DESIGN AND CONDUCT AN INTRODUCTORY COURSE UNDER CURRENT CHINESE CONTEXT

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Abstract

The college of Engineering, Shantou University adopted the CDIO initiative. Currently, Chinese freshmen are inexperienced in teamwork and project management. The freshmen in the College will choose their degree programs only at the end of year one. Hence an introductory course was designed to fit for general engineering students. It was aimed to prepare them for the CDIO learning styles. The course first discusses the roles and responsibilities of engineers. Then, riding on the development of products the students are gradually introduced some basic project management skills. The CDIO competencies are also incorporated into the course of the project conduct. After the first run of the course, the achievements and flaws of the course are discussed in this paper.

Keywords: Introductory course, CDIO competencies, Chinese context

Introduction

CDIO Standard 4 [1] requires an introductory course that provides the framework for engineering practice in product and system building, and introduces essential personal and interpersonal skills. The College of Engineering, Shantou University has adopted the CDIO initiative, completely revised its curricula and put the new curricula in force for students enrolled 2006 onwards [2]. An introductory course is thus designed for the students.

Two special features cause our introductory course deemed different from that conducted elsewhere. First, team projects have been commonly practiced in primary and secondary schools in many other countries. But they are relatively new in China. Currently enrolled university students hardly have any teamwork and project experiences. Second, the College of Engineering practices first year common engineering education. That is, the students have not decided which degree programs (there are five in the College) until the end of year one. Therefore, it is hard to choose proper products for the students to work in their projects. This paper presents the experiences, achievements and lessons learnt from the designing and implementing the introductory course for year one common engineering students under the current Chinese contexts.

Course Content Design

Sixteen contact hours are allocated to the course, titled “Introduction to Engineering Design”. It was evolved from an earlier course titled “Introduction to Engineering”, which was given to previous batches of students. In that course, faculty from each of the five programs attended

the class in turn to brief the students about their own programs. The purpose was to give the students enough insides about the programs they were going to choose. Under the CDIO context, such a practice is considered as inappropriate because, instead of being spoon feeding, the students should develop their own competences to explore engineering and their field of interests. Therefore, the course was redesigned.

Beside the CDIO requirements, considerations were made during the designing of the course content: a) engineers are in the core of all engineering creations. They must not be ignorant of the common practices of innovation processes and teamwork; b) many CDIO team projects will be conducted in the student's year two onwards. The students should as early as possible start to acquire some necessary skills like organizing, meeting, planning, project managing and decision-making.

The objectives of the course were set as that at the end of the course, the students should: a) understand the roles and responsibilities of engineers; b) be aware of some essentials of design processes management; c) have good senses of and consciously develop their teamwork spirit; d) be able to make reasonable judgments and resolutions; e) be aware of the importance of and consciously develop their oral and writing communication skills.

The objectives should be achieved via a series of in-classroom and out-of-classroom activities. Eight topics were then designed for the course: a) roles & responsibilities of engineers□b) find the design opportunities□ c) planning□d) cause & effect analyses□e) design concepts & objectives□f) design & prototyping□ g) operation summary; h) final report. Topics b onwards should ride on a product design-build process. These objectives can hardly be really achieved within mere 16 contact hours. Out-of-class activities were also arranged to integrate the education.

Tools introduced to the students include brainstorming, mindmapping, matrix table, Gantt Chart, Parreto analyses, survey form design, cause and effect analyses, tangible and intangible achievement analyses, etc. It was hoped that a brief usage of the tools would help the students to consciously search for proper tools to solve more complex problems they might encounter later.

Course Delivery

Classroom activities were divided into 8 classes of two hours each. The students were divided into groups of five. In the first class, students were very briefly introduced about the objectives, contents and the ways of teaching and assessing, followed by an introduction of the basics of engineering (in this society the terms of science, technology and engineering are fairly confusing. Most people cannot confidently differentiate them from one another). The first class was finished by classroom discussions to define the scopes of work and aspects of issues concerning engineers. After class one, each group was required to do a research on any one of the five engineering programs offered in the College, namely civil engineering, computer science, electronic engineering and mechatronics. They were required to write a report on the roles and responsibilities of the engineers and prepare an oral presentation in the next class.

In each of the next seven classes, half of the time was given for the students to do their presentations and discussions. The other half of the time was used to discuss the tasks to be done in the next step and some guidances helping the students to conduct their work smoothly. The class size was large. There were over thirty groups in a classroom. Hence, each time only five groups were randomly selected to do their oral presentations and the time allowed for criticizing and discussing was limited. Though less than one sixths of chances for a group to be selected for the oral presentation, results showed that all groups had seriously completed their assignments and prepared for their oral presentations.

As indicated earlier, by the time the classes were conducted the students had not chosen which program to study. We therefore did not require given products for the students to develop. They need to search for design opportunities by themselves. The rational for doing this was to stimulate the student's creativities, their care and concern to the society and the environments. The products they chose to work on did reflect care and concerns. Here are some examples of products they were working towards: noise monitoring and alarming devices, dustless blackboard erasers, bus stop information systems, electronic maps, bed side lighting devices, etc. However, being short of time and experiences the students could not converge their concepts into feasible designs. This has been a major flaw in the planning and conduct of this course.

In each topic, the students needed to prepare a written report based on their discussions and work. In addition to these, they had also to prepare a PowerPoint file for the possible oral presentations. All these work were done in group. But in the last the report, everyone must write a personal report summarizing what he/she had done and had learnt from the course. Each group had to submit a portfolio composing all the original records of the group's work, including meeting agendas, meeting minutes, sketches, designs as well as the written reports and PowerPoint presentations.

