Practice on Engineering Drawing Teaching Based on Persist in Cultivation of 3d Thinking Ability

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Abstract: Engineering Drawing is a basic course for undergraduates of science and engineering, which fully explains the principle, standards and the expression method of engineering drawing. To improve the student learning outcomes, it is important to cultivate and train the 3D thinking ability. Combined with the development innovative teaching measures, this paper present the teaching method and reform practice of teaching engineering drawing in our institute. The 3 years teaching practice shows that cultivation of 3D thinking ability can improve the students’ engineering drawing ability effectively and practically.

1. Introduction

Engineering drawing is a basic course in technology and engineering colleges, whose main task is to cultivate engineering graphics expression ability, graphic image thinking ability and engineering drawing ability. With the development of society, economics, science and technology, the teaching methods and system of engineering drawing course have been formed.

The engineering drawing courses have two main objects [1]:
1) To familiar with the technical standards and drawing rules, and master the reading, drawing and marking method of engineering drawing, so as to have the basic theory and professional knowledge related to mechanical drawing
2) To familiar with knowledge and skill of mechanical design applying engineering drawing principles, industry standards and specifications, have the ability to express geometry properly, so as to lay a solid foundation for reading and drawing mechanical drawings.

In order to achieve the purpose of teaching, teachers often teach traditional engineering graphics theory, have step by step drawing demonstration, showing 2D-3D presentation; students always read books, learn drawing knowledge and skills, manual drawing training. However, it is found inefficient and time-consuming for some students, they still confronting the problem of learning the courses well. In view of the weak spatial imagination and poor engineering drawing ability of some students, the teaching of the course should start from the cultivation of three-dimensional thinking, so as to be more in line with students' learning ideas and cognitive rules, and conform to the development of the courses.

“Pattern is the technical language of engineering” identified the importance of engineering graphics curriculum. How to enhance the quality of teaching has become the focus of teaching in colleges and universities. In order to improve the teaching effect, it is suggested to connect the teaching outline with the ability cultivation driving pattern [2], which means that in engineering drawing courses, the principle knowledge should be related to 3D thinking ability. Then the course teaching would be in line with students' thinking characteristics and cognitive rules.

Following the goal of improving the teaching quality, the teachers analyzes the relationship between the hand drawing and computer graphics and then builds a new teaching system based on the manual drawing and the advancement of computer graphics [3], and 3D modeling with computer is applied in the practice of engineering drawing teaching [4]. Some other examples of practices in teaching, implemented, and regularly are also presented, in which the Technical Drawing Learning Tool is developed for the improvement of the quality of teaching [5-6], the results shows the
developed tool greatly enhanced the understanding of engineering drawing course and made the teachers’ teaching easier. What’s more, it is found the application of AutoCAD can also improve learning activities and student learning outcomes [7].

Nowadays, in emerging engineering education, it is required to reform and innovate to explore the application of more modern curriculum as well as training engineering talents with innovative ability [8]. Several teaching content, teaching model, and assessment methods are carried to let students to master the engineering drawing skills and improve the professional ability [9-10]. What’s more, discussion and practice on the engineering drawing course are conducted to improve the relevance between engineering drawing course and professional courses, thus enhancing the students’ practical application ability [11]. And the researchers also analyses how to better proceed from graphic literacy discussion through communication skills and social/material interactions [12]. The more important point in engineering drawing teaching is to cultivate the thinking ability, and teach and train toward accessing how students think about the course [13]. Based on the cultivation of three-dimensional thinking, this paper present the teaching method and reform practice of teaching engineering drawing in our institute.

2. The Necessity of 3d Thinking Ability in Engineering Drawing

The development of computer technology has promoted the reform in almost all fields. Modern design requires engineers to establish the three-dimensional model directly by using 3D software, and then put out the two-dimensional engineering drawing in the national standard for production. Therefore, the teaching of engineering drawing based on persist in cultivation of 3D thinking ability is the inevitable result of the development of the times, and it is also in line with the law of human understanding of objective things. Therefore, students are required to achieve higher goals in knowledge, ability and quality.

In engineering drawing, designers express their ideas through the method of two-dimensional drawings. However, from the perspective of human cognition, any structural characteristics original appears in the form of three-dimensional thinking, that is, it appears in the way of thinking in 3D images. Therefore, it is necessary for students to have well 3D thinking ability to support the study of the courses.

