

Research on the Practical Teaching of Mechanical Drawing based on the Whole-Process Combination

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Abstract. In order to cultivate the mechanical drawing ability and technology of the students majoring in interdisciplinary combination of medicine and engineering of applied new engineering universities, and to meet the national "13th five-year" special plan for scientific and technological innovation of medical devices, this paper puts forward the practical teaching mode of mechanical drawing combined with the whole process of interdisciplinary combination of medicine and engineering. Here that means that the course content and teachers' demonstration practice are integrated, students' comprehensive surveying and mechanical drawing practice and specialty are integrated, skills competition and course innovation are integrated, and subject competition and course practice are integrated. Through constructing the curriculum practice platform, the skill competition platform and the discipline competition platform, the student's practice ability is trained step by step. The practice proves that the whole-process integrated practice teaching mode can effectively stimulate students' awareness of innovation and strong interest in professional research, highlight the awareness of engineering practice, and cultivate students' ability of practice and innovation. it is an effective way to cultivate applied innovative talents majoring in interdisciplinary combination of medicine and engineering.

Keywords: Mechanical Drawing; Whole-process; Combination; Practical Teaching; Biomedical Engineering Specialty.

1. Introduction

Biomedical engineering and clinical engineering are typical engineering specialty in our university. This specialty require that the cultivated students have clinical medical engineering technical accomplishment and the technical foundation of medical devices, and the ability to serve medical applications. They can engage in clinical application, maintenance, quality control of medical devices and equipment, and can extend to the application of biomedical engineering.

The national "13th five-year special plan for scientific and technological innovation of medical devices" proposes that advanced medical devices are an important foundation for the construction of health security system, the main driving force for the advancement of medical treatment technology, and an important symbol of national scientific and technological progress and national health security capacity [1]. The cultivation of "new engineering" talents by the ministry of education also requires a lot of engineering practice training, so that theoretical knowledge can be well applied in practice. Therefore, the cultivation of students' practical ability is an important part of professional construction.

The mechanical drawing course is the first course of engineering consciousness training for the undergraduates who combine the two interdisciplinary combination of medicine and engineering in our university. It is also the basic course for the students to study and engage in the engineering technology work in the field of medical equipment engineering. How to better deepen the reform of the teaching contents and methods of "mechanical drawing practice", and how to improve the teaching quality, and how to implement the training plan of "new engineering" and "application type" for undergraduates have become an important and urgent subject for the curriculum group of "mechanical drawing practice" to deepen the teaching reform.

2. The Requirements of Practice Teaching of Mechanical Drawing in Combination with Undergraduate Education

It is embodied in the whole process of mechanical drawing practice teaching that to cultivate innovative application-oriented talents in combination with practical interdisciplinary combination of medicine [2]. In the teaching of mechanical drawing practice course, we pay attention to cultivating students' engineering awareness and application ability, and utilizing typical medical device surveying and mechanical drawing project to supplement traditional surveying and mechanical drawing training program, then the implementation of teaching practical would meet the professional training standards. After the implementation of the teaching reform, the practice course of mechanical drawing was well connected with the subsequent professional course, which enhanced the students' ability of practical application and innovation and improved the teaching effect.

(1) The "integrated" mechanical drawing practice teaching site is enabled, which has both multimedia teaching function and traditional mechanical drawing room function. Multimedia courseware with large image, vividness and large amount of information and traditional mechanical drawing tools are applied interchangeably, which deepens students' understanding of course practice and improves students' practical ability.

(2) In view of the practice of mechanical drawing course teaching content reform, we have employed not only the traditional practice of surveying and mechanical drawing project "surveying and mechanical drawing training of reduction gearbox" and "surveying and mechanical drawing training of gear pump", but also develop the "surveying and mechanical drawing training hemodialysis peristaltic pump" and "surveying and mechanical drawing training of rehabilitation equipment" and other typical medical apparatus and instruments as practical project. The last two projects serve as enhancement course of mechanical drawing practice.

(3) We also encourage students to use AutoCAD, Solidworks and other mechanical drawing software to innovate, to participate in the tutor's research group, to take part in various skills competitions and discipline competitions. so far, they have won a number of Shanghai and national awards, and it also realized the sustainable application of mechanical drawing practice course in higher education.

3. The Whole-process of Mechanical Drawing Practice Teaching Mode

To meet the above practical teaching goals, we have realized the whole-process integrated practical teaching mode, and carried out reform attempts on teaching methods and means, teaching contents and teaching system [3-7].

3.1 The Integration of Course Content and the Teacher Practice Demonstration

The courses of mechanical drawing practice are usually taught by first-year students, who have little contact with production practice and know little about the major, and lack the awareness and practical ability. Driven by project-type objectives, with AutoCAD and Solidworks as tools, the teaching mode of combining classroom teaching with practical teaching is adopted relying on the self-compiled teaching material of project-oriented teaching.

The specific plan is to teach CAD basic operation based on the representation of the project, teaching in the computer room with teacher demonstration practice and students studying with a computer, while speaking and practicing, completing the two-dimensional drawing and three-dimensional modeling of four kinds of parts including shaft sleeve, plate cover, fork rack and box. In the practice stage of surveying and mechanical drawing, the teacher adopts Solidworks model and animation form demonstration and drilling, and the students complete surveying and mechanical drawing of reduction gearbox, gear pump, hemodialysis peristaltic pump and prosthesis knee joint, etc. then that would complete the practical course requirements of three-dimensional model and two-dimensional view.

