

Exploration on Project-based Teaching Reform of Engineering Drawing Course

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Abstract—Engineering Drawing is a basic course of mechanical specialty, and it is a link to follow-up specialty courses. In order to improve the quality of classroom teaching, project-based teaching reform is implemented in 10 projects based on curriculum objectives and job requirements. Through the project-based teaching design, which takes students as the main body, project theme as the center, and aims at cultivating students' inquiry learning, the integration of knowledge, theory and ability practice can be realized.

Keywords—Engineering drawing , Project-based teaching , Reform in Education

I. INTRODUCTION

Engineering Drawing is an important basic course for mechanical majors in Colleges and universities. It mainly trains students' drawing and drawing ability. It is the earliest course for students to receive engineering training. It is also the transition and foundation for students to learn follow-up related professional courses. For the students majoring in mechanical engineering, how to draw and read is particularly important. The learning effect of the course will directly affect the students' learning of follow-up courses and mastery of professional skills.

However, the course began in the first semester. Students have just come into contact with professional courses. It is not clear how to apply the knowledge in the follow-up courses and work. Therefore, learning enthusiasm is not easy to stimulate; using traditional teaching methods, teaching and learning interaction is poor; curriculum knowledge points are numerous and difficult to remember, students are at a loss when drawing drawings, it is difficult for them to understand and master the curriculum knowledge systematically, which is not conducive to the cultivation of students' engineering literacy and engineering application ability.

Therefore, how to make students understand and master the important knowledge points of this course, how to design teaching in order to improve students' interest in learning, drawing and reading ability are all urgent problems to be solved in order to improve the teaching quality of mechanical specialty. For this reason, we have carried out the reform and exploration of the course, and carried out the project-based teaching practice according to the course objectives, so as to make the teaching of the course more suitable to the actual situation of students. To pave the way for students' follow-up courses, especially professional curriculum design and graduation design.

II. DESIGN OF COURSE OBJECTIVES

The project-based teaching is based on ability, and the teaching goal of the course should be more prominent in setting the ability (skill) goal. The overall ability goal of Engineering Drawing course is to enable students to learn and train systematically in knowledge, skills and methods through the implementation of project-based courses, and to realize the integration of knowledge, theory and practice. To cultivate good professional quality and values, lay a solid foundation for improving the professional ability of mechanical students. The specific objectives are as follows:

- Skill objectives: to be able to quickly consult national standards, read parts and assembly drawings with moderate complexity, and draw general parts and simple assembly drawings.
- Knowledge objectives: to master the basic theory and methods of orthographic projection method; to correctly read and use drawing instruments to draw part drawings and assembly drawings according to national standards, and to have certain drawing skills and skills; to cultivate and develop students' spatial imagination, and to have three-dimensional shape conception and thinking ability.

- Quality objectives: to cultivate students' ability to analyze and solve practical problems, conscientious and responsible working attitude; to cultivate students' spirit of seeking truth from facts, working methods of integrating theory with practice and rigorous and meticulous working style; to cultivate students' team spirit, and to improve students' professional quality and comprehensive quality.

III. PROJECT DESIGN OF COURSES

Project-based teaching is a kind of teaching activity that teachers and students carry out through a complete project together. It is practice-oriented, project-driven, teacher-led and student-centered. It integrates the learning of theoretical knowledge into the process of project completion, organizes teaching activities through the joint completion of project tasks by teachers and students, so that students can better complete the study of engineering drawing course. The purpose of project-based teaching is to combine theory with practice teaching organically. Through the completion of specific projects, students' comprehensive professional ability and team spirit can be cultivated and improved.

A. Modular Decomposition of Engineering Drawing Course

Engineering Drawing is a professional and technical basic course with rigorous theory and strong practicality. It is a compulsory course for students to study mechanical specialty. It is mainly divided into four modules, namely, descriptive geometry, basic drawing, mechanical drawing and computer drawing. It focuses on training students' drawing and reading ability. The module of engineering drawing course is decomposed as shown in Table 1.

