IMPLEMENTATION OF CDIO THEORY IN EDUCATION OF INDUSTRIAL DESIGN STUDENTS

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ABSTRACT

Industrial Design (ID) requires an unremitting innovative ability, broad academic vision, multi-discipline knowledge and strong team cooperation willing, since ID targets to design the future human life and appears in the early stage of a product project where nearly 80% of the manufacturing and marketing effectiveness is determined by ID. In order to maximize the ID students' capability and meet the engineering requirements of society, the CDIO theory is implemented in education of industrial design students of China. By CDIO education, students have lots of opportunities for internship and participation in real design projects, and several research and design centers and practice bases are installed to allow students to connect companies and manufactures more closely. First of all, the curriculums are set to support CDIO. Another method is that an exploratory learning method is introduced. To achieve exploratory ability training, work studios are established under supervisions of different tutors specializing in different research fields. A third case is the logical reasoning design training. Instead of inspiration focus, a strict logical thinking process is emphasized whether in class or in design practice. Students are required to think about questions like what? why? and how? This helps them improve their ability of spotting problems, analyzing problems and solving problems. On top of that, the personality shaping is the most important part of engineering education. Some practice courses are set to let students to learn about gratitude, goodness, honest, responsibility, care for other people. In short, the outcomes from ID department in Tianjin University of China are welcomed by the society. Most become top designers or managers in various companies.

KEYWORDS

CDIO, industrial design students, exploratory learning, personality shaping, Standards: 1

INTRODUCTION

Industrial Design (ID) is an inter-discipline focusing more on establishment of a new reasonable, healthy and comfortable style of living, working and socializing of the future, rather than merely combination of art and technology. As an application science, ID is employed in solving many kinds of practical engineering problems. Therefore, ID students should connect themselves closely to the society and manufacturing companies, and this condition necessitates the liaison between theory and practice. ID designers' virtue and cultural value are vital to society as they are committed to pursuit the truth, happiness and beauty of the human life.

In order to maximize the ID students' capability and meet the social engineering requirements, the CDIO theory is implemented in education of industrial design students of Tianjin University, China. CDIO provides an engineering education that stressing engineering fundamentals set in the context of the Conceiving–Designing–Implementing–Operating process in team-based environments(Gu et al. 2008, cdio.org). Many institutions have been employing CDIO pattern in engineering education, for example, elementary electrical engineering education(Marasco et al. 2013), Human-Machine interface course(Liu et al. 2013) and electronics(Svensson et al. 2012). However, ID is in between art and engineering, thus inspiration is probably thought as the most influential factor while engineering education is neglected, but in fact, CDIO education is urgent in ID education since ID is very close to life. ID students need to culminate in the realization of their proposed work. In this paper, CDIO is implemented and integrated with new concepts in ID students' education.

CDIO EDUCATION SYSTEM DIRECTED BY REAL DESIGN PROJECTS

In the CDIO education system of ID department in Tianjin University, China (as Fig.1), students are strongly centered while teachers and institutions function as support.

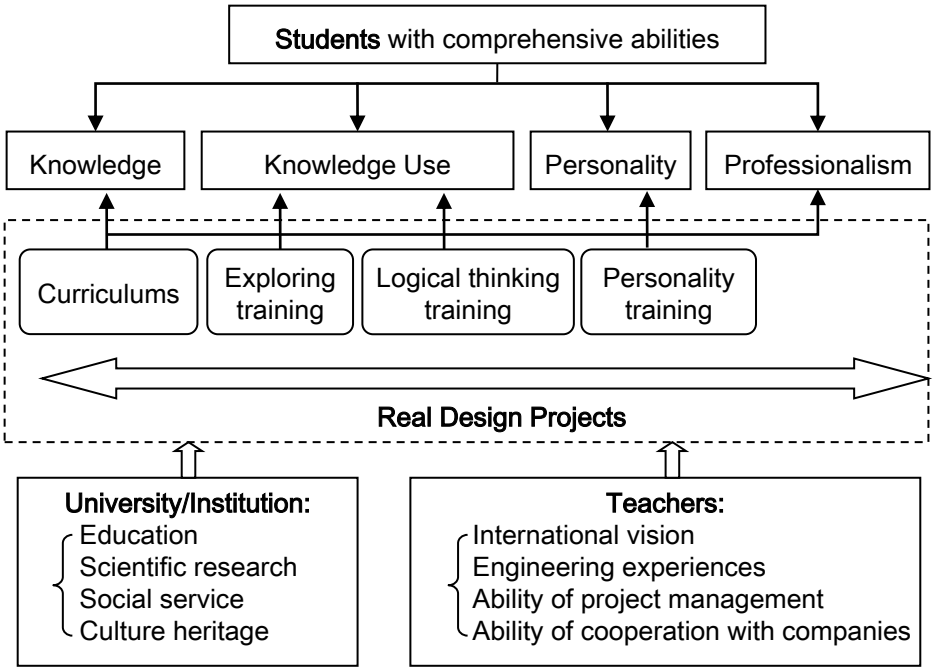

Fig.1 CDIO education system of ID department in Tianjin University

CDIO theory is introduced to Tianjin University according to the society requirements since 2006. Nowadays, companies emphasize on various personal abilities, such as knowledge use, active learning, problem solving, team cooperation and management, instead of specialized knowledge alone. At the same time, employees are required to be ethnic. Thus, educational reform has been carried on under the guidance of CDIO theory.

From the whole process of Conceiving to Designing, Implementing and Operating, real design projects are studied all the way. To encourage early industry participant in project research, the institute sets up joint laboratories with long-standing partners to allow students to connect companies and manufactures more closely, for example, XCMG Group - the largest construction machinery manufactory of China, Robotic company and Medical machinery company. Therefore, students have lots of opportunities for internship and participation in real projects. The partners also ease the transfer of technology from its research to industry.

