The Three-Dimensional Practice Teaching System in Software Engineering Based on CDIO

Zhang Xiuhong; Wen Bin
School of Information Science and Technology
Hainan Normal University
HaiNan Haikou 571158
443633106@qq.com; 951714238@qq.com

He Shuqian; Han Bing
School of Information Science and Technology
Hainan Normal University
HaiNan Haikou 571158
76005796@ qq.com; 27312585@qq.com

Abstract—**Today, the CDIO engineering education concept has gotten attention widely and use in the field of international education. We describe the content of CDIO vision, syllabus and standards, discuss the content of software engineering personnel training practice teaching system, and propose the Three-dimensional software engineering practice teaching system based on CDIO on the basis of software talent training goal. We also summarize the software engineering talents cultivation practice teaching reform scheme and results combining with the implementation of the software engineering undergraduate professional practice teaching reform in this paper.**

Keywords—Software Engineering; CDIO; Three-Dimensional Practice Teaching System

I. INTRODUCTION

CDIO engineering education mode is the latest achievements of international engineering education reform in recent years. It is the multinational special research formed by the Massachusetts institute of technology, the Swedish royal institute of technology, Sweden, moss industrial university and Sweden Linkoping University. The international cooperation organization has been established named by CDIO. CDIO means conceive, design, implement and operate. Its purpose is to provide students with a practical system and product conception, design, implementation and running under the background of engineering education, and cultivates the engineering talents by society and the enterprise needed. CDIO created the concept of engineering education and the corresponding study of the syllabus, implementation planning and inspection evaluation of 12 standards and practice resources. Dozens of world famous universities international joined the CDIO organization fully use the CDIO engineering education concept and teaching outline, has obtained the good effect, was warmly welcomed by society and enterprises.

For a long time, there have always been two kinds of growing demand in the higher education personnel training. On the one hand, graduates of colleges and universities require students to master the basic theory and professional knowledge; on the other hand, Society and enterprise need the graduates with vocational skills and quality, communication and cooperation ability, and the practice innovation ability. Especially in the era of Internet + today the new requirements has been prompt for training the professional and international software engineering talent.

Two aspects requirement increased. On the one hand, students should possess solid professional basic theoretical knowledge; on the other hand, students should have good engineering system builds and coordination ability.

As the talent cultivation of universities, therefore, must develop a clear and reasonable talent training target system framework, build the basic theory and experimental teaching, engineering practice for the integration of the overall training mechanism, lets the student in a good educational environment for solid basic knowledge of professional theory, professional knowledge, but also will be applied in practice, makes engineering practice ability, innovation ability and professional quality of balanced development, and become useful advance IT talents. Therefore, in the build process for software engineering talent cultivation system, we pay attention to with the CDIO concept as the instruction, proposed the three-dimensional software engineering practice teaching system, and has carried on the beneficial exploration and practice.

II. OVERVIEW OF THE CDIO ENGINEERING EDUCATION

The basic content of CDIO including CDIO vision, CDIO syllabus and CDIO standards

A. CDIO vision

CDIO vision based on the product lifecycle process from research to move as the carrier, make the student through the organic connection between active, practice, course engineering way of learning, to cultivate the students' engineering ability, the concept and "learning by doing" is "based on education and learning" the concentration of generalization and abstract expression. [1-4]

B. CDIO syllabus

The CDIO syllabus mainly includes four aspects: (1) technical knowledge and reasoning ability; (2) personal professional skills and professional ethics; (3) interpersonal skills: team collaboration and communication; (4) the enterprise and the social conception, design, implementation

and operation system. [1] Unlike previous curriculum teaching in the CDIO syllabus, in addition to the teaching effect on technology subject knowledge put forward clear requirements, emphasizes the students' individual ability (Personal), Interpersonal coordination (Interpersonal), products, processes and systems to build capacity requirements. Emphasizes the students' awareness of personal and emotional level, including engineering reasoning and problem solving ability, experimental ability and knowledge ability, system thinking and creative thinking ability, critical thinking ability, professional quality and interpersonal coordination ability, products and systems of conception, design, implementation and operation ability and the ability to build (Building Skill). The CDIO syllabus clearly engineers the required knowledge, ability and attitude. The needs of society and enterprises, is the talent training standards of evaluation.

