Study and Practice on Teaching System Reform of Engineering Graphics Based on Training Engineering Consciousness

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***Abstract*— It is very important and meaningful to improve college students' engineering consciousness and project practice ability in engineering graphics teaching, so that excellent engineers, who adapt to the development of economy and society, can be cultivated. Based on the research and analysis situation of the home and abroad in engineering graphics teaching, many methods to cultivate students' engineering consciousness are proposed, concrete measures include: constructing the teaching method system of case-based teaching technique; building the content system which begins with the three-dimensional configuration design as a starting point, lays equal stress on a variety of expression modes, emphasizes the cultivation of ability to freehand drawing and teaching of engineering application, and pays attention to practical teaching.**

Keywords-engineering graphics; case teaching; teaching reform; engineering consciousness

I. INTRODUCTION

Engineering graphics is technology basic course which has strong engineering consciousness and the practical requirements, and it is the first important compulsory course for engineering students [1]. The problems which the engineering graphics teacher must be meet, think about and solve are: how to improve the students' engineering consciousness, how to bring up students' engineering ability in order to develop students to adapt to social and economic development, with the development of manufacturing industry and science and technology [2].

Based on the analysis of American, Japanese engineering graphics teaching contents, teaching methods, and combined with Chinese teaching practice of engineering graphics, this article structure engineering graphics' curriculum system including to teaching content system, teaching method system based on training university students' engineering consciousness.

II. THE SURVEY OF THE TEACHING ACTUALITIES OF ENGINEERING GRAPHICS

Some American engineering graphics teaching revolves around product design to bring up students' engineering expressive ability, and combining with engineering practice and the requirements of enterprises in teaching. Their teaching are not only pay attention to the cultivation of students' researching thinking, but also emphasize to develop students' practical ability and expression skills through combining with the practice teaching and classroom teaching [4]. For example, California University pay attention to the cultivation of students' ability to solve practical engineering problems and manipulative ability, combined with practical teaching and classroom teaching [5].

In Japan, graphics curriculum emphases are different for different professional students, in order to combine with the subsequent course. In addition, Japanese graphics teaching pays more attention to the combination of enterprise requirement. Teaching contents are integrated with product manufacturing and designing, and emphasize to cultivate students' creative thinking and practical ability.

In China, owing to long-term influence of examination oriented education, it is difficult to realize the transformation from theory education to engineering education when students entered the university stage. The students' engineering consciousness is eroded so that it is very difficult to combine knowledge and engineering practice, so our students' design is unrealistic.

In recent years, some domestic universities carried out some exploration and research of engineering graphics teaching reform. The Supervision Board for teaching engineering

graphics education of Ministry of education revised "Basic requirements for Engineering Graphics Teaching in ordinary colleges and universities", it introduced the ideas about industrial product design, it proposed engineering graphics teaching should begin with training of engineering culture quality and setting up innovation design thinking, should base on carrying out the new standard of engineering drawing, configuration expression design, and configuration design, should take basic theory, basic knowledge, and basic skills of graphical representation as the basis to cultivate three kinds of ability to the drafting, gauge drawing and computer drawing.

III. Construction of Engineering Graphics Teaching System Based on Cultivating Students' the Engineering Consciousness

A. Construct "Case-Based" Classroom Teaching Method System

The "case" teaching method can help students to understand the relevant knowledge and principle about teaching object by case analysis, so as to set up the engineering concept and enhance the engineering practice consciousness.

First, teaching case selection: In the whole course of teaching engineering graphics, choose cases following three aspects: First, cases should serve for theoretical knowledge. The case selected should have effect of guidance and inspiration. Trigger students interest easily, hence stimulate students' enthusiasm in exploration and innovation; second, the case must be typical and representative. Usually display the most common characteristics, meaning in the same kind of things, through the study of one case, we can explore the inherent law of the same kind cases; third, case should be practically in engineering and close to the production practices. Case selection is better from the project site, it can enhance students engineering consciousness and make up for students' lack of engineering background, greatly reduce the gap between teaching situations and practical engineering situations.

Second, design the teaching process: "Case-based" classroom teaching is usually describe the subject and teaching goal of this knowledge at start, and leads to the basic concepts, characters of teaching content and explore problem-solving ideas by using teaching cases, and finally solve the problem raised by the case, as shown Figure 1.

