Practical Exploration on the Construction of Experiment and Practice Teaching Links System of "Engineering Drawing + CAD"

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Keywords: "Engineering Drawing + CAD"; Experiment and Practice; Practical Exploration

Abstract: "Engineering Drawing + CAD" is a professional basic course with strong theory and practice. According to the principle of consistency and practicality between the "Engineering Drawing + CAD" course knowledge and subsequent related courses, and the characteristics of engineering drawings as engineering technical languages, the experiment and practice of "Engineering Drawing + CAD" is divided into three parts: inside the course, outside the course and engineering practice. The experiment and practice teaching links system of "Engineering drawing + CAD" for new energy science and engineering majors is constructed. The construction and implementation of the "Engineering Drawing + CAD" experiment and practice teaching links system effectively stimulates the enthusiasm and initiative of students in curriculum learning, improves the quality of drawing teaching and strengthens the comprehensive drawing ability, improves the students' CAD technology level, improves the students' graduation thesis drawing tasks quality, and improves the training quality of innovative talents in universities.

1. Introduction

"Engineering drawing + CAD" is a theoretical and practical basic course for new energy science and engineering major in our university. Engineering drawing is composed of graphics, symbols, words and numbers. It is a technical "language" in the engineering field. It is a tool for technical personnel to carry out technical exchanges and an important technical data for design, manufacturing and use of products. CAD (Computer Aided Design) refers to the use of computers and graphic equipment to help designers with drawing design. With the application of computer and CAD software, the functions of plane drawing, plane drawing editing, plane drawing annotation, writing text, three-dimensional drawing and drawing printing can be realized. The application of CAD technology greatly improves the efficiency of drawing and design. The course knowledge of "Engineering drawing + CAD" is not only applied in the experiment and practice teaching links of the follow-up professional courses, but also widely used in the employment work [1-2].

The teaching purpose of "Engineering drawing + CAD" course is to learn the theory and method of reading and drawing engineering drawings, to train students' ability of space imagination, thinking, reading and drawing, so that students can master the technology of reading and drawing engineering drawings. On the basis of mastering manual drawing, be able to use CAD technology for drawing work. Through the follow-up training of relevant course experiment and practice teaching links, as well as organizing and guiding students to participate in innovation and entrepreneurship competitions, to achieve the goal of application-oriented innovation talents training. In the teaching practice of "Engineering drawing + CAD", it is deeply realized that in order to realize the above teaching purpose, the experiment and practice teaching links of "Engineering drawing + CAD" must be strengthened.
2. The Importance of Constructing "Engineering Drawing + CAD" Experiment and Practice Teaching Links System

"Engineering drawing + CAD" course knowledge is strong in theory, practice and specialty, and covers a wide range of knowledge. The course knowledge not only plays a very important role in the subsequent professional course learning, but also the engineering drawings as the communication tool language of engineering and technical personnel continues to be widely used in engineering practice. The "Engineering Drawing + CAD" course of our university's new energy science and engineering major is arranged in the first semester. Due to the lack of spatial imagination and related engineering knowledge, students feel boring and difficult to learn about this course. At the same time, some students who have relatively little computer contact have some difficulty in mastering CAD drawing technology. In the teaching, the teachers of the course group realized that the experiment and practice teaching link of "Engineering Drawing + CAD" is not only an important guarantee for students to master the contents of "Engineering Drawing + CAD", it is also an indispensable teaching link to train engineering and technical personnel and applied innovative talents [3-4].

3. Construction and Implementation of "Engineering Drawing + CAD" Experiment and Practice Teaching Links System

The course of "Engineering Drawing + CAD" for the major of new energy science and engineering in our university has a total of 64 hours, including 34 hours for theoretical course and 30 hours for experimental course. The experiment and practice of "Engineering Drawing + CAD" course is divided into three parts: inside the course, outside the course and engineering practice. 30 hours of experiments are arranged in the "Engineering Drawing + CAD" course, including 2 hours of basic cognition, 10 hours of manual drawing and 18 hours of CAD drawing training. The contents, requirements and semester arrangement of the experiment and practice teaching links in the course of "Engineering Drawing + CAD" are shown in Table 1 [2,4-5].