As one of the important support part of education, teachers should have international vision, ample engineering experiences, abilities of project management and cooperation with companies.

SETTING OF CURRICULUM IN CDIO

CDIO sets a close connection between teaching, learning and doing according to the whole life cycle of a real project(Zha 2008), which requires different courses be tightly linked and duplicate course contents be avoided. In this way, students could understand explicitly the relationship between each course and then could use corresponding knowledge well in the right project stage. Thus, it is urgent to break the barriers between courses and between teachers.

In ID education, there are some courses about introduction and basic skills for the freshman students. After that, four main teachers charge four branch fields respectively, which are graphic design, product design methodology, human-machine interaction and semantics. The four branches are carried through the next three years in parallel, and move in-depth gradually. Taking the human-machine interaction branch as an example, the Ergonomics about physical constraints goes first, and then human-machine interface design about psychological constraints goes after. More importantly, there is a practice of curriculum design based on real projects after each in-class theory teaching course, by which students can apply the theory to practice immediately. This curriculum of “one theory course, one practical course” could help make up for the limitation that mere CDIO education would probably result in the lack of systematicness or integrality in professional knowledge. At the students’ fourth year, a lecture course about foremost international researches is programmed to help expand students’ horizon.

WORK STUDIO BASED EXPLORATORY LEARNING IN CDIO

Exploratory ability is particularly important for ID students since ID targets to plan the life and behavior in the future, and existing knowledge is difficult to solve unknown future problems. Therefore, ability, especially active exploring and active learning, outweighs knowledge itself. Students should have broad academic vision, cross multi disciplines and unite different kinds of intelligence in real life designs.

Work studios are established to support the production of new interdisciplinary work and then help develop high exploratory ability in ID education. A work studio is a centrally located open space that is part of the university’s main gallery where the students carry out work in a public domain. One tutor is responsible for a special work studio positioning to a specialized design branch area. Activities in a work studio may include market researches, academic

exchanges, critiques, and manufactory visiting, and so on. Work studios offer junior and senior undergraduates extensive opportunities for specialisation according to individual preferences, and enable students to develop sepcialised knowledge in areas such as graphic design, product design, ergonomics, interaction design, sustainability and entrepreneurship relative to specialisation. Thus, during the work studio research and discussions, students have a deep understanding of ID, know well about how skills and knowledge support the design process and are aware of the job and society requirements in advance. They become more initiative and collaborative.

The emphasis on student-directed learning and integrated practices in project design within work studios makes it a dynamic and rewarding pattern of study.

LOGICAL REASONING DESIGN TRAINING IN CDIO

Stages in CDIO training are relevant to each other. When it comes to ID, which is the forefront of new product development, its idea, orientation and concept determine nearly 80% quality of a new product. Meantime, ID affects the effectiveness of later production and manufacturing importantly. Thus, it is an armchair thing if it lacks reasonable, logical and systematic analysis in project development.

Instead of inspiration focus, a strict logical thinking process is emphasized whether in class or in design practice. Students are required to think about questions like what? why? and how? At the end of each CDIO stage, a presentation that summarizes the process and work accomplished needs to be given by a project group, where students and lecturers would argue the cause and effect, advantages and disadvantages, positive and negative, etc.. By the argumentation, students could command the basic professional knowledge better and improve their language skills such as verbal ability and graphing. The presentation tends to be inexplicit and incomprehensive if students have not been provided with systematic knowledge. Finally, students are expected to culminate in the realization of the proposed work.

Logical reasoning design training helps students improve their ability of spotting problems, analyzing problems and solving problems.

CDIO INCORPORATING WITH PERSONALITY SHAPING

In China, most engineering education is centered on knowledge and skills. Due attention is scarcely paid to education of integrity and ethics, especially professional ethics, since students do not have to take a test of personality. Professors and lecturers have to admit that many students are not gaining enough understanding of the culture, history and environments. Thus, the gap between social requirements and available unqualified engineering graduates, who may pursue individual benefits and have no cooperation intention, has been widening. Therefore, in education of ID students of Tianjin University in China, personality shaping is incorporated in CDIO, and cultivating people is seen as important as imparting knowledge.

Starting from the perspective of curriculum, some practice courses are set in summer or winter vacations. In these courses, students are asked to help their parents in doing housework or find a way of loving parents, for example, helping wash feet and doing

massage. The course results show a significant effect on students' attitude of gratitude, which is very different from the traditional way of historical or political course. Students learn to know and love their family and friends. In the same way, they learn how to get the needs and wants of general customers. Meantime, students gain many skills of communications, enhance the sense of responsibility, and feel grateful to the society in the process of understanding others.

Another influential method is training by real life design projects, where humanities are emphasized throughout the whole development process. As the Master's saying goes, "Being a man is a great enough achievement". This helps educate a real qualified engineer or designer with professional ethics and integrity.

CONCLUSIONS

ID is far more than a subject with mere combination art and technology. It's a vital area influencing the success or failure of a new product. In order to maximize the ID students' capability and meet the social engineering requirements, the CDIO theory is implemented and improved in education of ID students of Tianjin University in China.

- Curriculums cover systematic theoretical courses and practical courses, which makes it supportable to CDIO.

- Work studios are established under supervisions of different tutors specializing in different research fields to achieve exploratory ability training.

- A strict logical thinking process is emphasized whether in class or in design practice rather than inspiration focus.

- Personality shaping is incorporated in CDIO education.

Facts show that about 1/3 graduates become top designers or managers in top design companies of China such as Baidu Company, Tencent Company and Lenovo Company, about 1/3 graduate choose to gain a master degree of ID, and about 1/3 graduates go abroad to study ID further. The employment is rather high compared to similar subjects.

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