

# Application of Independent Thinking Mode in Civil Engineering Drawing Classroom-based Activity

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## **Abstract:**

Through the reform and practice of independent thinking mode in civil engineering drawing course, this paper explores the ways to reform the study method, which takes learners as the main body and takes the coordinated development of knowledge, ability and quality as the goal, and solves the difficult problems in knowledge system by using appropriate studying methods and independent thinking, so as to train learners' practice and innovation ability, and guide learners to change the passive studying mode into the active exploratory studying mode, put forward suggestions and measures to improve the reform of the independent research studying mode of civil engineering drawing course.

**Keywords:** *Civil Engineering Drawing, Independent thinking, Thoughts of study activity, Practice of study activity, Evaluation of study activity.*

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## I. INTRODUCTION

Civil Engineering Drawing is an important professional basic course of civil engineering specialty. The teaching and assessment of the course take application as the starting point, and pay attention to practicality and pertinence in the teaching content and teaching methods. On the one hand, pay equal attention to drawing and drawing recognition, give guidance on drawing and drawing methods and steps for typical drawings, and master relevant drawing specifications, methods and skills; On the other hand, pay attention to the professionalism of drawing and drawing recognition, from unarmed practice, ruler and gauge drawing to computer drawing, from the use of drawing tools to mastering the skills of drawing, so that students can obtain the basic drawing knowledge and skills that contemporary engineering technicians should have. In the teaching process, combined with the students' learning feedback, we constantly feel the role of "independent thinking" in the learning of civil engineering drawing course. Therefore, combined with its connotation and teaching practice, we try to clarify the teaching and research ideas of "independent thinking" in civil engineering drawing course, and improve its application in teaching practice, in order to provide guidance and help for the professional learning of this course and subsequent students.

Independent thinking is not only an embodiment of students' learning ability, but also a dynamic process of learning. Its connotation is to think and judge the learning objects and objectives independently

according to the existing knowledge and experience of students' observation and thinking. Civil engineering drawing has a strong theoretical and practical nature. Its content runs through the whole professional learning stage. The traditional teaching means no longer meet the development and needs of society. It is inevitable to study and introduce the teaching mode of "independent thinking". According to the characteristics of civil engineering drawing course, students can learn independently through the design of teaching methods and the guidance of teachers, improve the initiative of learning, and cultivate ability to solve practical problems[1]. At the same time, through teaching practice, students can actively and effectively carry out dynamic learning after graduation, better apply their professional knowledge to their work, adapt to the development and needs of society, and become an excellent high-tech talent. Therefore, independent thinking is a learning mode worthy of promotion. Combined with the in-depth development of civil engineering drawing teaching, we can continue to explore and practice, summarize experience and gradually improve it according to the actual problems and improvement suggestions.

## **II. ACTIVITY THOUGHTS OF INDEPENDENT THINKING**

Independent thinking learning mode means that learners actively consult materials according to the characteristics of learning objectives or learning contents, dynamically expand the depth and breadth of knowledge structure[2], and independently find problems, raise problems, discuss problems, and explore methods and ways to solve problems in the process of summarizing and sorting materials, gradually form a learning mode with comprehensive practical ability under independent thinking.

### **2.1 Integration of Design Object Expression and Spatial Thinking Ability**

The teaching goal of civil engineering drawing course is to meet the needs of senior engineering and technical talents for the expression of design objects, which requires the cultivation of their effective spatial thinking ability[3]. The cultivation of spatial thinking ability can be obtained not only through the practice of some projection exercises, but also requires students to establish an effective connection between the two-dimensional line expression of design objects and three-dimensional space, and skillfully convert between them. In view of this goal, independent thinking and learning encourage students to actively participate in the whole process of teaching activities. In the process, on the basis of obtaining sufficient projection and drawing knowledge, conduct comprehensive dynamic observation of three-dimensional entities and architectural space, understand the relationship between their expression and actual objects, and expand their knowledge through design questions, answer questions, comments and explanations. This is conducive to students to construct the external knowledge system in their own cognitive structure and achieve the goal of autonomous learning.

