CULTIVATION OF INNOVATIVE ABILITY IN MULTI-LEVEL CDIO WORKSHOPS

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ABSTRACT

As education of student's innovative ability becomes increasingly importance recently, CUIT takes it as one of the significant parts into syllabus design. Currently, the students actually are not strong in promoting their innovative ability. Due to this situation, CUIT has adopted CDIO concept since 2012 by which exerts function of enhancing innovative ability for undergraduate students. Through CDIO workshops, students take part in some projects design and express their own ideas during the process, in which students could experience the process of conceiving, designing, implementing and operating.

There are three levels in CDIO workshops. The first level is basic innovation workshop, which aims at cultivation of creative consciousness for 1st year students. The second level is normal innovation workshop, which aims at training of basic innovation ability for 2nd year students without using specialized knowledge. The third level is specialty innovation workshop, which aims at cultivation of specialty technology ability for 3rd year students, and the works in workshop are closely related to students' majors. In these multi-level workshops, we only provide basic tools, materials and components for students. Students need to design their projects by themselves. There is no limit to the forms of innovation projects, but the projects designed by students must manifest their new ideas or innovative work. The levels of projects are from easy to difficult. In this way, students' creation consciousness and ability are improved step by step. Up to now, there are about 60-70 student teams, about 200 students of photoelectron major have worked in these workshops. The feedback from students is positive.

The motivation of the paper is to describe the practice process, project achievements and effect of innovation ability in CDIO workshop, and to discuss the improvement of future work in CDIO workshop.

KEYWORDS

Innovation ability, CDIO workshop, CDIO practice

INTRODUCTION

CDIO represents Conceive, Design, Implement and Operate. CDIO is one of engineering education models, which offers an alternative educational framework for project-based learning [1, 2]. This education model aims to emphasis engineering fundamentals based on the life cycle of a product. During the life cycle of some products, the students will learn how to solve practical problems and complete projects following the stage of Conceive, Design, Implement and Operate. The CDIO syllabus divides the students' ability into four levels. Those are engineering foundation knowledge, personal ability, team ability and engineering system, respectively [3, 4]. In all these skills and abilities, the innovation consciousness and

ability are very important to an engineering student.

However, there is less effort on promoting the innovation ability under present education system. Based on CDIO concept, a series of CDIO workshops are gradually built in Chengdu University of Information Technology (CUIT) since 2012, which aim at training innovation ability of undergraduates. In these CDIO workshops, students do some projects. Through CDIO workshops, students take part in some projects design and express their own ideas during the process, in which students could experience the process of conceiving, designing, implementing and operating.

The motivation of the paper is to describe the practice process, project achievements and effect of innovation ability in CDIO workshop.

MULTI-LEVEL CDIO WORKSHOPS

Innovative practice education is the important guarantee for innovative ability formulation. The innovative practice education is one of the effective ways to build up students' innovation ability. On the other hand, the cultivation of innovation ability becomes increasingly important in now days. To improve the practice ability of students, we built multi-level creative CDIO workshops in our campus since 2012.

These multi-level creative CDIO workshops are designed in three levels. The first level is basic innovation workshop, which aims at cultivation of creation consciousness for 1st year students. In this workshop, students begin to carry out some simple physics or engineering practices, where these practices may be unrelated to their majors. The students analyze and solve engineering problems by using their knowledge of Physics. In this workshop, we mainly concentrate on the originality or improvement in the students' work rather than technical complexity. By this way, the creation consciousness may be strengthened.

The second level is normal innovation workshop, which aims at training of basic innovation ability for 2nd year students without using specialized knowledge. We mainly focus on the thought of "My idea, I do". In this workshop, we only provide basic tools, materials and components for students. Students need to design their projects by themselves. The projects are not restricted to their major. If it is can train the abilities of Conceive, Design, Implement and Operate of students, the project is permitted to be carried out. In the normal innovation workshop, students often experience the whole C-D-I-O process, thus the innovation consciousness and abilities are further trained. There is no limit to the form of innovation project, but the project designed by students must show their own distinctive features.

The third level is specialty innovation workshop, which aims at cultivation of specialty technology ability for 3rd year students. This third level is different from other two, where the work is closely related to students' major. So far, this workshop mainly focuses on photo-electron fields such as photoelectricsensorand control, machine vision and 3D printing. This workshop is equipped with sensors and control module, laser components, machine vision detecting element and 3D printers and other equipment.