C. CDIO standards

CDIO standard proposed the implementation of the standards and goals with the CDIO cultivating mode, in its teaching reform and teaching evaluation standard. Including article proposes 12 evaluation standards summarized as the following 6 aspects: (1) the professional training concept (standard 1); (2) the curriculum planning (standard 2, 3, 4); (3) design and implementation experience and practice of place (standard 5, 6); (4) a new method of teaching and learning (standard 7, 8); (5) the improvement of teachers (standard 9, 10); 6 assessment and evaluation (standard 11, 12) [2-7]

CDIO standard provides guidance for the realization of the professional construction and reform, and set up a bridge for the feasible for engineering education to the reform practice results from the input, process implementation. It professional guidance university how to realize the CDIO engineering education concept, making engineering graduates to meet the demand of social essential knowledge, ability and level, to achieve the ultimate goal of engineering education.

III. THE THREE-DIMENSIONAL PRACTICE TEACHING SYSTEM BASED ON CDIO

Software engineering is the study and application of engineering method to build and maintain effective, practical and high quality software subject. It is very important to cultivating students' engineering quality. The design of the practical teaching system is the key to achieving CDIO elements.

For improve software engineering students can achieve CDIO standards required by the knowledge, ability, level and engineering quality improve fully, The software engineering of School of Information Science and Technology in Hainan Normal University formulated the practical teaching system, includes practice curriculum setup, practice, practice process execution way and the method of evaluation practice after years of exploration practice.

The construction of the teaching practice system is based on CDIO concept, as a general guideline, the CDIO engineering design concept through to the entire practice activities of each link, formed a set of practice teaching goal, the practice teaching level, the practice teaching process, which

integrates practice teaching system three-dimensional model in software engineering. Three-dimensional model in software engineering practice teaching system is shown in Fig. 1.
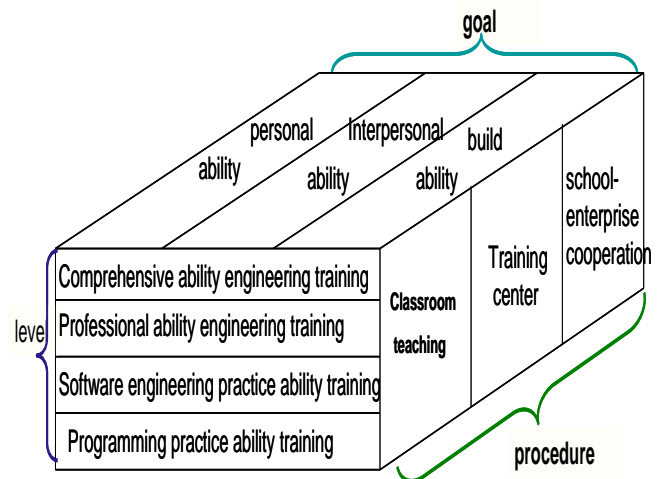

Fig. 1. Three-dimensional model in software engineering practice teaching system

Three-dimensional model in software engineering practice teaching system includes the following contents:

A. training objective

Based on CDIO vision of engineering education, the training objectives of the syllabus and the qualities of software engineering talents should be have according to CDIO standard, the goal of software engineering professional talent cultivate is that the undergraduates should practice the basic theory knowledge and professional knowledge, Omni bearing trained in the software programming, system analysis and design, software testing, software project management and operation maintenance of professional skills and personal abilities and teamwork, system implementation and the construction of comprehensive training, etc.

B. The hierarchy of engineering practice teaching

We should emphasizing the engineering quality cultivation in basic theory, professional knowledge, engineering skills and ability training of comprehensive ability training step process in the all culture period.

1) First stage: programming practice ability training.

Studying advanced language programming, object-oriented programming courses, practice experiment content, increase the application practice link, so as to strengthen the theoretical knowledge and basic programming skills, training students' comprehensive ability of programming and design more complex algorithm and comprehensive programming ability. This stage mainly through internship program links strengthened high-level programming language, such as C, JAVA, etc.

2) The second stage: Software engineering practice ability training.

We should train students the ability of the research and development of software; simulation experience engineering environment and train the ability of software engineering, through the engineering practice and course design, such as data structure course design, software engineering, requirement analysis, software design, software test course design, information system course design concentrated practice experience of software development process.

3) The third stage: professional ability training engineering time.

By two professional practice link, and makes practical experience and practice of engineering environment, engineering apprentice 1 mainly please university-enterprise cooperation unit into the school and corporate training institutions, training for software design and system building. Engineering apprentice 1 is the students out of the school, into the enterprise, causes the student to enter the enterprise's actual engineering environment exercises, training software engineering quality, and cultivate professional quality and accomplishment

4) The third stage: Professional ability engineering training.

We arrange two professional trainees, the one is inviting enterprise professional and corporate training institutions come into the school to teach and training students for software design and system building. The an other is that students go out of school and enter the enterprise, trained software engineering quality and cultivate professional quality and accomplishment in the enterprise's actual engineering environment.