For students in the class, the overall cognition of drawing structure should be combined with three-dimensional thinking in order to carry out the two-dimensional drawings; and it is also necessary to determine the direction and position of the local features in three-dimensional space; finally the views and marking in the two-dimensional drawings should be determined to meet the standard. From the perspective of teaching practice, the three-dimensional thinking ability determines the teaching effectiveness, and the cultivation of three-dimensional thinking plays an important role in improving the teaching quality of engineering drawing course.

Fig.1 3d Thinking Ability in Engineering Drawing

3. Teaching Methods Persist in Cultivation of 3d Thinking Ability

1) Real-time display of 3D CAD software

With the development of computer technology, students are generally interested in computer software, so they can apply 3D CAD in drawing course. The combination of design software and existing course teaching methods enables students to understand drawing objects easily and cultivate their three-dimensional thinking ability continuously; at the same time, the introduction of three-dimensional software also stimulates students' interest in the course, enhances their enthusiasm for learning the course, and improves the teaching effect.

2) Hand-by-hand model structure introduction

Many model features in the engineering drawing course can be found as application in daily life, teachers and students can also present structure features through self-made models. The model structure introduction in class can enable students to restore three-dimensional scenes, which can also
exercise students' logical conversion ability and cultivate their 3D thinking ability. With the model by hand, students can pay more attention to the internal and external structure of the object model, so as to improve the learning effect in the course. At the same time, practical cases let students understand the practicability of engineering drawing course.

3) Integrating of 3D geometry knowledge of all the subjects

Engineering drawing is a basic course for college students, and there are some other subjects involving three-dimensional knowledge. Sometimes, students are lack of in-depth understanding because of three-dimensional thinking problems. With the integration of 3D geometry knowledge, students can learn from each other in the learning methods and thinking mode. For example, geometry knowledge in math can achieve the transformation and consolidation of three-dimensional thinking. Relying on this, applying “think out” instead of “draw out” can improve the efficiency of drawing, and improve the learning effect of drawing course and related courses.

4. Practice and Effect

The cultivation of three-dimensional thinking in engineering drawing course can enable students to form the thinking ability from two-dimensional to three-dimensional. With the teaching method of three-dimensional thinking training, students can effectively realize the intuitive conversion between 2D and 3D graphics and then improve the level of teaching.

Taking the 3-year teaching practice in our college as example to discuss how to improve students' 3D thinking ability and what the teaching quality is effected by the teaching reform based on persist in cultivation of 3D thinking ability. The teaching practice process is divided into three stages, namely the original stage, primary stage, mature stage. During the first stage (original stage), teacher have lesson according to the traditional mode; in the second stage (primary stage), the cultivation of 3D thinking ability is applied in the class; in the third stage (mature stage), the cultivation is through the whole process involving class preparing, class practice and ability training.

After the 3-year teaching reform practice of engineering drawing courses, the effect of 3D thinking ability cultivation in the education is analyzed as shown in Table 1. With the cultivation of three-dimensional thinking, students can gain better grade which means it can improve the teaching quality of engineering drawing; the evaluation of teachers in the questionnaire is better, indicating that students are more receptive to such teaching methods. Therefore, the analysis results show that continuous persistent cultivation of 3D thinking ability can improve the engineering drawing ability.

Table 1 Table of Teaching Effect Analysis

<table>
<thead>
<tr>
<th>Teaching Effect</th>
<th>Original stage</th>
<th>Primary stage</th>
<th>Mature stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Testing</td>
<td>71.25</td>
<td>71.89</td>
<td>75.72</td>
</tr>
<tr>
<td>Excellent Rate</td>
<td>9.33%</td>
<td>10.14%</td>
<td>12.68%</td>
</tr>
<tr>
<td>Evaluation of teaching</td>
<td>89.85</td>
<td>91.07</td>
<td>93.88</td>
</tr>
</tbody>
</table>

5. Conclusions

For the highly development of science and technology, the cultivation of higher education talents is getting much more important, in which the 3D thinking ability is the base of engineering drawing and engineering design. Combined with the development innovative teaching measures, the continuous persistent cultivation of 3D thinking ability can improve the engineering drawing ability effectively and practically. Teachers can further explore integration, transformation, innovation and optimization, to promote the development of Higher Education.

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References


