





Curriculum Construction and Teaching Practice of CAD Drawing Course for the Major of Planning and Design

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Abstract. The major of planning and design is a discipline containing both art and engineering elements and its expression is mainly based on graphics, so there are many industry drawing standards. The patterns of planning and design are tools for designers to express creative ideas and multi-communicate with each others, also are the basis for producers to understand processing objects and control processing productions. Therefore, through the teaching practice of computer-aided design (CAD) course for the planning and design program, students can be quickly familiar with and master these basic industrial or engineering drawing specifications. On the basis of summarizing and analyzing the previous research works, this paper expounded the research status and significance of curriculum construction of CAD drawing course for the major of planning and design, elaborated the development background, current status and future challenges of teaching practice of CAD drawing course, introduced the knowledge structure of planning and design major and the theory and teaching of CAD drawing, proposed the curriculum construction model of CAD drawing course based on course strategy and structure optimization, constructed the teaching content system of CAD drawing course, analyzed the informatization teaching mode of CAD drawing course, performed the analysis of planning and design ability cultivation, and finally discussed the integrated teaching of CAD drawing based on the project-driven method. The results of this paper provide a reference for further researches on curriculum construction and teaching practice of CAD drawing courses for the major of planning and design.

Keywords: Planning and Design; Computer-aided Design (CAD) Drawing; Curriculum Construction; Teaching Practice

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1 INTRODUCTION

Computer-aided design (CAD) is an important aspect of computer applications, which plays a significant role in the revolution of engineering design and drawing and will undoubtedly occupy the fields of engineering technology design and become a magic weapon for engineers, architects,

and planners. The patterns of planning and design are tools for designers to express creative ideas and multi-communicate with each other, also are the basis for producers to understand processing objects and control processing productions, which can be considered to be the most popular and powerful engineering language in engineering world [1]. Jaakma et al. (2019) pointed out that the predecessor courses of computer drawing software include engineering drawing, mechanical drawing, architectural drawing knowledge, professional standards of drawing, etc. If the foundations of these predecessor courses are not laid, students can only use computer drawing software to make some simple modeling drawings and mechanical parts, and the design of architectural engineering drawings will face some problems [2]. With its good working interface, perfect drawing and editing functions, and powerful modeling and analysis methods, the CAD working platform has rapidly developed into an indispensable computer application technology in the field of architectural design. Alvesa et al. (2019) concluded that the entire design process should be completed from the preliminary design structure calculation of the scheme concept to various construction drawings [3].

The major of planning and design is a discipline containing both art and engineering elements and its expression is mainly based on graphics, so there are many industry drawing standards. Through the teaching practice of CAD course for the planning and design program, students can be quickly familiar with and master these basic industrial or engineering drawing specifications [4]. Balana et al. (2019) suggested that the CAD courses of various majors in architecture, machinery, and electronics have received great attention, but for the planning and design majors in colleges and universities, the role and position in teaching are not yet in place [5]. Most planning and design majors use architecture and the textbooks compiled by the majors of study, and the CAD textbooks for planning and design majors, have very few books, and its teaching content, teaching system and teaching methods have not been standardized. The traditional CAD classroom teaching mode is generally carried out in accordance with the order of the course chapters. The teacher usually first explains a few commands, and then let the students operate the training on the computer; the students are not motivated to learn, lack interest in training, and the teaching effect is not ideal. Therefore, Gül et al. (2015) believed that how to combine the cultivation of comprehensive skills of planning and design students with computer teaching, so that students can use them flexibly have become important research contents [6].

On the basis of summarizing and analyzing the previous research works, this paper expounds the research status and significance of curriculum construction of CAD drawing course for the major of planning and design, elaborates the development background, current status and future challenges of teaching practice of CAD drawing course, introduces the knowledge structure of planning and design major and the theory and teaching of CAD drawing, proposes the curriculum construction model of CAD drawing course based on course strategy and structure optimization, constructs the teaching content system of CAD drawing course, analyzes the informatization teaching mode of CAD drawing course, performed the analysis of planning and design ability cultivation, and finally discusses the integrated teaching of CAD drawing based on the project-driven method. The detailed chapters are arranged as follows: Section 2 introduces the curriculum construction of CAD drawing course for planning and design major based on course strategies and structure optimization; Section 3 analyzes the teaching practice of CAD drawing course for planning and design major including teaching content system and curriculum construction model; Section 4 discusses the planning and design ability cultivation and the integrated teaching of CAD drawing based on the project-driven method; Section 5 is conclusion.