TABLE 1 MODULAR DECOMPOSITION OF ENGINEERING DRAWING COURSE

No.	Modular	Sub module
1	descriptive geometry	Basic concepts of orthographic projection method
		Projection of Points, Lines and Planes
		Projection of Basic Stereo
2	Basic drawing	Relevant Provisions of National Standards for Basic Knowledge of Cartography
		Reading and dimensioning of assembly
		Expressions of Machine Parts
		Isometric drawing
3	Mechanical drawing	Standard and Common Parts
		Drawing and Reading of Part Drawing
		Drawing and Reading Assembly Drawing
4	Computer Drawing	AutoCAD Drawing Training

In the traditional engineering drawing curriculum system, the relevant provisions of the national standard, projection theory, drawing method and other contents are more theoretical, and can be taught in accordance with the traditional teaching methods; at the same time, the teaching order of some contents is adjusted, and where knowledge points are used to explain, such as section drawing can be described in the expression of axle parts, slope and taper can be described in standard parts and common parts. The cone pin narration makes it easier for students to understand and closer to the actual situation.

The drawing of mechanical drawings mainly includes drawing and reading of part drawings, drawing and reading of assembly drawings, interpolating drawing of standard parts and common parts, and the expression method of machine parts can also be explained in this part. In order to solve this problem, we can insert the course content of AutoCAD software into a specific project; when teaching the project content, we can introduce related graphics from shallow to deep, from simple to complex, and explain the relevant drawing and editing commands of AutoCAD in the process of drawing.

B. Project-based Teaching Content Design

Project-based curriculum design should take quality as the benchmark, ability as the standard, project as the carrier, and work process as the guide to realize the integration of knowledge, theory and practice. It should focus on how to improve students' drawing and reading ability. The content of teaching project should come from real cases in production practice, but not too complicated, so as to facilitate students' learning, such as reducer, valve body, gear pump in engineering drawing course. According to the requirement of post professional ability, according to the cognitive law, around the curriculum goal, relying on gear pump project, 10 projects are integrated. The teaching content and project design are shown in Table 2.

The whole implementation process of the teaching project will run through the basic knowledge points and implement the whole teaching content in accordance with the six-step method. The drawing, reading method and the relevant provisions of the national standard will be described from the point, line, surface, body, part drawing and assembly drawing. In the process of teaching, we should embody the design of teaching tasks, and adopt various modes in actual teaching: in the early stage of teaching, teachers can demonstrate and guide students to complete tasks step by step for the part with strong theoretical nature; with the adaptation of students to teaching methods, it gradually becomes the synchronization of teachers and students; finally, it becomes the mode of students' autonomy, in which teachers ask questions and assign tasks to students. Find information with questions, learn independently and discuss the plan, then summarize knowledge points through interactive way, improve and improve the task. Through various modes of teaching methods to stimulate students' learning initiative.

C. Examination Method

In traditional assessment methods, the results are emphasized while the process is neglected. The project-based teaching emphasizes the working process and practice, so the evaluation method of this course has changed, increasing the proportion of process assessment, reducing the proportion of results assessment, and emphasizing the cultivation of students' ability in the process of project learning. The design of the assessment scheme is shown in Table 3.

TABLE 2 TEACHING CONTENTS AND PROJECT DESIGN

Module	Project Name		Teaching Task	Competence Requirements
Basic drawing	Item 1: Drawing of simple two-dimensional graphic		1. Draw the plane figure of the hook and mark the size. 2. Copy the outline of a given part and mark the dimensions	1. Draw the plane figure of the hook and mark the size. 2. Copy the outline of a given part and mark the dimensions
	Item 2: Reading and Drawing Three Views of Geometric Volumes		1. Draw the part drawing of the block and mark the size. 2. Draw part drawings of connecting rods and mark dimensions; 3. Draw part drawings of valve body and mark dimensions; 4. Using AutoCAD to Draw Plane Drawing of Press Block, Connecting Rod and Valve Body	1. Projection law of point-line-surface and combination; 2. The expression method of machine parts; 3. Using the method of shape analysis and appropriate expression to draw the combined volume view
	Item 3: Drawing of Axonometric maps		1. Drawing the positive equiaxonometric map of the compact; 2. Drawing Equal Axis Mapping of Connecting Rod	1. Understanding the classification of Axonometric maps; 2. Grasp the drawing method of positive equiaxonometric map
Mechanical drawing	Drawing and Reading of Part Drawing	Item 4: Drawing of Standard Parts and Common Parts	1. Draw thread fasteners and mark them. 2. Draw keys, pins, bearings and mark them. 3. Drawing Thread Fasteners with AutoCAD	1. Grasp the drawing and marking methods of standard parts and common parts, and consult the technical data of standard parts. 2. Grasp the content of part drawings; 3. Ability to read and draw parts drawings of various parts;
		Item 5: Gear drawing	1. The content of the part drawing and the reading of the gear part drawing; 2. Gear mapping in gear pump;	
		Item 6: Shaft sleeve parts	1. Shaft Parts'structure analysis, expression scheme and technical requirements; 2. Drawing of gear shaft parts in gear pump; 3. Surveying and mapping of parts drawing of middle pressure sleeve of gear pump; 4. Drawing Part Drawing of Gear Shaft and Compression Sleeve with AutoCAD	
		Item 7: Cover Parts	1. Structural features, view selection, dimensioning, technological structure and technical requirements of wheel and disk parts drawings; 2. Drawing of pump cover in gear pump 3. Drawing Part Drawing of Pump Cover with AutoCAD	
		Item 8: Fork rack, box parts	1. Structural features, view selection, dimensioning, technological structure and technical requirements of fork-shelf box parts drawing; 2. Drawing of pump volume in gear pump 3. Drawing the Drawing of Pump Body Parts with AutoCAD	
	Drawing and Reading Assembly Drawing	Item 9: Reading assembly drawings of jacks; Item 10: Drawing assembly drawings of gear pumps	1. The content, view selection and dimensioning of assembly drawing; 2. Reading assembly drawings of jacks; 3. Drawing assembly drawing of gear pump; 4. Drawing assembly drawing of gear pump with AutoCAD	1. The content, view selection and dimensioning of assembly drawing; 2. Reading assembly drawings of jacks; 3. Drawing assembly drawing of gear pump; 4. Drawing assembly drawing of gear pump with AutoCAD