The schematic diagram of multi-level CDIO workshops is shown in Figure 1. From first-year of college, the above three workshops are introduced to students at the same time. Students may choose one and more of the three workshops to participate according to their own interests. Actually, the students are strongly encouraged to go through all three workshops. If some students directly involved in the later levels by ignoring the first or second level, they

will be asked to participate a test and the teachers will evaluate the performance and skills. They can join directly the higher-level workshop only when the teachers are satisfied with them. For some students, especially those experiencing all three phases, the innovation abilities of students have been greatly improved.

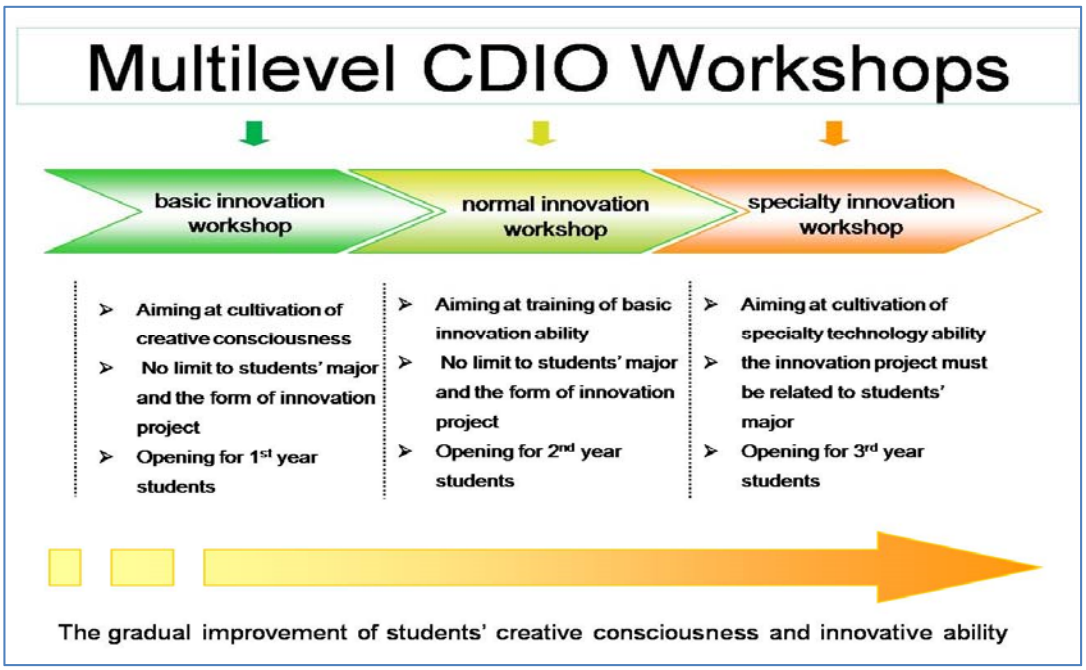

Figure 1.The schematic diagram of multi-level CDIO workshops

IMPLEMENT AND ACHIEVEMENTS IN MULTI–LEVEL CDIO WORKSHOPS

The three-level workshops are open for the students in optoelectron major. In general, one work team includes two or three students and a teacher. At the beginning of their project, the teacher and students will discuss the title, the content, the novelty and the feasibility of the project in details. Then the student needs to submit the application form for their project. During the project, the teacher provides a good direction to the implementation. After the project, the students show the finished work, and write a report of summary and achievements. Each project is limited within five weeks. According to the outcomes of the project and the performance students, the teacher evaluates their works and innovation ability, and gives 2 credits for eligible students.

Figure 2 presents the working scene of students in the basic innovation workshop. We can see that the students carry out circuit tests in the workshop. Figure 3 shows the working scene of students in the normal innovation workshop and the production of one team, which is a wind mill model. Figure 4 gives the working scene of students in the specialty innovation workshop and the students' production named collision-avoiding model. From above three workshops, we can see that the students are glad to participate in these kinds of practice, and their performances are also excellent. They think these practices are helpful to the improvement of their operating, cooperation and innovation ability.

Figure 5 shows the student's works in three different workshops. It can clearly be seen that the student's innovation ability is gradually improved from level one to three. For example,

the simple system of sewage disposal was made in basic innovation workshop of figure 5(a) when the student is in the 1st year. After one year, a model of steering engine was produced in normal innovation workshop, shown as figure 5(b). When the student is in the 3rd year, an airplane model is produced by using photoelectric sensor and 3D printing in specialty innovation workshop, shown as figure 5(c). From figures 5(a)-(c), it is obvious that the productions of the student are become more and more complicated. So the students' abilities are trained more effectively when they do different jobs gradually.