2 CURRICULUM CONSTRUCTION OF CAD DRAWING COURSE

2.1 Curriculum Construction Strategies

The requirements of the center line type and font only refer to the requirements of the final drawing; from the perspective of actual production, the drawings drawn by the technical personnel are not the final CAD drawings only in terms of the lines and fonts. Therefore, students are

required to understand the content of these standards. The quality of the drawing can be neat, clear and straight, and the fonts are correct, in exchange for the time to complete a sufficient amount of other content exercises. From a practical point of view, sketches are increasingly used in the concept of technical communication and computer drawing. Therefore, in the teaching of the course, the practice of freehand drawing should be introduced as soon as possible, and be guaranteed to be completed in each teaching section of the course. A certain number of sketch exercises can not only improve students' ability to draw sketches, but also ensure the total amount of practice in this course. Although descriptive geometry plays an important role in training and enhancing the concept of space, due to its own characteristics, descriptive geometry determines that it is difficult to complete the teaching requirements of this part of the content without spending a certain amount of time and energy [7]. Practice teaching has proved that under the current conditions, this method of using descriptive geometry as an introduction to cartography courses not only consumes time and energy, but also often makes students lose their interest and enthusiasm for drawing courses (Figure 1).

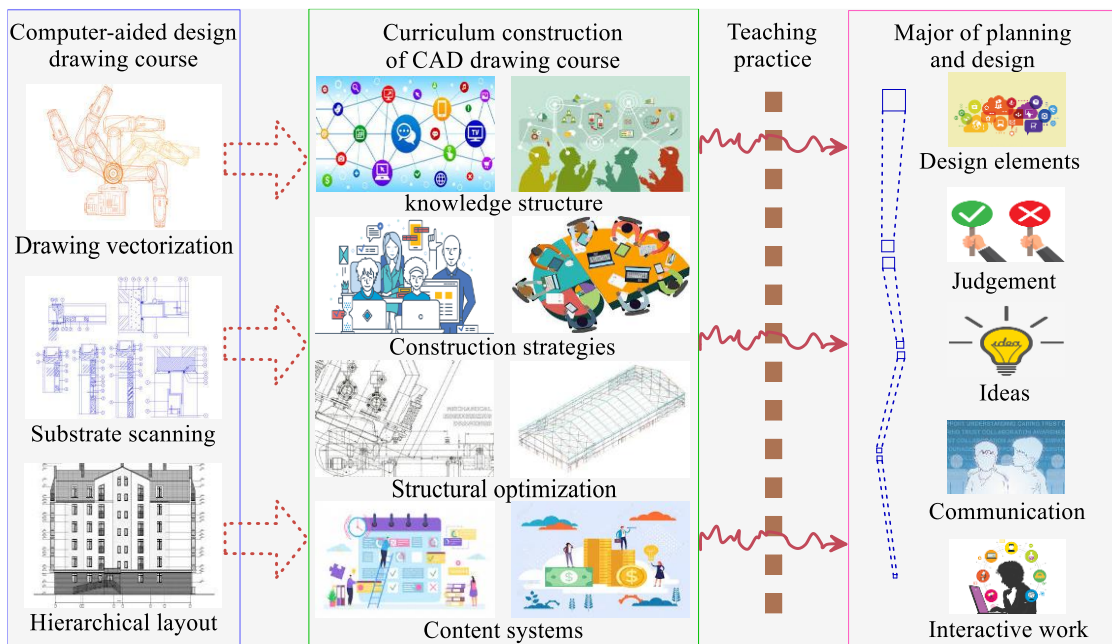


Figure 1: Curriculum construction framework and teaching practice process of CAD drawing course for the major of planning and design.

After the first stage of comprehensive professional auxiliary design training, students have been able to use the computer as a modern tool for professional design. At this time, teachers should pay attention to training students' more advanced skills. Also, teachers should explain macro definitions, professional graphics libraries, menu files, development languages, and data exchange with other advanced languages. The students in the previous stage know what CAD is like and how to draw. At this stage, students should understand why this is so, how to make the work more efficient, and how to use the results calculated by the program for design drawing. In planning and design, pipeline synthesis and road traffic design involve a large number of data calculation and analysis problems. In response to this problem, students are required to write programs in development languages or other advanced languages to calculate and analyze engineering data, and the results are used in planning and design, so as to make a true auxiliary design. Students

also need exert their creativity and initiative, and set up professional settings to make the CAD system more suitable for their respective design habits and design methods. For some students who have the abilities to learn, teachers should encourage them to further study and conduct professional development.