Table 1. The contents, requirements and semester arrangement of the experiment and practice teaching links in the course of "Engineering Drawing + CAD".

<table>
<thead>
<tr>
<th>Experiment and practice links (Hours)</th>
<th>Contents and requirements of experiment and practice</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic cognition (2 hours)</td>
<td>Watch the mechanical device model in engineering drawing and mechanical design model room, visit the manufacturing workshop, understand the basic theory of drawing and national standard specification, understand the relationship between drawing and mechanical equipment.</td>
<td>1</td>
</tr>
<tr>
<td>Manual drawing (10 hours)</td>
<td>Draw the part drawing and assembly drawing of manual jack (Single and complex three-view drawing of combined model is completed in the course drawing homework), and train the students' spatial thinking ability, enable students to master the drawing of assembly, parts drawing and assembly drawing.</td>
<td>1</td>
</tr>
<tr>
<td>CAD drawing training (18 hours)</td>
<td>Combined with knowledge of drawing, CAD technology is used to draw plane figure, combined volume view, parts drawing and assembly drawing.</td>
<td>1</td>
</tr>
</tbody>
</table>

In addition to the course of "Engineering Drawing + CAD", according to the consistency of the drawing knowledge and the enhancement of the practicality of the drawing knowledge, the experiment and practice teaching links of the course of "Engineering Drawing + CAD" are included in the unified planning of the experimental and practical links of the professional courses. Generally, 6-64 hours are arranged according to the different experimental and practical links of the professional courses. The specific contents, requirements and semester arrangement of the experiment and practice teaching links outside the course of "Engineering Drawing + CAD" are
shown in Table 2 [2, 5-6].

Table 2. The contents, requirements and semester arrangement of the experiment and practice teaching links outside the course of "Engineering Drawing + CAD"

<table>
<thead>
<tr>
<th>Experiment and practice links (Hours)</th>
<th>Contents and requirements of experiment and practice</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical design and course design (16 hours)</td>
<td>Determine the design of the transmission scheme, design the reducer, shaft, gear, etc., apply CAD technology to draw part drawings and assembly drawings.</td>
<td>5</td>
</tr>
<tr>
<td>Principle and design of heat exchanger (6 hours)</td>
<td>Disassemble, survey and map the heat exchanger device, apply CAD technology to draw part drawings and assembly drawings, and apply 3D drawing software for modeling.</td>
<td>6</td>
</tr>
<tr>
<td>Principle and technology of biomass energy conversion (6 hours)</td>
<td>Disassemble, survey and map biomass gasification combustion devices, apply CAD technology to draw part drawings and assembly drawings, and apply 3D drawing software for modeling.</td>
<td>6</td>
</tr>
<tr>
<td>Recycling and energy use of waste (6 hours)</td>
<td>Disassemble, survey and map the main body of the biomass pulverizer, apply CAD technology to draw part drawings and assembly drawings, and apply 3D drawing software for modeling.</td>
<td>6</td>
</tr>
<tr>
<td>Biogas preparation engineering (6 hours)</td>
<td>Disassemble, survey and map the biogas preparation device, apply CAD technology to draw part drawings and assembly drawings, and apply 3D drawing software for modeling.</td>
<td>7</td>
</tr>
<tr>
<td>Wind energy utilization engineering (6 hours)</td>
<td>Disassemble, survey and map of wind energy utilization devices, apply CAD technology to draw part drawings and assembly drawings, and apply 3D drawing software for modeling.</td>
<td>7</td>
</tr>
</tbody>
</table>

The engineering practice part of the "Engineering Drawing + CAD" experiment and practice teaching links, include professional comprehensive curriculum design, graduation design, innovation and entrepreneurship competition, etc. In engineering practice, the teachers of the drawing course group arrange the drawing tasks, define the drawing workload and quality assessment, and strengthen the training and application of knowledge and skills of drawing, image recognition and CAD. The specific contents, requirements and semester arrangement of the experiment and practice teaching links in the engineering training of "Engineering Drawing + CAD" are shown in Table 3.