### **2.2 Integration of Foundation and Advancement**

Introducing the modern computer graphics teaching practice course into the traditional engineering drawing teaching is not only a change in the way of drawing, but also a reflection that the teaching content itself can meet the requirements of practical work from the basis. It lays a foundation for the comprehensive expression and reading of information graphics in the traditional basic and professional

courses of civil engineering. It also lays a good foundation for the following modern computer aided design (CAD), finite element analysis (FEA), building information model (BIM) and other courses.

### 2.3 Integration of Civil Engineering Industry and Urban Construction Needs

In order to meet the needs of civil engineering, building materials industry and local economic construction, appropriate ideological and political contents should be integrated into class preparation, class teaching and class practice. On the one hand, students can expand and apply new fields in combination with known knowledge by setting appropriate ideological and political entry points, On the other hand, it also enables students to make necessary scheme formulation, data collection, analysis and solution for a specific problem situation, so as to cultivate their good innovative consciousness and creative ability. After the theoretical course of civil engineering drawing, practical courses such as architectural drawing, house architectural drawing and architectural CAD are specially opened for college students. Their assessment should extend the foundation of engineering drawing to the field of professional foundation as far as possible, and directly lay a foundation for subsequent professional courses and graduation design. This not only helps to cultivate students' scientific work attitude, but also meets the needs of society for talent training.

## **III. PRACTICE OF INDEPENDENT THINKING IN CURRICULUM**

### 3.1 Reasonable Use of Appropriate Teaching Means

The first is to pay attention to dynamic demonstration. The application of engineering drawing and computer drawing technology runs through all stages of architectural engineering design and construction. Engineering drawings need to be drawn and read in all links from initial conceptual design, sketch design, scheme design, preliminary design to construction drawing design. Therefore, multimedia display, especially phased animation demonstration, is used in course teaching, make students feel the expression content and specific application of engineering drawing and computer drawing in each design stage in a hierarchical and orderly manner, and make students have an overall understanding of the course overview and learning content[4]. The second is to emphasize the switching between two-dimensional and three-dimensional. In the process of drawing learning, students are required to transform their previous plane thinking habits into three-dimensional graphic thinking. During learning, students must often be reminded to pay attention to the analysis of spatial geometric relations and the relationship between spatial geometric elements and plane graphics, and students are required to explain their corresponding ideas and application principles for each problem-solving process. At the same time, students are required to understand the meaning and spatial relationship of each concept, principle, law and method, fully master these basic contents and be good at using them through practice, demonstration and explanation. With the development of these teaching activities, students can intuitively understand the composition of form and architecture[5]. Finally, it combines ideological and political elements. Teachers are the leaders of teaching activities. They should organize all links of teaching reasonably and scientifically, they also should carefully sort out ideological and political clues before class to effectively guide autonomous learning. In the course of civil engineering drawing, teachers not only require students to master basic concepts,

drawing methods and other knowledge points, and guide students to skillfully transform two-dimensional projection and three-dimensional space, but also carefully excavate ideological and political elements in the teaching process and organically penetrate them into all links. Combined with the teaching contents, the corresponding ideological and political contents of the course are designed for each chapter, and the list of Ideological and political contents of the course is compiled. By infiltrating the ideological and political content into each specific teaching node, the students will combine the knowledge points learned with the professional needs, and better master the corresponding content through autonomous learning TABLE I.