The planning function displays the current campus in the form of a three-dimensional model diagram or an effect diagram. It provides a bird's-eye view function under a unified interface, provides user planning and arrangement, and finally provides electronic pictures, paper pictures and three-dimensional animations in the form of three-dimensional renderings. The auxiliary decision-making function needs to draft the relevant engineering volume according to the user's construction project land requirements, architectural drawings, etc. to generate a virtual house model, provide users with relevant effect scenes, and provide a basis for users' related decisions. Data automatic update and manual update and adjustment capabilities, according to user requirements and actual planning decision results automatically update the relevant values in the database. And with the construction of buildings and other related projects, the system can provide manual adjustment capabilities to better describe the actual situation. Data collection, inspection and editing are mainly used to obtain relatively complete geographic data related to geographic sampling points. They ensure the integrity of the data in the database in terms of content and space. The browsing function is to provide a three-dimensional dynamic browsing function under its unified management interface according to user requirements. These models can start with basic primitives, first draw standard geometry or composite geometry, and then form some non-standard geometry through their corresponding combinations and operations.

2.2 Curriculum Structure Optimization

The requirements of the center line type and font only refer to the requirements of the final drawing; from the perspective of actual production, the drawings drawn by the technical personnel are not the final CAD drawings only in terms of the lines and fonts. When organizing the teaching content during the curriculum construction, the curriculum can start from the following aspects. First, the course content should be selected in accordance with the professional characteristics of the student; secondly, the course content should be determined in accordance with the professional development goals of the student; finally, both theory and practice must be adhered to. The support for student hands-on practice is that the construction of the course content should not pay too much attention to practice and ignore the study of theoretical knowledge. In the course of CAD curriculum construction, it is necessary to further do a good job in the selection of teaching resources and choose the resources suitable for students' learning development needs. Teachers should prepare reasonable curriculum standards and choose appropriate teaching resources in accordance with the content of the curriculum standards. In this process, there is no need to pay too much attention to the integrity and discipline of the teaching materials.

The syllabus of planning and design program requires students to learn CAD drawing and the basic purpose is to learn to use drawing language editing tools. In actual work, drawings are used to express the design content. Therefore, in the learning process, it is necessary to combine the knowledge of drawing with CAD teaching, such as the drawing specifications, the drawing frame, icons, line type, line width and other drawing requirements, to follow the unified drawing specification only when under the guidance of the drawing theory and method of drawing. Figure 2 shows the relationship between curriculum proportion and integration efficiency in CAD drawing course for the major of planning and design. For students of different majors, the instructor should prepare different teaching case demonstrations, and pay attention to the connection between the demonstration cases, and the generalization ability and difficulty of the design case for various drawing tools, editing tools and other functions. If students have studied the basics of graphics before learning this course, they should briefly introduce the principles and basic specifications of graphics in the teaching of this course; after all, the teaching reform of any course has an exploration and improvement process. This kind of teaching method also needs to be gradually improved in the teaching practice, and hope that relevant experts provide valuable comments and

suggestions to make the teaching content and teaching methods of this course more scientific, more systematic, and more effective in teaching.

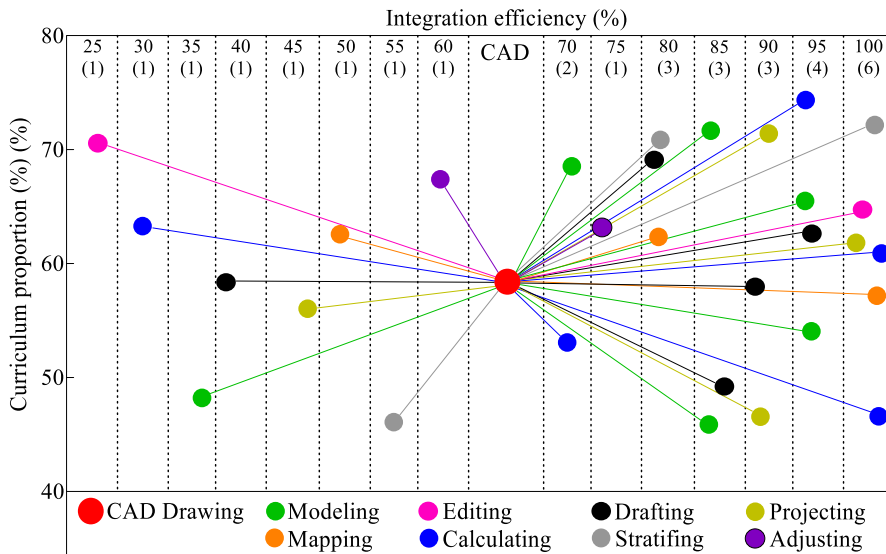


Figure 2: Relationship between curriculum proportion and integration efficiency in CAD drawing course for the major of planning and design.