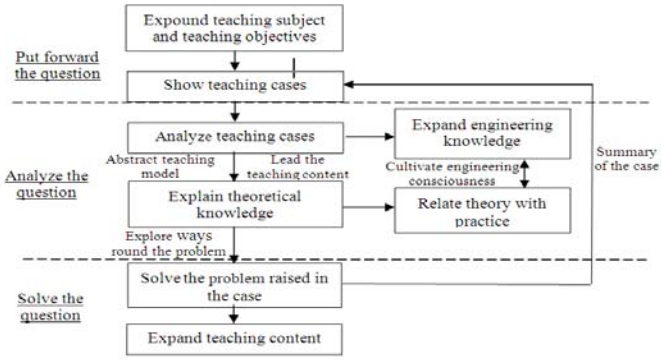

FIGURE I.TEACHING PROCESS DESIGN

The whole teaching process is based on "case" as the clue, using the process of cognize things that people are most familiar which is "ask questions, analyze and solve problems" to complete the teaching process of the whole teaching knowledge points. First, raise questions through teaching cases. Cases can take full advantage of illustrated multimedia, present engineering practice scenes with a rich three-dimensional multimedia, help students understand some principles of the machine, analyze background of teaching cases, expand students fundamental knowledge of engineering. Next, analyzing the basic concepts, nature of the teaching content which be led by the case, and exploring the solutions of raised questions. Guide students to think actively about how to solve the problems raised in the teaching case, so that students know where to use what they have learned; and finally, use of theoretical knowledge to solve practical problems raised in the teaching case, improve students' ability to solve practical problems. At the same time, it requires the ability to draw inferences, and to expand the teaching content.

The last, an example of teaching process: The teaching process about "intersection of a plane and a cylinder" can begin with the "ball valves" teaching case. When teaching case is showed, all the parts of ball valve can be dismantled, and its internal structure can be show through the teaching video. By the analysis of working principle, the structure and function of the valve stem can be clearly grasp, then the stem can be simplified to a cylindrical tenon model. At last, the projection of intersection of a plane and a cylinder can easily be draw. The teaching process is as shown in Figure 2.

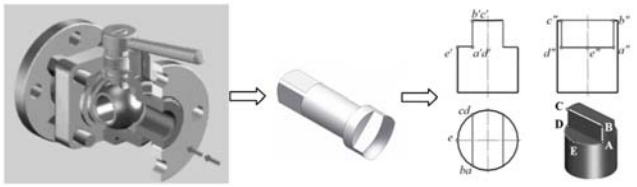

FIGURE II. TEACHING CASE——"BALL VALVES"

B. *The Construction of Teaching Content System Based on Cultivating Students' the Engineering Consciousness*

First, build teaching content system along the main line of designing three-dimensional configuration: The product design process is often around the subject of product design and manufacturing, start from the three-dimensional configuration and expression to a two-dimensional view, and highlight a variety of visual expressions in the integrated application in the process of design and manufacture. Based on studying object configuration method, students are required to master a variety of expression methods of three-dimensional shape, to meet the requirements of product design. Combined with requirements of designing and processing product and based on three-dimensional expression, teaching a two-dimensional view is started, and from an engineering point, the basic view, cross-sectional view and direction view is introduced.

Second, integration of a variety of drawing methods, emphasizing cultivating students' ability to freehand drawing and the part of teaching engineering application: The three parts of descriptive geometry, engineering drawing, and computer drawing are integrated into the whole teaching process in order to achieve comprehensive training three graphics capabilities of manual sketches, instruments drawing, and computer drawing. In the early stage of product configuration design, freehand drawing three-dimensional and two-dimensional sketch could express the design intent in the most directive and convenient way, more importantly, which can play a key role in quickly capturing design ideas, inspiring design idea in the design process. Therefore, the freehand drawing ability is an important capability which students should have. Comprehensive applications of expression method, technical requirements, standard parts and commonly-used parts, detail drawings and assembly drawings are applied in actual production and reflect the engineering awareness, so teaching about these parts should be strengthened. Cut off part of the contents of descriptive geometry, as to those problems which can be solved easily by graphic and the difficult and abstract part that automatically generated intersection line when the three-dimensional is modeled could be deleted, and recommends drawing intersecting lines in a simplified way. It doesn't affect manufacturing and could save drawing time; reduce the difficulty of drawing so that students accepted easier.

At last, strengthening practice: Practical part of drawing integrates the drawing, mechanical practices with survey and draw together. In teaching organization, understanding modern mechanical design and manufacturing technology, applying basics mechanical drawing knowledge, learning parts survey and draw, and taking part in redesigning typical products are taken as important teaching part, built practical skills and project's awareness of students. In practically training of survey and draw, from measuring the simplest assemble model to shaft-sleeve group, to the parts of the case-housing group and fork-frame group, and learn the component structure, process requirements and the functions of parts in the machine. Through drawing sketches, then understanding the effects and requirements of the process structure, and lay the foundation for subsequent courses of study, make students to possess basic capability of engineering application. Strengthen the practice content of computer graphics. Use computer graphics software to complete the entity modeling, three view drawing, section view drawing, detail drawing, assembly drawing and other special training.

IV. SUMMARY

Nowadays, with the rapid development of the manufacturing industry and science and technology, and training of excellent engineers, means not only updating educational ideas and concepts, but also the need to reform the teaching content system, teaching methods system. How to combine the specific circumstances of different universities for different engineering professional features, further deepen classroom teaching reform of engineering graphics, it needs for further research and try in the future.

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