5) The fourth stage: Comprehensive ability engineering training.

Students would be trained by developing and implementing enterprise projects or teachers' scientific research and actual project so as to training students' comprehensive to analyze and solve practical problems and team coordination ability during the graduation design and graduation practice link.

C. process implementation

To reach the training goal, we need comprehensive reform of software engineering personnel training mode, adjust the course system, enrich the teaching contents, improving teaching methods, establishing engineering practice teaching system, and fully reflect the thinking of engineering ability and professional quality training according to the basic idea of CDIO. We should through classroom teaching, training center and university-enterprise cooperation training mode, combines the basic theory, experimental teaching, and the engineering practice of holistic cultivation mechanism, and lets the student ability to fully balanced development, so as to adapt to the needs of modern software industry.

1) Class training

Too many traditional engineering courses teaching content reform enrich the content of the engineering teaching, emphasizing the "high school".

2) Training center

We should build the real engineering practice environment, emphasis on team, cultivating team spirit, ability of organization, ability of coordination, communication skills in simulate real scene complete practical to students. Students could experience the complete software development engineering practice process, in the process of professional knowledge and engineering skills training.

3) School-enterprise cooperation

We should further deepen and widen the university-enterprise cooperation, so as to make students would have more opportunity to experience the enterprise in actual engineering environment to rise the engineering ability, perfect oneself, exercise engineering ability, and become good quality IT talents with society, enterprises needed base on establishing multiple practice base software to enterprises.

IV. THE PRACTICE OF SOFTWARE ENGINEERING PERSONNEL TRAINING

Hainan Normal University set up the software engineering in 2010, according to the planning information intelligent island of Hainan province development demand for software talents. We have pay attention to the students' ability training in software engineering, computer network and application, intelligent information processing, information intellectualization of accumulation, committed to the tourist information management, computer aided teaching and mobile application software development and other projects in the field of software development and design technology research and development, to realize the combination of production base on CDIO concept as guiding .

At present, we have established relatively close university-enterprise cooperation pattern with Shenzhen soft and cool network technology co., LTD., Hainan Yingli technology co., LTD., and so on. "Soft inc." practice teaching platform have been introduced in order to students could practice the major core theory course to application. Soft and Cool engineering practice curriculum is shown in TABLE 1.

The teaching method of "case teaching" and "learning by dong" have raised students skill, Master programming tools and frameworks to understand the project planning process, master of programming skills, understanding of UML modeling, through the actual project development to grasp the method of coding specification, programming, debugging, testing, etc, in the cooperation between colleges, In recent years, the student to obtain national and provincial practice innovation projects and various national provincial competition winning number increases greatly, employment, social enterprise or business the welcome of the unit received.

TABLE I.   TABLE 1 SOFT AND COOL ENGINEERING PRACTICE CURRICULUM

No	Course	period	knowledge	lever
1	software modeling	4	UML	understand
2	Java Develop	20	Java+Eclipse+Tomcat	master
3	Android Develop	20	Eclipse+android sdk	master
4	Database System	4	MYSQL	master
5	Management tool series	1	Soft Cool platform	master
6	occupational qualities	2	Program life	know
7	software engineering	1	Software engineering general	understand
			software evaluation	understand
			Requirements analysis	understand
		1	Soft Design	understand
			coding	understand
			,software testing	understand
8	project management processes	1	Process system overview	understand
			project startup	understand
			approve and initiate a project	understand
			Requirements analysis	understand
		1	systematic design	understand
			system implementation	understand
			project acceptance inspection	understand
9	Review and summary of the project	1	project review	know
		1	Personal summary and review	know
10	Project Training	123	Project Training	master
	total	160		

V. CONCLUSION

Software engineering CDIO three-dimensional practical teaching system research and application of software engineering of Hainan Normal University undergraduate course of practical teaching system construction, and build a practice teaching system, established the close cooperation of university-enterprise cooperation relations, set up the multiple factors: practice base. In addition, combined with the national and provincial all kinds of computer software design contest, college students' innovation of science and technology plan projects, every year to launch the institute of science and technology activities, combined with the enterprise to carry out college students' science and technology innovation contest.

Build incentive mechanism to encourage and promote students' professional skills, engineering consciousness, innovation ability, and the professional quality of ascension, such as students can through competition winners, published papers, and the professional qualification certificate of professional society for innovation such as credits. Practice results show that the implementation of the reform has achieved initial results. We also need to further deepen cooperation between colleges and further perfect the content of the practice and specification details, cultivate good software for intelligent Hainan island construction engineering talent.

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