The primary task of teachers is to fully mobilize students' enthusiasm for learning, to encourage students to acquire knowledge and develop their own abilities, so that they can find problems, raise problems, analyze problems, and solve problems. Therefore, effective use of some commonalities or correlations between the content of CAD courses and other disciplines becomes a necessary topic for teachers. When preparing cases and tasks, the typical case should be divided into several steps according to the teaching module. A teaching module can consist of one or more cases. Based on the basic commands of the textbook, the learning tasks are integrated into specific examples to explain, and by drawing actual engineering drawings, students can master the commonly used commands and improve the speed and skills of drawing. In the actual teaching of CAD courses, there are many contents learning that are inextricably linked with other disciplines. For example, courses such as mechanical drawing, mechanical design, and computer-aided design have inherent consistency and compatibility. Ng et al. (2019) concluded that teachers should try their best to combine with the relevant subject knowledge learned by students, combine the theoretical knowledge in the textbook with the student's subject learning practice, give more examples that students are familiar with to enrich the teaching content, and require students to use the knowledge learned Phenomena and problems of life [8].

3 TEACHING PRACTICE OF CAD DRAWING COURSE

3.1 Construction of Teaching Content System

Computer drawing is the embodiment of drawing modernization and CAD is not only a drawing tool, but also a tool for creativity and thinking. Manual drawing is the basis for cultivating students' thinking and drawing ability, and it is also a necessary prerequisite for better mastering CAD course. Through the study of this part, students will lay a good foundation, which mainly introduces the national standards of engineering drawing, drawing tools and geometric drawing

methods, basic knowledge of projection, the establishment of three-sided projection system, the formation and corresponding relationship of three views of objects, the setting of axonometric and computer drawing environment, the basic drawing commands of how to use it etc (Figure 3). Students are required to master the basic skills of drawing graphics by hand and the basic operations of computers. The content of the exercises in this part is the practice of drawing graphs by hand and drawing isometrics and oblique secondary mappings by computer. The exercises are arranged with freehand drawing and using computers to do exercises. Through exercises, students can master the basic rules of combined projection, and then use computer drawing to do combined projection exercises to enhance students' understanding, understanding, and mastering of the process from three-dimensional to view, and then from view to three-dimensional process. Regular training can learn the graphics editing function in CAD through computer drawing.

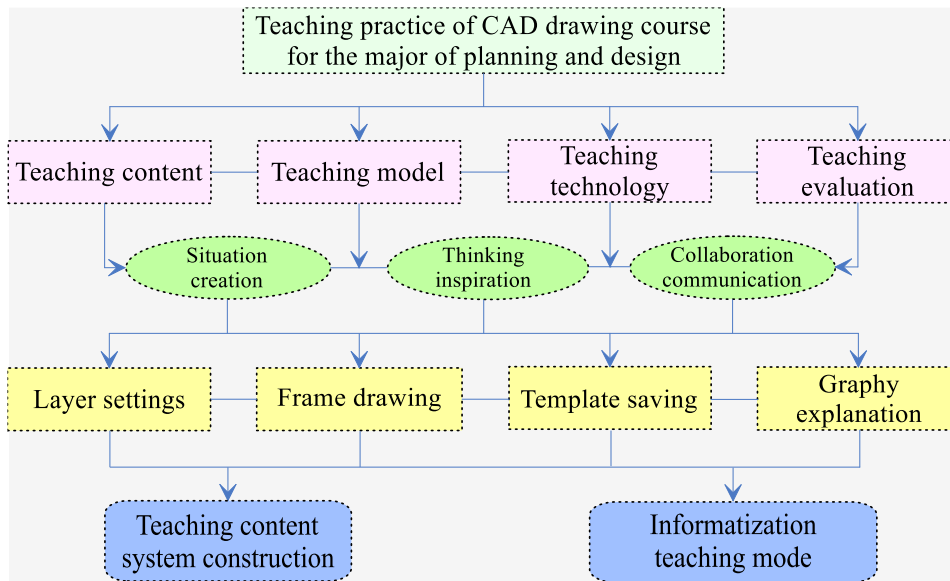


Figure 3: Framework and structure of teaching practice of CAD drawing course.