Up to now, there are about 60-70 student teams, about 200 students in optoelectron major to work in the workshops. The students like the jobs in workshops. The feedbacks from students are positive.

Figure 2. The working scene of students in basic innovation workshop

Figure 3. The working scene of students in normal innovation workshop and the production of students.

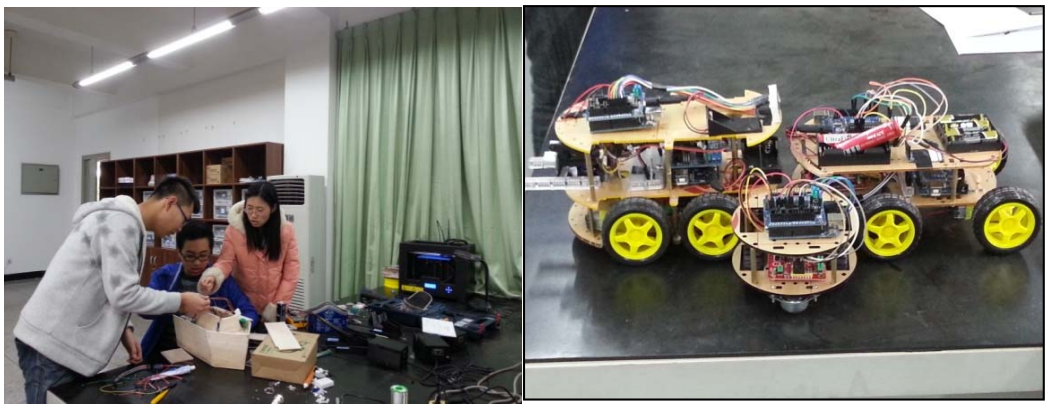

Figure 4. The working scene of students in specialty innovation workshop and the production of students.

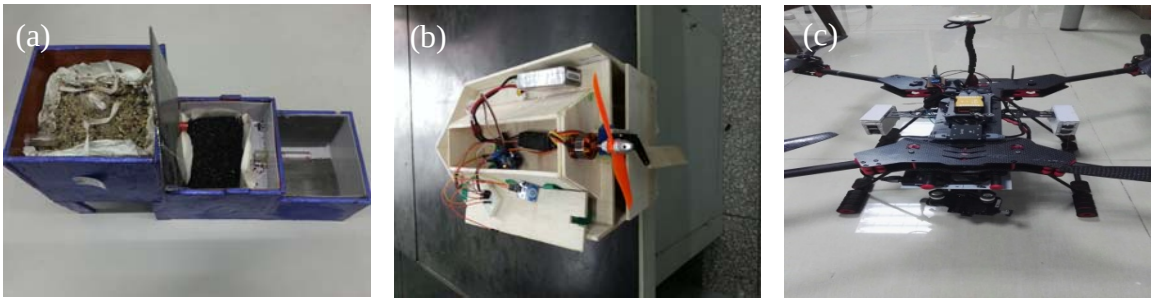

Figure 5.The student's works from the first level to the third level. (a) A model of a system of sewage disposal; (b) A model of steering engine; (c) An airplane model.

SUMMARY

Multi-level CDIO workshops based on the CDIO conception has been built to improve the students' operating, cooperation and innovation ability in Chengdu University of Information Technology (CUIT) in the past few years. The CDIO workshops are designed in three levels. They are basic innovation workshop, normal innovation workshop and specialty innovation workshop. In these multi-level workshops, we only provide basic tools, materials and components for students. Students need to design their projects by themselves. There is no constraint to the form of student' project, but the project designed by students must show their new ideas or innovative work. It is believed that multi-level creative CDIO workshop is an effective way to achieve CDIO initiative and standards.

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BIOGRAPHICAL INFORMATION

Min Chen is a Professor in Material Science and a teacher in the Department of Optoelectronic Technology at Chengdu University of Information Technology. She works on topics related to engineering education reform in the department, and focuses on the curriculum design and the improvement of teaching in recent years. She is also the education administrant of Chengdu University of Information Technology. Her current research focuses on implementing of CDIO engineering education model in the University.

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