IV. THE EFFECT OF REFORM

Compared with the traditional teaching methods, the project-based teaching reform of engineering drawing course breaks the curriculum content framework based on subject system and can improve students' enthusiasm and autonomous learning ability. While gaining knowledge and solving practical problems through the completion of the project, it also increases the sense of teamwork and makes the knowledge and skills learned more cohesive. The ability of drawing and reading maps has been developed, and the final examination results and pass rate have been improved year by year.

TABLE 3 ASSESSMENT SCHEME DESIGN

Assessment Items		Assessment Methods	Assessment Proportion
Process Assessment	Attitude to Learning	Attendance and Behavior of Students	10%
	project training	Whether the project training work plan is reasonable, whether the implementation plan is correct, whether the skills are skilled, whether it can be completed on time, whether the results are correct and conform to the norms	40%
	Homework	completed on time and quality of work	10%
Result examination	Final written examination	In view of students' learning ability, learning methods, learning content and other aspects of reasonable questions, closed-book examination	40%
Total			100%

REFERENCES

- [1] Sun Weihang and Wen Aimin, "Exploration on the construction of textbook of Mechanical Drawing based on Project-based Teaching," China:Journal of Jiamusi Institute of Education, pp.138-139, February 2011.
- [2] Zhang Meimei ,Liu Yusheng and Xie Yumin, "Practice and exploration of project teaching method in mechanical cartography teaching ," China:Guangxi Light Industry, pp.211-212, September 2011.
- [3] Li Yutong and Yan Chengxin," Equipment Manufacturing Technology," China: Equipment Manufacturing Technology, pp. 219-221, October 2012
- [4] Feng Dongju, Wang Danhong and Xu Zhengguo," Project-driven teaching reform of mechanical drawing," China:Laboratory Science, Vol.15,pp. 25-27, March 2012 .
- [5] Zhang Xiaochun, "Practice and exploration of project teaching method in mechanical drawing teaching," China: Heilongjiang Science, Vol.12,pp. 119, May 2014.
- [6] Zhang Meimei, Liu Yusheng and Xie Yumin. "Practice and exploration of project teaching method in mechanical cartography teaching," China: Guangxi Light Industry, pp.206-207, September 2011
- [7] Sun Weihang and Wen Aimin,"Exploration of textbook construction based on Project-based Teaching + mechanical drawing , China:"Journal of Jiamusi Institute of Education, pp.128-129, February 2011
- [8] Liu Wengang, "Applied Research of Project Teaching Method in Mechanical Drawing Teaching ," China: Science and Technology Information, pp. 193, October 2011
- [9] Li Mei, Tong Shuqi and Zhang Xueli,"Project-based Teaching Reform and Exploration of Engineering Drawing Course," China:Journal of Kunming Metallurgical College, Vol.27,pp.73-76, January 2011
- [10] Guo Lin,"Project-based teaching practice of Mechanical Drawing and Computer Drawing," China:Vocational and technical education. Vol.37, pp.51-53,No.35.2016.