The current CAD teaching is generally in the computer room. The teacher first demonstrates the operation to the students through the teaching software in a short time, so that the students can master the use of commands. In this process, only teach students the use of CAD commands, and then arrange for students to work on the computer, homework is mainly around the CAD commands learned. After the students have finished, the students can discuss the errors and problems in the homework, try their best to find the reasons and corrective methods, and finally the teachers will summarize and explain [9]. The CAD course greatly enriches the teaching content of mechanical drawing and changes the teaching method of drawing, and more and more are used in actual production. As long as the three-dimensional part drawing is designed, the processing equipment connected to the drawing software can directly produce the product, which greatly improves the production efficiency. The combined course model takes CAD courses as the main skill line and mechanical drawing courses as the application topics. The skill modules are interspersed and arranged organically. Throughout the courses, the ability to draw drawings manually and the ability to recognize pictures is the appropriate selection of the necessary theoretical course content, focusing on practical hands-on application skills and improving students' interest, and cultivating skilled workers.

The fundamental starting point of the curriculum teaching reform is to combine the use of computer software with the auxiliary planning and design courses, focusing on explaining the methods and processes of auxiliary design, and the explanation of the software is fully integrated in the design process and is only used as a tool treat. By explaining the process of different auxiliary planning and design to comprehensively use the software, students can learn to use the software in the design, make the application of the software well integrated in the auxiliary design, and truly reflect the purpose and characteristics of the course (Figure 4). In the course of teaching and guidance, combined with the detailed explanation of the order, each class is arranged with corresponding actual engineering drawings for training, from simple to complex, from small planning to medium planning, from plan drawing to construction drawing, allows students to master the teaching content gradually. When the students have completed the practice tasks, the teacher once again focuses on explaining and elaborating the problems that all students have. In this way, this theory and practice are parallel, and timely operation allows each student to operate and practice step by step. The enthusiasm of the students is very high, which improves the efficiency of the classroom and enables students to get started quickly. As the content of the lecture continues to explore, the more experience, the more and more knowledge becomes, and ultimately achieve excellent teaching results.

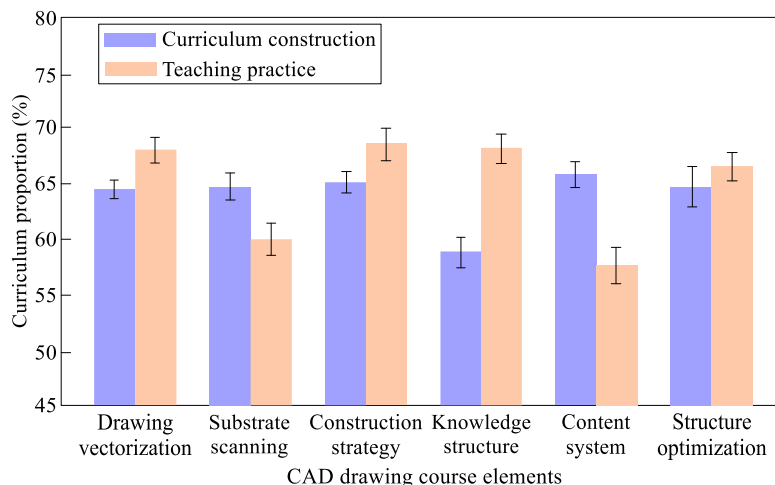


Figure 4: Curriculum proportions of different CAD drawing course elements.

3.2 Informatization Teaching Mode

Informatization teaching refers to the application of modern teaching methods guided by modern teaching concepts and supported by information technology. In the information-based teaching, teachers insist on organizing students as the center, and design the teaching content, mode, technology, evaluation and other elements to complete better teaching activities. The teaching content design breaks the traditional teaching mode based on teaching materials in the past, and transforms into a task module based on drawing engineering drawings, extracting the weight and difficulty of each teaching unit, designing knowledge points and making micro-classes for students to pre-class review later. During the teaching process, teachers should explain the relevant knowledge of CAD software to students, such as what function the software has, and then use appropriate examples to encourage students to master the specific application methods of the software. At the same time, when planning and designing, on the basis of fully grasping the measurement results, the designer needs to draw a plan drawing with the help of CAD software, and with the help of the site map, the vector drawing is scanned by the method of image substrate scanning to adjust the area to actual specifications. In addition, teachers should analyze

professional position groups, use professional knowledge modules to determine the corresponding professional positions and professional abilities of the courses, and based on the analysis of position requirements, clarify the typical work items of the courses, and promote the theoretical knowledge of the subject to penetrate different.

