Development of engineering drawing ability for emerging engineering education

Jian-Wen Guo*, Xiao-Chang Cao, Li Xie, Jian-Jun Jin, Chu-Diao Wang

Dongguan University of Technology, Dongguan, GuangDong, 523982, People’s Republic of China

*E-mail: given_gjw@163.com

Abstract: Students majoring in engineering is required by the emerging engineering education (3E) in the aspect of their ability of engineering drawing. This paper puts forward training mode of engineering drawing ability for 3E. This mode consists of three kinds of training including training in courses, training in competitions and training in actual demand. We also design the feasible implementation plan and supplies viable references to carry out the mode.

1. Introduction

The new round technological revolution and industrial transformation are accelerating and the competition in overall national strength is fiercer. The new booming economy which is characteristic of new technology, new condition and new industry asks engineering talents for higher ability of innovation and entrepreneurship and of transboundary integration to boost economic transformation and upgrading. Now, many universities are urgent to carry out emerging engineering education (3E) [1]. On the one hand, they need to establish and develop several new engineering majors. On the other hand, they must promote the existing engineering majors to reform and innovate and explore the application of more modern curriculum as well as training engineering talents with innovative ability.

Engineering drawing is a required skill in engineering majors, such as Mechanical Manufacturing, Industrial Design, Industrial Engineering, Environmental Engineering, Civil Engineering, Process Equipment, etc.. The rapid updating of manufacturing technology and the unending changes of manufacturing market demand put forward new requirements for students' drawing ability. In the new background of new engineering, the training of engineering drawing ability needs to be based on the needs of society, closely combined with the development of the market, cultivating the training of innovative engineering talents. Combined with the development needs of new engineering majors, we establish engineering drawing ability training mode. This mode creates an environment to study, research and innovate for students and provides a referenced scheme to train engineering drawing ability of engineering majors for the requirements of 3E.

2. Training mode of engineering drawing ability

Development of engineering drawing ability for 3E is a kind of teaching mode which relies on engineering drawing courses and uses innovative teaching measures to enable students to master the skills of engineering drawing and to improve the professional ability. This training mode is shown in figure 1.
(1) Training in courses. When students have their courses Mechanical Drawing in their first year, we are going to improve the quality of course teaching through establishing the teaching system-Virtual Reality based on Mechanical Drawing system.

(2) Training in competitions. When students have the course Three-Dimensional Drawing Skills Training in their second year and third year, we are about to integrate competitions at home and abroad and professional skills certification requirements as well as theories into the creative education in engineering drawing. What’s more, in order to promote the teaching effect, we will mobilize students to compete and obtain certificates.

(3) Training in actual demand. At the time of learning Three-Dimensional Software Integrated Training in students’ fourth year, we will make full use of students’ spare time to organize them to have practical training using the mode of Witkey. Therefore, students’ ability of engineering drawing will develop under the motivation of daily and common tasks.

Figure 1. Training mode of engineering drawing ability

3. Implementation

3.1. Engineering drawing ability training in courses
The core of this kind of training is to enhance students’ spatial imaginative ability and drawing capacity. The training adopts engineering drawing teaching system-Virtual Reality to assist students to study. The Virtual Reality based on mechanical drawing system is explained in our previous research [3]. The system is realized by VRML and Java. According to the teaching process of mechanical drawing course, this system provides Virtual Reality to support students to learn by themselves. Through this system, students can have interaction with relevant virtual object or event in the virtual environment and realize the perception of 3D Model. Figure 2 is the system interface.

3.2. Engineering drawing ability training in competition
This kind of training regards engineering drawing skills competitions as its carriers and encourages students to take part in various kinds of engineering drawing competitions and to study for their certificates. It combines knowledge of different subjects and skills to arouse students’ interests and to offer a platform to them to study and improve themselves. In doing so, not only can students perfect their quality in competitions and practical activities, but also form a mechanism which depends on drawing skills competitions and obtaining certificates and other creative activities to advance students’ creative skills.

In the course of Three-Dimensional Drawing Skills Cultivation, the training attaches importance to drawing standards and three-dimensional drawing skills training. In the extracurricular practice, teachers divide students into several after-school clubs so as to further foster students’ ability by the
form of training and lectures. We mobilize students to join in professional competitions as well as certificates. Figure 3 is students’ training for competition.

**Figure 2.** Virtual Reality based on Mechanical Drawing teaching system

**Figure 3.** Students’ training for competition

### 3.3. Engineering drawing ability training in actual demand

Engineering drawing ability training in actual demand will be conducted by the form of Witkey. Witkey is the person transforming knowledge and ability into actual income through internet [3]. This mode will be carried out in the course of Three-Dimensional Software Integrated Training in the fourth year. The Witkey platform is referred specifically in our previous research. [4] It is more similar to operation pattern of great enterprises. Students will establish virtual studio and participate in corresponding Witkey tasks according to their own hobbies, interests and professional expertise.

### 4. Conclusion

Under the background of new technology, students’ ability of engineering drawing is required and therefore this article puts forward training mode of engineering drawing ability. This mode can provide feasible reference for implementation of engineering drawing training.

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