Electronic and Information Engineering Personnel Training based on CDIO Mode: Taking Practice and Certification as the Core

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Abstract — CDIO is a classic mode of engineering education and emphasizes that the engineering education should pay attention to practice. Taking Practice and Certification as the core, the basis for Practice Platform and Certification System, the framework of Training Mode and Cultivation Process based on CDIO combined with Electronic and Information Engineering Personnel Training in our college were described, in order to provide CDIO application example for Engineering major.

Keyword - CDIO; framework; Training Mode; Cultivation Process

I. INTRODUCTION

CDIO is about doing and project-based education and learning principles [1]. The syllabus for CDIO talent cultivation will divide engineering graduate’s ability into basic knowledge of engineering, personal ability, ability in interpersonal communication and teamwork, as well as ability in engineering system. Students should reach these four intended targets based on the comprehensive cultivation methods. CDIO has systematically proposed 12 standards for the training of operational ability, comprehensive implementation, as well as inspection and evaluation [2] [3]. Thus, students who are cultivated under CDIO mode are very popular in the society and enterprise. CDIO Engineering Education Mode has changed the situation where great attention is paid to knowledge instead of ability in the teaching system of traditional colleges. The abilities necessary for engineer will be integrated into certain courses in the form of knowledge-ability matrix, and mechanism for implementation and assessment will be proposed [4].

The key to improve student’s engineering practice ability is that the cultivation process must cater to the needs of society and closely integrate with the industry. On the one hand, a practicing platform with superior practicing organization should be set up for students. In this way, students will be familiar with their enterprise culture and equipped with a background of engineering project development; on the other hand, such industrial certification system as electronics engineer establishes certification platform by summarizing the main demands of the industry. If a person passes the certification, it means that this person is equipped with skills that can be adopted in certain jobs of industries.

II. BASIC FOR PRACTICE PLATFORM AND CERTIFICATION SYSTEM IN ELECTRONIC AND INFORMATION ENGINEERING

(1) Carry out the training of engineering practice ability on “practicing” platform

“Practice” means that some intermediary organs or large industrial enterprise provides college students with new staff recruitment training or enterprise culture training, so that college students can work in the enterprise directly after graduating from the college. The advantage of such practicing mode is that enterprise can get involved in the training of college students in advance. In addition, the “practicing” project, which is usually a real project developed by the enterprise, helps college students understand the social and corporate culture as well as the development environment of the enterprise. Besides, win-win phenomenon is created as practicing not only improves college student’s ability in teamwork cooperation and engineering practice ability, but makes students understand the flow of developing real project. Enterprise, on the other hand, can directly hire employees who can be used at work, reducing the cost of employment as a result.

(2) With industrial “certification”, guarantee demand for industry

“Certification” means that the certification authority verifies whether the product, service, and management system conforms to relevant technical specification, mandatory requirement of relevant technical specification or standard conformity assessment activity. Generally, industrial “certification” verifies the typical or most representative technology or requirement of this industry. If a person passes the certification, it means that this person is equipped with skills that can be adopted in certain jobs of industries. Industrial “certification”, to some extent,
represents the requirements of talent cultivation in this industry. Hence, according to the current situation of students in the college, and associated with their employment, the most representative certification criterion that is recognized by the industry is selected among various employment certifications. After analysis and integration, this certification is included into the practical teaching system of this cultivation project, so that practical teaching can closely connect to the practical requirement of industry and society.

III. FRAMEWORK OF ELECTRONIC AND INFORMATION ENGINEERING PERSONNEL TRAINING

According to CDIO framework, a talent cultivation system has been constructed for this major, forming a diagram of talent cultivation (as shown in Figure.1).

(1) The Level 1 Project. The Level 1 Project is a comprehensive design for an intelligent vehicle, which comes from the experience when we participated in the national college student electronic design competition and intelligent vehicle competition. This project will be lasted for three years, and through the integrated design of intelligent vehicle, students can understand the comprehensive and professional knowledge of electronic information engineering as well as its position and role in related courses. The integrated design of intelligent can be divided into several levels and developed step by step: part one, with accessories of intelligent vehicle provided by the teacher, students complete specific function design so as to improve their C language programming ability; part two, after learning analogy circuit design and digital circuit design, the teacher designates specific function and the students select devices to complete functional circuit design. This part aims to train student’s design ability in analog and digital circuit; part three, after learning the design of microcontroller, the teacher designates certain function while students complete the design of master microcontroller. This part aims to train student’s ability in designing microcontroller system.