The informatization teaching mode combines the teacher's engineering practice experience to redesign the curriculum structure. When explaining the basic knowledge of drawing, it introduces auxiliary drawing tools such as object capture, polar axis, and orthogonal, and runs it through the entire CAD learning process, so that students can accurately draw at all times (Figure 5). In the basic drawing and editing and modification commands, students should have a solid grasp of the foundation, construct planning and design scenarios for students, and teach in the order of engineering drawing, in order for layer setting, drawing frame, model file preservation, architectural and structural engineering drawing wait, and intersperse text, tables, annotations, etc., and finally explain the graphics printing and query functions [10]. Combining the geometric features of the two-dimensional graphics leads to the necessary setting parameters of the drawing. For example, there are many modes for drawing rectangles. If explained in the order of CAD software development, the order is chamfering, elevation, rounded corners, rectangles with thickness and width, etc. Ordinary rectangle, then explain the chamfered rectangle and rounded rectangle in a similar form, and then let the students understand the rectangle with roundness through the legend, and finally explain the rectangle with thickness and elevation.

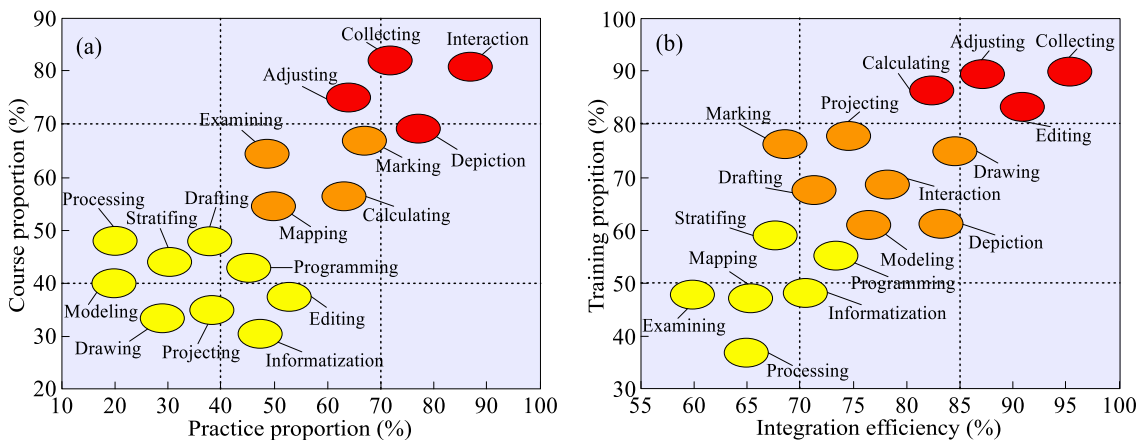


Figure 5: Distribution of different CAD drawing elements in the relationships of course and practice proposition (a) and of training proportion and integration efficiency (b) (Different colors of ellipses belongs to different classification categories).

The planning-driven method is that the teacher classifies the overall tasks of the course according to the relevance or logic of knowledge, and finally presents them in the form of planning. The planning includes coordinate and dynamic input, layer management and drawing process, precise drawing of simple graphics, dimensioning of graphics, creation of blocks and attributes, and drawing of building plans and drawing of building elevations, etc. This teaching method has been reduced to zero and various breakthroughs. Through the refinement, explanation, implementation and assessment of each plan, it can effectively improve the learning efficiency of students. Taking the initiative to discuss with teachers and classmates with questions has greatly stimulated their desire for knowledge and ability to solve problems, and thus effectively formed a virtuous circle of thinking and learning. In the teaching process, teachers can add engineering drawings of actual projects of enterprises according to different professional needs as a case to integrate into classroom teaching. On the other hand, it also enables students to master the basic knowledge of

CAD drawing, editing and other knowledge points through practice. Finally, while rationally applying various teaching methods, teachers should also pay attention to the speed training of students. Students can combine assessment, rewards and punishments and other means to arrange appropriate extracurricular homework to encourage students to practice more to improve the drawing speed.