**TABLE I. List of Ideological and Political Contents of Civil Engineering Drawing Course**

<b>TEXTBOOK CHAPTERS (EXCERPTS)</b>	<b>KNOWLEDGE POINTS</b>	<b>IDEOLOGICAL AND POLITICAL CONTENT</b>
<b>CHAPTER 1</b> Introduction	Tasks and learning methods of civil engineering drawing	<ul style="list-style-type: none"> <li>·What is engineer spirit?</li> <li>·How to understand drawings is the technical language of engineering</li> <li>·How to master the language?</li> </ul>
<b>CHAPTER 2</b> Basic Knowledge of Drawing	Drawing standard, font, dimension, scale, geometric drawing, plane graphic analysis, etc	<ul style="list-style-type: none"> <li>·Familiar with relevant drawing standards</li> <li>·Consciously abide by national standards</li> </ul>
<b>CHAPTER 3</b> Basic Knowledge of Projection	Formation and classification of projections Characteristics of parallel projection Graphic method commonly used in Engineering	<ul style="list-style-type: none"> <li>·Cultivate scientific drawing habits</li> <li>·Improve logic derivation ability</li> <li>·Systematic concept of problem solving</li> </ul>
<b>CHAPTER 4</b> Projection of Points, Lines and Planes	Projection drawing of point, line and plane	
<b>CHAPTER 5</b> Stereoscopic Projection	Prism and pyramid Points and lines on solid surfaces	Through the introduction of various types of civil engineering components and accessories, combined with the problems related to stereo projection, understand the

		following problems: <ul style="list-style-type: none"><li>·Aesthetic elements in architectural design</li><li>·Classical culture contained in sloping roof</li><li>·Stereoscopic aesthetic appreciation of art</li></ul>
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### 3.2 Solve Difficult Problems in Teaching

Civil Engineering drawing requires students to carry out sufficient spatial imagination and three-dimensional construction on the basis of mastering the basic principles and rational thinking[6]. This two-dimensional and three-dimensional transformation always runs through the learning of the course. For example, in the axonometric projection part, students are encouraged to carry out three-dimensional modeling design with the help of computer drawing software to dynamically demonstrate the formation process of three-dimensional objects[7]. Students' independent thinking and learning not only enable them to truly understand the drawing method of axonometric projection, but also further become familiar with the solid modeling method, which not only reflects the application of information technology means in teaching and achieves the teaching effect that is difficult to achieve by traditional teaching means, but also helps students transform three-dimensional space and two-dimensional plane. Students' independent thinking is an effective means to solve difficult problems in teaching. Guiding students' independent thinking requires teachers to set appropriate, scientific and effective problems at all levels, such as basic problems, expansion problems and discussion problems[8]. The organization of teaching is a sensitive and interactive process. Different knowledge points introduce corresponding learning requirements, guide students to actively think and discuss, and finally the teacher explains and summarizes the overall framework, while leaving room for students to supplement after class for in-depth extended learning. Therefore, how to effectively set questions in teaching, integrate students' professional cognition and life experience with their own roles, and take the initiative to think and feel is an important aspect of Civil Engineering Drawing teaching.

### 3.3 Cultivating Engineering Practice and Innovation Ability

Students' drawing practice is one of the characteristics of engineering drawing course. Civil engineering drawing courses have such a characteristic: listening clearly, it is difficult to do questions; It is easy to see a picture, but difficult to draw it. In order to solve this problem, students are required to gradually and independently realize the logical steps that each problem must go through: firstly, convert the two-dimensional known conditions in the problem into three-dimensional spatial information, and clarify the mutual position relationship of various spatial geometric elements[9]; secondly, formulate the basic drawing method combined with the projection principle and clarify the drawing steps; Finally, the problem-solving steps of space are implemented on the projection map, completed step by step, and the correct answer is obtained. What is more valuable is that in the process of research-based learning, students can constantly put forward new ideas and methods to solve problems, and their practice and

innovation ability have been greatly improved. In the teaching of building structure construction drawing surveying and mapping, we introduce the research, inquiry and cooperative learning methods into the practical teaching of Surveying and mapping, guide students to fully demonstrate various expression schemes in groups, find out the problems existing in the surveying and mapping object, boldly evaluate the characteristics of various expression schemes, and finally select the best expression scheme for innovative drawing. While arranging practical tasks, teachers, combined with the actual situation, make students clear that the drawing of civil engineering construction drawings is a comprehensive and systematic project. They should not only accurately grasp the projection principle, but also scientifically think about the design principle. To solve the practical problems of civil engineering construction drawings, they must comprehensively use all kinds of relevant professional knowledge[10]. Therefore, after the important knowledge points, they will actively organize students to carry out relevant practical activities, through task explanation, data collection and sorting, group discussion, selection of Representatives, report and display, drawing, comment and summary, so that students can find reasonable solutions to problems in the real situation through their own active participation, feel the value and significance of engineering practice and innovation TABLE II.