The assessment scheme combines the student's written reports, oral presentations, portfolio and their personal reviews. The breakdown of the assessment scheme are: a) the report on the roles and responsibilities of engineers, 10%; b) oral presentations, 20%; c) personal reflections, 20% and d) report & portfolio, 50%. The last item is further broken down into format (abstract, reference, etc) of report, introduction of the project, project management (process, meeting agendas & minutes, ect), design& prototyping (ideas, sketches, drawings and prototyping), case studies (problems encountered and ways of solving them), group summary on the project, and the PowerPoint slides.

Student's Performance

Classroom time was short and the class sizes were large. The students conducted their discussions and their assignments outside the classrooms. Each group managed its own project. They needed to learn how to decompose their tasks, plan their projects, distribute the tasks and coordinate the work. They needed to learn how to organize meetings, how to layout the agendas and how to take the meeting minutes. They needed to learn how to search for information, how to generate ideas, how to express their own opinions, how to compromise and how to reach resolutions. They needed to learn how to design survey forms, conduct

customer surveys and analyze the survey results. Some students did not have opportunities to use computers and the internet before they came into the university. This course provided good opportunities for them to practice the skills. Observing their reports and their PowerPoint presentations one could easily see the fast progress of the students.

Both sketches and precise drawings were allowed for the expressions of the design ideas. Most of them used the simple drawing tools in MS Word. Some tried to learn AutoCAD. Some groups asked their seniors to help them producing 3D-MAX drawings. Figure 1 shows a few of the student's designs.

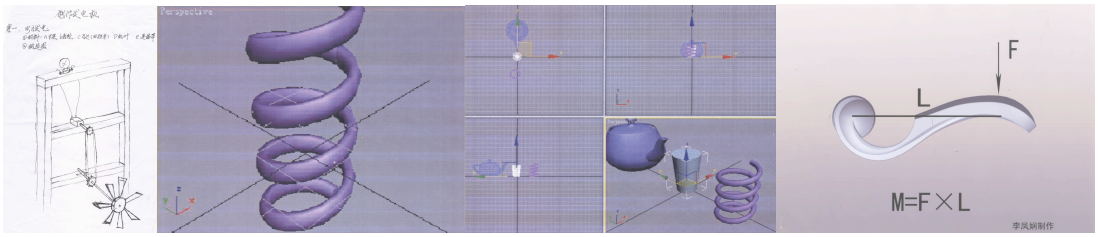

Figure 1. Some student's designs

In managing the project, the students learnt to coordinate the tasks among group members. In one occasion, a group leader complained that one of his group members was doing the minimum and this had affected the progress of the whole group. This was an anticipated phenomenon. This was used as an opportunity to help the students to realize the importance of team spirit, ethics, integrity and professionalism. In a class discussion many people expressed their opinions. Some gave ideas that how such kind of people should be handled. Through this incident the students experience something usually not taught in classrooms but often encountered in team collaborations.

Though not required, many groups conducted customer surveys to assist their product developments. One of them had conducted a survey from over a hundred people to determine the marketable price range of their product. These show that once facing practical problems the students are able to find the right ways to solve their problems.

It was a pleasure observing the student's oral presentations. In the beginning, most of them were shy and not confident. Gradually they became much more confident and then the PowerPoint slides and the presentation styles varied. The presentations became more interesting. Creative ways of presentations were performed in the classes. Chinese students, especially Chinese engineering students are usually weak in oral communications. The student behavior demonstrates that they are able to become fluent speakers if they are given enough chances to practice. This also proves that the CDIO initiative helps to develop the student's potentials.

The CDIO training helped the students to become more organized. They learn and apply the skills in their daily life. The authors are also the mentors of a group of freshmen. We participated two class get-togethers and an evening concert. They did written agenda for

meetings and planned the programs. Attending the concert one would really be surprised by the organizing skills of these inexperienced young people.

The students are very inexperienced in hand on work. They tend to be fascinated by their brilliant ideas but do not know that even a very simple product would need much greater efforts and more considerations than they could imagine. For instance, one group wanted to develop a massaging eye mask with wakeup alarming function. It seemed to be a wonderful idea. However, when it came into design and implementation, they soon realized that their current technological background and their means of fabrication were far from adequate for them to go any further. Another group wanted to develop a transformer-like power socket and plug set. And that was intended for replacing portable power extensions. They finally realized that, theoretically possible ideas may not be practically feasible or economical. Beside these, the students are not skillful in searching for helpful resources. While developing a product, they did not start from providing the functionalities of it. Instead, they tried to start from learning the background theories of the relevant technologies. This is of course impossible with their current background and in such a short time.

At the end of the semester, every student wrote a review about the course. Overall, the responses are very positive. Most people were happy with the different ways of learning, the discussions and the project skills and tools. Some complained that the actual time spent was longer than what it should be for a one credit point course, which is supposed to be 40-50 hours total. Most pities were focused on the inability to produce the prototypes of the products.

Being inspired by some TV programs, we plan to change the next session of the course from product developing to a creative competition. The rough plot is as follows. The students will be required to use an easily available material, like paper to design a set of device. The device should contain as many as possible mechanisms using mechanical, chemical, optical and whatever principles. Once triggered, the device will automatically run from the first mechanism to the last one. In such a way they try to apply various of physical and chemical principles in simple device design and prototyping. The device itself is structure-civil linked. Thus, the students have chances of experiencing all the five engineering disciplines the College offers. On top of this, they learn project management and team spirits.

Conclusions

Current Chinese university students are inexperienced in teamwork and project work. The introduction course helped the students to develop their team spirit, project management skills and communication skills. The content chosen and the way of delivering the course appeared proper. It is constructive in developing the student's personal and interpersonal competencies. However, the way letting the students freely choose the products to work on had problems. The projects the student chose exceeded time constraints and the student's ability. Measures need to be taken to confine the student's projects within realistic scopes.

References

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Biographical Information

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