At the end of the project, various electronic documents and PPT concluding reports such as paper surveying and mechanical drawing, AutoCAD drawings and Solidworks model were submitted. In

the total 128-class teaching process, driven by the project, students learn to use two CAD software and practice the teaching mode, which improves students' learning interest and practical ability.

3.2 The Integration of Students' Comprehensive Surveying and Mechanical Drawing Practice and Specialty

Mechanical surveying and drawing practice are an important practical teaching link after the students have learned the theory, and it is also the first design training conducted by students, which can make the knowledge learned to be integrated. As the four-year study in university is a systematic engineering, the connection between each course is very important. If this training is closely related to the major students have learned, it will be more helpful for students to learn subsequent professional courses. For the course content reform of mechanical drawing practice teaching, we have not only the traditional practice of surveying and mechanical drawing project "surveying and mechanical drawing training of reduction gearbox" and "surveying and mechanical drawing training of gear pump", but also develop the "surveying and mechanical drawing training hemodialysis peristaltic pump" and "surveying and mechanical drawing training of rehabilitation equipment" and other typical medical apparatus and instruments as a practical project.

Served as enhancement course of mechanical drawing practice, the last two projects make the drawing content and subsequent professional learning has better cohesion, which also further improving the ability of using the CAD software to design. Such course content design is conducive to the training of students' comprehensive ability, which not only conforms to the actual CAD design process, but also improves students' engineering awareness and engineering accomplishment, and also cultivates students' practical and innovative ability, cooperative spirit and communication ability.

3.3 The Integration of Skill Competitions and Course Innovation

The technical competition related to mechanical drawing course is mainly Shanghai "advanced drawing cup" mechanical drawing technology and innovative design competition. In recent years, our school has achieved remarkable achievements in this project and so as to have realized the goal of promoting learning by competition, teaching by competition, and building by competition, as shown in table 1.

Table 1. Awards on "advanced drawing cup" of students of Shanghai University of Medicine & Health Science

Skill competition name	competition time	award
The 8th "advanced drawing cup" innovative design competition	2018.5	6 first prizes, 9 second prizes and 5 awards for excellent instructors
The 7th "advanced drawing cup" innovative design competition	2017.5	4 first prizes, 5 second prizes and 4 awards for excellent instructors
The 6th "advanced drawing cup" innovative design competition	2016.5	9 first prizes, 6 second prizes and 5 awards for excellent instructors
National 3d digital innovation design competition	2017.11	1 special prize, 1 second prize and 2 third prize

3.4 The Integration of Subject Competition and Course Practice

Biomedical engineering is a multidisciplinary fusion result, so we encourage the students to participate in mentor's research group and employ AutoCAD, Solidworks, such as mechanical drawing software to innovate.

In recent years, the project team to guide students to participate in the "national college of biomedical engineering innovation design competition", "Internet +" innovation and entrepreneurship competition, "Challenge cup" extracurricular academic competition, national e-commerce "innovation, creativity and entrepreneurship" challenge competition and so on. They have won many

Shanghai and national awards, and which also have realized the sustainable application of mechanical drawing practice courses in higher education, as shown in table 2.

Table 2. Awards on discipline competition of students in Shanghai University of Medicine & Health Science

Subject competition name	competition time	award
The fourth national biomedical engineering innovation design competition of college students	2018.08	The first prize
The third national "Internet +" innovation and entrepreneurship competition of college students	2017.10	Bronze
The 15th "Challenge cup" extracurricular academic competition of science and technology works of university student's in Shanghai division	2017.05	2 second prize
The third and fourth China "Internet +" innovation and entrepreneurship competition of college students in Shanghai division	2017.09 2018.07	Special award 2 second prize
2018 "creating youth" entrepreneurship competition of college students	2018.05	third prize
The 8th national e-commerce "innovation, creativity and entrepreneurship" challenge competition of college students	2018.06	First prize 1, second prize 1, third prize 2
The "maker competition" of Shanghai university student	2016.12	First prize
ICAN innovation and entrepreneurship competition	2017.11	The second prize

4. Summary

According to the decision of the state council on accelerating the development of modern career education and the implementation opinions of the general office of the state council on deepening the reform of innovation and entrepreneurship education in institutions of higher learning and other documents, the comprehensive reform of education in colleges and universities is further promoted to improve students' professional quality and innovation and entrepreneurship ability[8]. The practical teaching mode of mechanical drawing based on the whole-process of interdisciplinary combination of medicine and engineering integrates the course content and teachers' demonstration practice, students' comprehensive surveying and mechanical drawing practice and specialty, skills competition and course innovation, and subject competition and course practice. Through constructing the curriculum practice platform, the skill competition platform and the discipline competition platform, the student's practice ability is trained step by step. The practice proves that the whole-process integrated practice teaching mode can effectively stimulate students' awareness of innovation and strong interest in professional research, highlight the awareness of engineering practice, and cultivate students' ability of practice and innovation. It is an effective way to cultivate applied innovative talents majoring in interdisciplinary combination of medicine and engineering.

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