Table 3. The contents, requirements and semester arrangement of the experimental and practical links in the engineering training of "Engineering Drawing + CAD"

<table>
<thead>
<tr>
<th>Experiment and practice links (Hours)</th>
<th>Contents and requirements of experiment and practice</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional integrated curriculum design 1 (60 hours)</td>
<td>Disassemble, survey and map biomass compression molding machine and other devices, apply CAD technology to draw part drawings and assembly drawings, and apply 3D drawing software for modeling.</td>
<td>6</td>
</tr>
<tr>
<td>Professional integrated curriculum design 2 (60 hours)</td>
<td>Disassemble, survey and map of biomass pulverizer and other devices, apply CAD technology to draw part drawings and assembly drawings, and apply 3D drawing software for modeling.</td>
<td>7</td>
</tr>
<tr>
<td>Graduation design (Unlimited hours)</td>
<td>Apply drawing, mechanical principles and design knowledge, complete mechanical device design, apply CAD technology to draw part drawings and assembly drawings, and apply 3D drawing software for modeling.</td>
<td>8</td>
</tr>
<tr>
<td>Innovation and entrepreneurship competition (Unlimited hours)</td>
<td>Apply drawing, mechanical principles and design knowledge, disassemble, survey, or innovate the design of new energy product devices, apply CAD technology to draw part drawings and assembly drawings, and apply 3D drawings software for modeling.</td>
<td>Unlimited</td>
</tr>
</tbody>
</table>

In the implementation of the "Engineering Drawing + CAD" experiment and practice teaching
links system, for the experiment in the "Engineering Drafting + CAD" course, the teaching teachers of the drafting course organize the implementation; for the "Engineering Drawing + CAD" off-course experiment and practice links, the lecturer of the course is responsible for arranging, and the drawing course group teachers participate; for the professional comprehensive curriculum design, graduation design, innovation and entrepreneurship competition, the drawing course group teachers arrange the drawing tasks, clarify the drawing workload and quality assessment, and strengthen the application of engineering drawing knowledge.

4. The Implementation Effect of "Engineering Drawing + CAD" Experiment and Practice Teaching Links System

4.1 Effectively Stimulate Students' Initiative and Initiative in Learning

The implementation of the experiment and practice teaching links of "Engineering Drawing + CAD" has improved the students' interest in learning and made students' learning become passive. In the process of experiment and practice, students take the initiative to solve problems encountered in the experiment and practice through autonomous learning. While deepening the students' understanding of the theoretical knowledge, it also cultivates the students' habit and ability of autonomous learning. In addition, students experience the joy of applying what they have learned. Not only students no longer be boring to learn about drawing, but students also play a positive role in the study of subsequent related professional courses [7].

4.2 Improve the Quality of Course Teaching and Strengthen the Ability of Comprehensive Drawing and Reading Mechanical Drawing

The course content of "Engineering Drawing + CAD" mainly includes Descriptive Geometry, Basic Drawing and Mechanical Drawing. Descriptive Geometry requires students to master the basic principles and methods of orthographic projection, graphic spatial geometry, and simple spatial geometric problems. This requires students to have strong spatial imagination and thinking skills. Through basic cognitive experiments, assembly model drawing, part drawing and assembly drawing drawing experiments, students are guided to combine observation, spatial analysis and imagination, analyze the relationship between objects and projections, and gradually cultivate students' spatial imagination, thinking and skills of analyze. The Basic Drawing require students to understand the basic requirements of national standards such as "Engineering Drawing" and "Technical Drawing", and to be able to use tools and instruments for drawing; the basic theory, basic knowledge and basic skills in Basic Drawing are the guidelines for learning to draw and read mechanical drawings, students must learn well, but this part is more content and more complicated. Mechanical Drawing is the practice and application of Descriptive Geometry and Basic Drawing. It is a teaching content that is closely related to theory and practice. Students are required to master the basic ability to draw and read parts and assembly drawings of common parts. Through tasks such as design, disassemble and surveying in extracurricular experiment and practice teaching links, the use of computer-aided design software for two-dimensional graphics drawing and three-dimensional modeling has not only trained students' practical skills, but also cultivated students' comprehensive skills of drawing and reading mechanical drawing [2, 8].

