communication ability, team spirit, professional moral responsibility and legal consciousness. To achieve this goal, we should educate and cultivate student systematically and roundly in basic courses, analytical ability, creative and design ability, communication cooperation ability, leadership, professional morality, language ability and so on. Combining with application-oriented school localization and teaching reality of network engineering, we determined the training goal of this professional. The goal is to raise senior engineering applied talents who can adapt to the development of the computer network industry. At the same time, the person should possess good comprehensive attributes and professional ethics, master solid network elementary knowledge and network development skills, as well as have strong network design construction and testing ability, team cooperation ability, analysis and solving problem ability, communication and coordination ability and lifelong learning ability.

Professional design manifests in the teaching goal and cultivating mode. In the teaching goal, we combine with different discipline knowledge, taking comprehensive quality raising as the goal. At the same time, to adapt to the development of technology and social changes, we synthesize activities inside and outside classes, paying attention to professional morality, professional skills, interpersonal skills and system development ability, and strengthening professional practice and knowledge. In the cultivating mode, by introducing international advanced CDIO engineering education framework, we take raising individual vocational skill (including practical ability and lifelong learning capability), team ability as well as system construction and control adaptive ability as the essential target. And on basis of emphasizing integrity, professional morality and responsibility, we implement NE-CDIO

mode. The mode takes engineering development life cycle as the carrier, oriented to practical and exploratory network engineering design.

In curriculum aspect, we introduced network engineering introduction and professional practice courses to stimulate student's seeking knowledge interest and establishing engineering concept and professional preliminary understanding. We adjustment convention subjects according to discipline knowledge system, and pay attention to integrate, so that make them links up and fuses mutually. Meanwhile, we show students multi¬disciplinary knowledge the network engineer needed, and the correlation and comprehensive application of knowledge. Through more basic course setting, student will lay a solid foundation. Simultaneously, the new program pays attention to raising integrity, professional ethical and legal consciousness, and offer "network engineers profession morality and responsibility" course.

In teaching schedule and distribution, we refer to the present procedure and experience of overseas same type colleges, and adjust tradition in the program. Under maintaining curriculum relevant premise, we enlarge the study period intensity of the first five semesters, so all of the professional foundation courses and professional elective courses are mainly in the first five semesters, while few compulsory courses and part specialized optional courses in the sixth semester. In the sixth semester, students are encouraged to work in network companies, so that obtain practical work experience as well as opportunities and conditions for employment.

4. Strengthening Practical Teaching

The engineering feature of network engineering disciplines emphasizes importance of practice teaching. The practice is the important supply of theories, and provides support and foundation for the theories. It is the important component part of "network engineering". Practice teaching effect and quality of computer professional students have a direct relationship. Practice teaching should cover the major aspects of network engineering, limited targets, operable, easy to carry out.

Through practice activities, students can master basic method, process and the basic tools of network system analysis, design, implementation, testing and maintenance and project management. According to the engineering methods, students can complete the network development task by the role of project team. Through these activities, they will understand network engineering concepts, principles and theories deeply, and their network development skills, team cooperation ability, system design and construction capacity, as well as professional attributes will be cultivated.

For the realization of network engineering educational target, we strengthened specially the practice teaching link in the cultivation plan. Besides the traditional experiment courses, strong comprehensive network design project practice courses are arranged each semester, uninterrupted for four years. Meanwhile, we design carefully eight project courses, including "network engineering practice foundation", "information system design and implementation", "network projects comprehensive practice", "innovative design project" and so on, to realize the comprehensive application and integration of core professional theory courses. We arrange more practice credits which ensure students can effectively complete technical knowledge learning and the ability training in the limited teaching time. For example, "network engineering practice foundation" project course drives learning and integration application of the three core courses of "programming foundation", "object-oriented technology" and "network engineering introduction", relating and intertwining theoretical knowledge learning and project practice activities closely, simultaneously requesting the synchronization maintenance between the theory and practice project courses in the progress arrangement. Moreover, we encourage and impel students to carry out various and lively extracurricular practice activities for displaying special and promoting personal value, through setting up innovation credits and innovation practice project elective course.

The new NE-CDIO cultivation plan abandoned tradition of heavy theory knowledge and light practice. The consequence is to cultivate students' innovation consciousness, team cooperation spirit and style of

applying theory to reality. Project design courses drive some core courses, which makes students learn more actively, studying with problems, and more with pertinence and effectiveness. The backbone and leading direction of core course cultivation structure is the project courses, and every project practice course drives some professional courses. There are several advantages studying in this way. First, the course plans develop in the way of applying theory to reality, which can promote students" enthusiasm and initiative, make them learn more with pertinence, thus study for application. Second, the project is launched by the association cooperation. Students can cultivate their own team cooperation spirit, team communication skills and system regulation ability through projects. The projects drive learning of core professional knowledge. The project practice causes students to obtain necessary network development experience, improving and cultivating engineering practice ability, synergy ability, and professional attributes comprehensively.

Moreover, in addition to setting "team motivation and communication" as specialized fundamental course independently, we emphasize that network design projects are carried out in team cooperation way, and stress cultivation of team cooperation spirit, communication skills and the system control ability in the process of completing projects. It is most important for students to learn to know, to learn to do, to learn to live together, to learn to be, and finally to become higher quality network engineer who has lifelong learning capability.

Students lack understanding to society and enterprise environment, as well as engineering background and actual system development experience. In order to resolve these problems, the institute and the taiji computer company reaches an agreement. Taiji Computer Company provides students with the production practice environment of network engineering. Both sides cooperated have established the practice base. All students in this specialty complete production and practice of network engineering in the base. This is an effective mechanism established, by which students develop the network engineering practice in network factories and the enterprises, and the evaluation mechanism of enterprise participating in student's inspection has been introduced as well. At present, three grade students have practiced in the company, and about 90% students have obtained the state-level "Network engineer qualification certificate", and the outstanding accounts for 20%.

5. Conclusion

NE-CDIO mode takes latest achievements in overseas engineering education and benign proposal of the network industry as a foundation. Resting on the CDIO international engineering education idea and the framework, the mode instructs network engineering education teaching reform. According to the request of the CDIO standard and IEEE, we establish engineering practice teaching system by adjusting the course system and teaching contents, improving teaching methods and means. Combining network engineering discipline development status and characteristics, we propose the NE-CDIO pattern suitable for network engineers" education and fostering, and have been implementing since 2015. The practice shows that student's network engineering skills, team cooperation ability have the remarkable enhancement, and that lower grade students had the initial concept and perceptual knowledge to the network engineering, more thicker learning interest, more strenuous self-learning power. We see that the education concept of "learning in doing, doing in learning, doing while learning, learning while doing", makes engineering professional education more effective.

Acknowledgements

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