**TABLE II. Integrating Independent Thinking into Practice**

TEACHING CONTENT	TEACHING PROCESS	INDEPENDENT THINKING	TEACHING DEVICES
Reading of Building Construction Drawings	<ul style="list-style-type: none"> <li>·Assign tasks</li> <li>·Data sorting</li> <li>·Group discussion</li> <li>·Report Exhibition</li> <li>·drawing</li> </ul>	Combined with students' reports, guide students to think about how to plan their own development in professional learning from the aspects of professional quality, social responsibility and professional ethics	Divide into several independent study groups to study, discuss and draw. Each group will report and display, then teachers will comment and supplement
Drawing of Building Construction Drawings	<ul style="list-style-type: none"> <li>·summary</li> </ul>	The drawing process shall be adjusted according to the drawing, so that students can understand how to abide by various specifications in practice, so as to cultivate the awareness of abiding by the law	

#### **IV. ACTIVITY EVALUATION OF INDEPENDENT THINKING MODE**

The teachers of engineering drawing series courses extend the teaching content to other teaching links, and infiltrate the development trends of other teaching links into the basic drawing courses. This coherent and systematic teaching context can not only help students master the basic knowledge of engineering drawing, but also enable students to understand the development trends of the frontier of the discipline and carry out professional practical operation. The learning mode of independent thinking guides students to master scientific design methods by reading a large number of professional drawings and design works, and enables students to learn to use them independently[11]; At the same time, students are encouraged to go out of the classroom according to the teaching materials, make full use of various advantageous teaching resources and experimental equipment, and learn to improve their research ability and comprehensive application ability in the process of acquiring knowledge. Through the annual analysis of teaching achievements and the evaluation of students' teaching effects on teachers, the adoption of independent thinking learning mode and corresponding teaching means can really fully mobilize students' learning enthusiasm and initiative, and lay a good foundation for the study of follow-up courses, graduation design and the development of future work.

#### **V. CONCLUSION**

Several years of exploration and practice have basically achieved the expected results in the teaching reform of "independent thinking" learning mode of Civil Engineering Drawing. More importantly, it has also had a very positive impact on cultivating students' good psychological learning quality and excellent professional quality. The following three gains can be summarized: First, the "independent thinking" learning mode provides a vivid and active learning atmosphere for the previously relatively boring and passive drawing course learning, and makes students truly become the masters of self-learning to a certain extent. Second, "independent thinking" makes students willing to accept research-based topics with practical application value. Even if they encounter various difficulties, they are also willing to face challenges, because they understand the value of pay and harvest in the process of completing a specific work. Third, more importantly, in the independent and open learning environment, students learn to cooperate, communicate and communicate, which effectively improves the comprehensive efficiency of learning[12]. It can be seen that the "independent thinking" learning mode is an effective and worthy of promotion. Combined with the in-depth development of civil engineering drawing teaching, we can continue to explore practice and summarize experience according to the actual problems and improvement suggestions.

In the follow-up teaching, combined with the in-depth understanding of the "independent thinking" learning mode, teach students according to their aptitude, constantly adjust the teaching means, highlight the dominant position of students, constantly innovate the new classroom learning mode, and strive to improve the actual teaching effect. Specifically, it can be gradually improved from the following points: first, combined with reality, further excavate the deep integration of "independent thinking" learning mode and curriculum content, and dynamically and continuously update the entry point; Secondly, in the process

of discussion and teaching, we should further strengthen self-learning and contact the latest engineering practice cases, so that students can learn more, feel the rapid development of China and enhance their enthusiasm for learning; Finally, it is considered to add the assessment link matching the "independent thinking" learning mode, reflect the relevant contents in the examination paper assessment and formative evaluation of the course, and improve the evaluation mechanism of the course.

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