(2) The Level 2 Project and Level 3 Project. The Level 2 Project and Level 3 Project were designed according to the requirement of certification projects of certain industry as well as the requirements of courses and curriculum group after integration. The Level 2 project is shown in Table 1. The Level 2 Project was designed according to the curriculum requirements.

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**Table 1. Level 2 Project List of Electronic Information Engineering**

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Corresponding Level 2 Project</th>
<th>Project Teacher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principle of Electric Circuits</td>
<td>Integrated Electronic Simulation and Design Project</td>
<td>Course Teacher of “Digital Electronic Technique”</td>
</tr>
<tr>
<td>Analog Electronics Technique</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital Electronics Technique</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-Frequency Electronic Circuit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signals and Systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital Signal Processing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principle and Application of Microcontroller</td>
<td>Intelligent Detection Integrated Design Project</td>
<td>Course Teacher of “Principle and Application of Microcontroller”</td>
</tr>
<tr>
<td>Measurement Technique</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intelligent Instruments</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VLSI Large Scale Integrated Circuit</td>
<td>Integrated Project of Digital Signal Processing</td>
<td>Course Teacher of “Verilog Programming”</td>
</tr>
<tr>
<td>VHDL/Verilog Programming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EDA Systematic Design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Structure and C Language</td>
<td>Integrated Design Project</td>
<td>Course Teacher of “ARM”</td>
</tr>
</tbody>
</table>

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Figure.1. Fishbone Diagram of Talent Cultivation of Electronic Information Engineering
The organizational condition is shown in Table II.

<table>
<thead>
<tr>
<th>Embedded System</th>
<th>Programming Principles of Embedded System</th>
<th>ARM System Structure and Programming</th>
<th>Embedded System Development</th>
</tr>
</thead>
</table>

(3) The second Level 1 project is introduced into practicing organization for participation. Students will be equipped with certain engineering practice ability after three years of project training according to the cultivation procedures as stated. But these engineering practices ability are far from systematic and certain time is needed to meet the requirements of the society and industry. Therefore, an in-depth and complete project practice experience is needed before students can master the real engineering practice ability. A practicing mechanism in the second level-I project of electronic information engineering major was introduced. The project design was completed and the goal of cultivating engineering practice ability was fulfilled by taking the practicing project as the final Level-I project with conception, design, implementation, and operation flow.

IV. CULTIVATION PROCESS

(1) Independent enrolment, college and enterprise tutors are arranged. After years of practice and exploration in information major, CDIO experimental class has been independently set up, and was put into practice in electronic information engineering major. According to the special requirements of CDIO experimental class, the college pays particular attention to set up a professional commission of teaching instruction that is composed of industry expert, enterprise manager, and educational expert, and to formulate cultivation plan. According to the requirement of CDIO cultivation mode, the college will take level-I project as the mainline running through the whole curriculum system, and take the Level 2 project as a centre setting relevant curriculum group; in the meantime, the college shall equip each student of the experimental class with a college tutor or an enterprise tutor, and provide assistance and guidance to their study and life.

(2) Confirm staged target, set up open practice teaching platform. During the cultivation process of experimental class and according to the requirement of level 1 and level 2 project, clear staged target were formulated and an open practical teaching platform which is based on “certification + practicing” was set up. The open practical teaching platform is composed of four staged target platforms: interest cultivate platform, professional quality cultivate platform, professional skill train platform, practice and innovation ability train platform. Different organizational form will be adopted to support the target of each stage. The organizational condition is shown in Table II.