4 DISCUSSIONS

4.1 Ability Training of Professional Planning and Design

From planning to design as a material spatial structure in the past to planning and design as a constantly changing and interconnected functional system, from the material and aesthetic perspective to observe and evaluate the results of cartography to the social life and economic activities to examine them, from design planning as the ultimate state or blueprint goal to process planning, all these changes imply that the technical means of the planning and design profession will change and need to be particularly rigorous and rational scientific analysis method. In communication planning, interpersonal communication and negotiation skills are the core. In the face of government, developers and the public, planners should not be used as technical experts, but more as coordinators of ideas. The planning theory oriented as a planning industry can be transformed, because the material environment construction has reached a certain level at that time, and for the rapid development stage, there is no sign that the material space planning will be completely replaced by communication planning. The computer can complete the design automatically, thus replacing the human brain and completely eliminate manual sketch design. These two viewpoints and attempts may have certain one-sidedness. In fact, it is not necessary to completely oppose the human brain and the computer and auxiliary design is the key to achieving human-machine harmony and interaction. Figure 6 gives an example of planning and design demonstration of construction engineering.

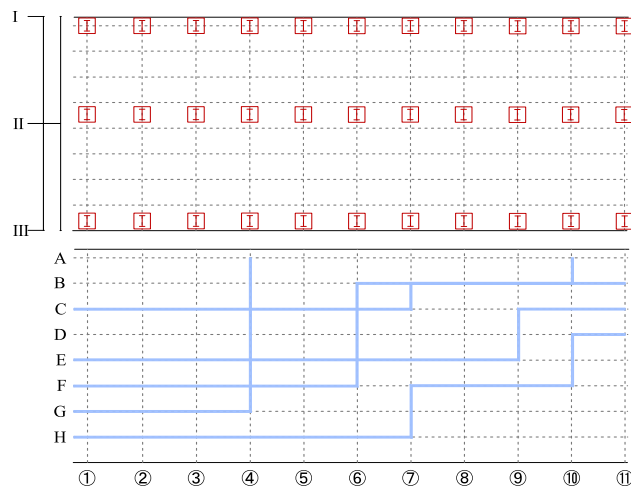


Figure 6: A planning and design demonstration of construction engineering.

The professional knowledge structure of planning and design is a system as a whole, and its internal composition is connected with each other. Its core is composed of four major parts of teaching modules, teaching content, teaching modes and curriculum practice. The teaching module is used to describe the design skills needs of urban planning students; the teaching mode is used to describe the form and method of teaching; and the course practice is used to describe the

students' hands-on basic training content. These four aspects are interrelated and influence each other, and jointly determine the teaching curriculum of the professional knowledge structure of urban planning and design. These four aspects are an interconnected whole and the former is the basis of the latter, the latter is the further skill upgrade of the former, and practical teaching is the common guarantee for the formation of the first three skills. The project-driven method is to take teachers as the lead and students as the main body of teaching and the fundamental goal is practical application. The teaching design is combined through the practical teaching of related projects and the specific content of mechanical drawing teaching, and the project design is completed in collaboration between teachers and students. The essence of project teaching is to use students as the main body of teaching activities, allowing students to give full play to the subjective initiative of learning, turning passive into active, so as to improve students' comprehensive quality and enhance professional ability [11].

The content of the descriptive geometry part of the planning and design major is based on practicality, and the projections of points, lines, and planes in the basic projection are deleted, and their basic knowledge is integrated into the projection of the basic body to explain and practice. This part of the content does not require students of industrial design majors; the content of truncated and intersecting lines is compressed. It is required to understand the concept and master the drawing of special intersecting lines. The intersection line or intersecting line made a requirement to understand its approximate drawing method, but does not require a specific method of seeking points for drawing, because now any 3D modeling software can solve the intersection or intersecting body Structural issues. The teaching of graphics and graphics are always connected, and the corresponding planning and design profession requires good drawing ability, editing function, control function, convenient operation interface, and intuitive three-dimensional modeling function, and drawing in planning and design a series of unique functions such as fast speed, many changes in the graph line, unlimited user interface and flexible movement, can draw both axonometric drawings of the plan and graphics. The projection principle is relatively abstract and difficult to understand, and simple geometric elements such as points, lines, and surfaces are relatively rare in engineering drawings. Therefore, simple theoretical knowledge such as the projection characteristics of points, lines, and surfaces is appropriately deleted and integrated into the projection of the shape introduced in is conducive to students' understanding and mastery.