4.3 Significant Improvement in Students' CAD Technology Level

Our university's new energy science and engineering major "Engineering Drawing + CAD" is arranged in the first semester of freshman. On the one hand, the application of CAD technology is affected by the original computer foundation of the students. The students' understanding of CAD software is abstract and difficult to understand logical association between plan, elevation, and section views. In the course of CAD teaching, students will find it difficult to learn and fully understand and master CAD application technology. In addition, because CAD application learning is only scheduled for 18 hours, less time is arranged, resulting in students being unable to systematically practice CAD technology applications, which affects CAD teaching and learning.
effects. Through the construction and implementation of "Engineering drawing CAD" experiment and practice teaching links system, the students constantly tried to design and draw with CAD technology in the experiment and practice teaching links, and gradually improved the students' ability to draw part drawings, assembly drawings and three-dimensional drawings with CAD technology.

4.4 The Quality of Students' Graduation Thesis Drawing Tasks Has Been Significantly Improved

In the fourth-year students of new energy science and engineering majors of our university, in the graduation design work, some students chose graduation design topics related to new energy engineering technology in mechanical design, and required students to complete the workload of two A0 drawings. Because students' drawing and recognition, and CAD technology applications are limited to the learning exercises in the course of "Engineering Drawing + CAD", they have low skills of drawing and reading mechanical drawing, and they cannot use CAD technology for drawing and design. Drawing tasks in graduation design cannot be completed with quality and quantity. The students' training in the "Engineering Drawing + CAD" experiment and practice teaching links has significantly improved their drawing and reading abilities, as well as the ability to apply CAD technology for parts drawing, assembly drawing, and three-dimensional drawing. It enables students to better complete the tasks of drawing work in graduation design, and the tasks of drawing design in graduation design are significantly improved.

4.5 Improve the Quality of Innovative Talents by Participating in the Innovation and Entrepreneurship Competition

Applying knowledge of engineering drawing, mechanical principle and design, CAD 2D graphic and 3D drawing, etc. , to participate in the science and technology innovation competition activities is to cultivate students' innovation consciousness and innovation ability, so that undergraduates can receive scientific research training as early as possible, to understand the industry, to understand the reality of society. In the process of innovation competition, graduation project and other practical links, students use their knowledge to disassemble, assemble and map products, improve students' engineering consciousness and engineering literacy, and cultivate students' ability of innovation and cooperation, the comprehensive ability of students is trained and the training goal of innovative talents is realized. In the past few years, the teachers of "Engineering Drawing + CAD" course group actively guide the students to participate in the National Three-dimensional Digital Creative Design Competition, Tianjin University Students' Engineering Training Comprehensive Ability Competition, Tianjin University Students' Extra-curricular Academic and Technological Work Competition and other activities, and obtained excellent results.

Conclusion

With the continuous deepening of higher education teaching reform, society's requirements for professional talents continue to increase, students' employment pressure and talent competition have gradually increased. "Engineering Drawing + CAD", as an important professional technical foundation course, plays a pivotal role in the training of talents. After years of continuous exploration by the course team, the experiment and practice teaching links system of "Engineering Drawing + CAD" has been established, and good teaching results have been achieved. With the updating of modern knowledge and the increasing demand for innovative talents in the society, the construction and improvement of the experiment and practice teaching links system of "Engineering Drawing + CAD" will be a continuous work. For example, with the adjustment of the professional curriculum, the drawing course teachers should actively participate in the experiment and practice teaching links outside the drawing course, participate in the formulation of the assessment content and assessment methods of the drawing workload; in engineering practice, innovation competition, graduation design and other practical links, strengthen the application and assessment of cartographic knowledge. In short, all the teachers in the course group have a strong sense of social
responsibility, a strong sense of mission to teach and educate people, and are full of confidence and make unremitting efforts to make greater contributions to the course construction, discipline development and the cultivation of professional innovative talents.

Acknowledgements

This work was financially supported by undergraduate education research and reform project of Tianjin Agricultural University fund (2018-A-27).

References