(3) Realize a close integration with society and industry through credit substitution. During the process of formulating training plan, Level 1 and Level 2 project were set up based on certification and practicing. To realize a close integration with society and industry during the student cultivation process, level-II project is usually based on curriculum group to integrate relevant certification requirement of electronics engineer; student team can also independently design Level 2 project according to the requirement of the industry and enterprise as well as guided by the tutor. The college introduces credit substitution policy, and student who conforms to the condition will be qualified to obtain the credits of relevant projects.

TABLE II. OPEN PRACTICAL TEACHING PLATFORM

<table>
<thead>
<tr>
<th>Teaching Process</th>
<th>Forms of Organization</th>
<th>Content of Course and Methods of Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interests Cultivation Platform</td>
<td>Electronics Association</td>
<td>Centre on the first level 1 project, cultivate basic knowledge of the major; students are required to record the solution process of practical problems</td>
</tr>
<tr>
<td>Professional Quality Cultivation Platform</td>
<td>All Interests Groups</td>
<td></td>
</tr>
<tr>
<td>Professional Skill Training Platform</td>
<td>Project Practicing Group (in class)</td>
<td>Centre on level 2 and level 3 project; selectively integrate the qualification authentication of electronics engineer industry and enterprise into practical teaching program</td>
</tr>
<tr>
<td>Practice and Innovative Ability Cultivation Platform</td>
<td>Development Team of “Talent” Project</td>
<td>Centre on the integrated design of the first level 1 project; introduce projects and demands of industry and enterprise, simultaneously, lead students to participate in various practical activity, such as academic competition, entrepreneurial plan, new talent plan, etc.</td>
</tr>
<tr>
<td></td>
<td>Qualification Authentication Senior Class</td>
<td>Centre on the second level 1 project; take project practicing as the major form; to cultivate engineering practice ability, based on college student academic competition, participate in teacher’s scientific research project, graduation design, etc.</td>
</tr>
<tr>
<td></td>
<td>College Student</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Graduation Design Group</td>
<td></td>
</tr>
<tr>
<td></td>
<td>College Practicing Platform</td>
<td></td>
</tr>
</tbody>
</table>

(4) Carry out reform of teaching method actively; improve the methods of assessment

CDIO mode has proposed higher requirements on dairy teaching method. During the process of talent cultivation, beneficial exploration on curriculum system, curriculum group construction, teaching method, reform of teaching methods, ways of assessment, and academic evaluation was conducted. In terms of teaching, practical cases, project-task-
driven method, elicitation method, exploring method, open
method, discussion method and case method were adopted
for teaching, so that students can play an active role in
learning; based on traditional ways of summative assessment
and by means of group cooperation and evaluation as well as
real evaluation, this method focuses on student’s changes of
learning and growth process so as to stimulate student’s
potential and help student realize self-improvement.

(5) Establish supportive and progressive laboratory
hardware platform. Certain hardware platform is required to
support the systematic cultivation of student’s engineering
practice ability. According to the progressive way of talent
cultivation, progressive hardware platform, such as basic
laboratory, professional laboratory, innovation laboratory,
university-enterprise associated laboratory, campus training
base, and extramural training and practice base have been
built, among which basic laboratory, professional laboratory,
and innovation laboratory were mainly built for college for
course experiment and training of Level 3 project; while
university-enterprise associated laboratory, campus training
base, and extramural training and practice base were built for
enterprise and practicing organization. While building
hardware, students are required to do some practical training
project. Student’s Level 1 and Level 2 projects were done
from these places. In this way, each laboratory was
independent from each other and coordinated from each
other in function. In addition, experts of society and
enterprise are introduced to build the laboratory and cultivate
talents, and students will have more opportunities to learn
something of the society from this process.

V. CONCLUSIONS

Taking Practice and Certification as the core, the
Electronic and Information Engineering Personnel Training
based on CDIO Mode requires that the cultivation of the
students’ engineering practicing ability should cater to social
needs and be in line with the industrial development. The
essence of this mode is to cover the industrial main demands
into the training plan with the help of certification needs, and
to expose the students to enterprise culture and real
engineering project development in college by practicing.
Such mode has been implemented and yielded fruitful results.
Practicing training base has been jointly built with such
companies in and out of the campus. The students have
higher levels of employment and their working ability and
working level are highly valued by the enterprise.

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