4.2 Integrated Teaching of CAD Drawing Course Based on Project-driven Method

The training content of the CAD course based on the project-driven method should not be limited to this course, but should be comprehensive training across courses, especially after the students have systematically mastered the CAD course knowledge system. They should strengthen the actual integration combat training, because the school of CAD course has been fully prepared for this knowledge structure. The use of social education resources can make school education closer to the needs of society, and the exchange of inter-school education resources is more conducive to the improvement of teaching levels. The mutual development of inter-school and school-enterprise can get rid of the closed education model. The using inter-school and educational resources and information resources of the enterprise can better enrich the teaching content of our CAD courses, so that the students' learning always maintains a certain connection with the society, and improve the students' goal of learning. The implementation of modern teaching methods and technologies requires the support of modern teaching facilities and teaching spaces (Figure 7). At present, many universities have basically equipped and perfected modern teaching equipment and teaching spaces, especially the introduction of multimedia technology and equipment has greatly improved the efficiency and quality of modern higher education.

In the classroom teaching process, you can continuously introduce some engineering examples that are easier to master and are representative of the explained commands. After each instance is explained, the teacher and students will summarize and analyze the knowledge points involved in the engineering example and draw the project. The key steps required by the example, students

can follow the steps to complete the project example during the computer operation. Teachers should guide students to think actively about the problems encountered during the operation of students, and try to let students solve the problems encountered through their own thinking [12]. Teachers can use simple engineering examples to explain in more detail, and at the same time require students to repeatedly practice these simple examples. Once the students are able to master these examples well, then in the process of using engineering examples for teaching, teachers can give a rough explanation, leaving students more room to think.

The CAD drawing teaching based on the project-driven method should not only stay on this basis. At the end of the course, some large-scale comprehensive exercises should be designed, such as the general layout of the project, the layout of the workshop equipment, and the design of textile patterns. The basic knowledge learned earlier is combined with practical engineering problems. At the beginning, they had no way to start. The teacher first demonstrated and explained the main steps of the operation, and then let the students practice. During the practice, the students will encounter many problems, which mean that they have discovered the deficiencies they usually learn after enlightenment and mobilization. The knowledge of CAD drawing based on the project-driven method is not mastered by the teacher, but the learner obtains through the absorption, practice and digestion with the help of the teacher in a certain situation. Combining engineering design, the establishment of each task depends on the students' existing professional knowledge and the overall arrangement of teaching content.

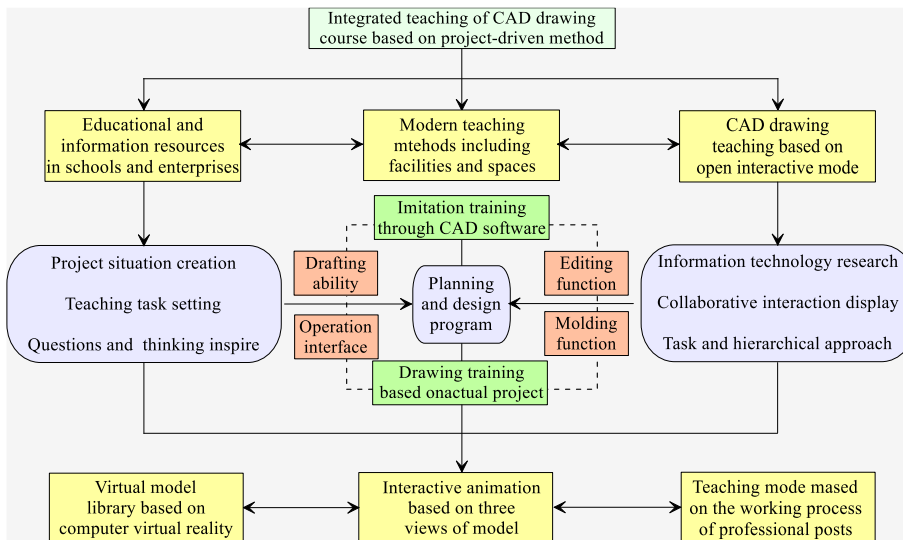


Figure 7: Integrated teaching model of CAD drawing course based on project-driven method.

5 CONCLUSIONS

This paper introduced the curriculum construction of CAD drawing course for planning and design major based on course strategies and structure optimization, analyzed the teaching practice of CAD drawing course for planning and design major including teaching content system and curriculum construction model, discussed the planning and design ability cultivation and the integrated teaching of CAD drawing based on the project-driven method. The teachers should explain macro definitions, professional graphics libraries, menu files, development languages, and data exchange with other advanced languages. The content of the exercises in this part is the practice of drawing graphs by hand and drawing isometrics and oblique secondary mappings by computer. The teaching module is used to describe the design skills needs of urban planning

students; and the course practice is used to describe the students' hands-on basic training content. The results of this paper provide a reference for further researches on curriculum construction and teaching practice of CAD drawing courses for the major of planning and design.

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