Reforming the Course of Computer Aided Design with an Application-Oriented Approach

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Abstract: Computer Aided Design is a comprehensive, practical, and applied foundational course offered to second-year undergraduate students majoring in human geography and urban-rural planning. With a focus on an application-oriented approach, the teaching team has actively explored various aspects such as teaching objectives, contents, and methods. This teaching reform revolves around the establishment of an integrated teaching framework, the introduction of the O-AMAS teaching model, and the enhancement of online and offline teaching platforms. Through these efforts, a multidimensional teaching model that combines software application, professional practice, and standard guidelines has been developed, forming a synergy between "in-class + out-of-class", "online + offline", and "academic knowledge + applied extensions". This has effectively elevated the quality of the course instruction.

Keywords: Application-Oriented; Computer Aided Design; Teaching Reform; Human Geography and Urban-Rural Planning

1. Introduction

In recent years, with the introduction of policy documents such as China's Education Modernization 2035 and Overall Plan for Deepening the Educational Evaluation Reform in the New Era, a significant strategic initiative of "transformation towards application-oriented education" has been proposed for higher education reform and development [1]. The cultivation of application-oriented undergraduate talents aligned with competency-based approaches has become a key objective in China's higher education system[2]. Guided by this educational philosophy, universities at different levels have actively engaged in research and practice, proposing the talent cultivation pathways of integrated development [1,3] and the teaching models of project teaching and so on [4]. In educational practices, outcome-oriented and student-centered project-based teaching models [5,6], as well as blended teaching model [7], have achieved favorable results in terms of educational reform.

Currently, China is comprehensively promoting the high-quality development of the new urbanization [8], which brings new requirements for the cultivation of talents in human geography and urban-rural planning. Our School has always focused on the cultivation of application-oriented talents as a characteristic of disciplinary development. In response to social and era advancements, we have carried out reforms in the Computer Aided Design course, leveraging the strengths and expertise of the institute. Emphasizing the application-oriented objectives of curriculum reform holds great significance for the development and construction of the profession.

2. Fundamentals of Computer Aided Design Courses

Computer Aided Design (CAD) technology is widely applied in urban-rural planning. The mastery of relevant CAD software applications is not only a basic requirement for professionals in the field of urban-rural planning but also an important skill for students to comprehend, express, and apply their acquired knowledge in the discipline.

According to the talent development plan, CAD belongs to the category of method and technical courses. It is a comprehensive, practical, and applied foundational course offered to second-year undergraduate students.

This course consists of a total of 54 class hours, including 30 hours of theory and 24 hours of laboratory work. The primary focus of this course is to cultivate students' software application skills and thinking abilities, aiming to enhance their overall qualities. It serves as a preparation for subsequent professional courses and also plays a significant role in graduation projects, social surveys, academic competitions and so on.

Students have already studied courses such as Architecture Graphics, Surveying and Mapping, which provide them with a certain professional foundation. They have also begun to be exposed to design courses such as Introduction to Architecture and Constructive Detailed Planning, which has increased their enthusiasm for learning. However, in previous teaching practices, the integration between courses has not been sufficiently tight, resulting in students facing difficulties in connecting the knowledge from different courses. They may have learned software operations but struggle with applying them in design practice or expressing their designs according to standards. Therefore, the key focus of this teaching reform is how to fully unleash the bridging role of CAD in the talent development plan, enabling students to truly apply what they have learned. The aim is to organically integrate the knowledge points from various courses and utilize modern technological methods for design and expression [9].

3. Exploration and Implementation of Teaching Reforms

The teaching reforms in this course primarily focus on teaching objectives, contents, and methods. The goal is to enhance the teaching quality of the CAD course and establish an integrated teaching model, aiming to improve students' overall qualities and their ability to apply what they have learned. The objective of this reform is to bridge the gap between "learning" and "application" [6], helping students enhance their professional competence through practical experiences. During the process of teaching reform, we leverage existing resources such as course platforms and practical bases. We actively engage in application-oriented integrated teaching practices, which have resulted in the development of a relatively comprehensive teaching system.

3.1 Teaching Objectives

The teaching team, in conjunction with the ongoing development of first-class undergraduate major, has distilled the teaching objectives into a holistic approach encompassing knowledge impartation, skill development, and value formation. These objectives align with the requirements for graduates in the respective field. They are as follows: 1. To acquire fundamental theoretical knowledge in CAD. To master proficiently the basic operation methods and functional skills of the AutoCAD software. To grasp the requirements and methods for creating professional drawings. 2. To cultivate proficiency in software operation. To foster professional communication skills. To develop autonomy in learning and lifelong learning abilities. To enhance spatial imagination and thinking capabilities. To cultivate the combined ability to solve practical problems. 3. To foster a sense of patriotism, instill the spirit of craftsmanship, establish professional ethics, and enhance overall qualities.

3.2 Course Contents

To begin with, departing from tradition and emphasizing practicality, we aim to break the existing teaching model and promote the integration of software operation, professional practice, and adherence to standardized learning. An integrated teaching framework has been established, considering the close connection between this course and other relevant courses. Therefore, the course contents should not be limited to the software itself; instead, it should emphasize the integration of software instruction with professional teaching. This approach fosters the transferability of students' knowledge and skills in diverse contexts.

The teaching team has conducted analysis and organization of the talent cultivation program, as well as the syllabus and schemes for related courses. This process aims to determine which courses and knowledge points can be carried out an integrated teaching approach. Through communication and discussions with relevant faculty, students and employers, the actual needs in teaching and practice have been understood, allowing for the reasonable identification of key teaching areas in the

curriculum. By combining the knowledge points of related courses with the demands of practical work, diverse teaching and practical activities are strategically arranged. For example, exercises on architectural plans are selected from the textbook Architecture Graphics, incorporating knowledge on land classification from courses like General Theory of Urban and Rural Planning and Rural Planning, as well as topics on horizontal curve planning and design from Traffic Geography and Traffic Planning. Additionally, elements of design and mapping are integrated into lectures from courses such as Applied Fine Arts and Geographic Information Systems. By integrating these teaching methods, a stronger connection is established between courses, allowing students to gain a more systematic understanding and application of various knowledge points.

During the period of online teaching influenced by the pandemic, the teaching team had the responsibility of concurrently instructing two courses: CAD and Constructive Detailed Planning. In order to optimize teaching design, the team implemented a pilot project for multi-course integration. In Constructive Detailed Planning, the emphasis was on teaching design methodologies, while in CAD, the focus was on instructing graphical representation methods. The team decomposed the design process, starting from interpreting design conditions and consulting regulations, progressing to conceptualizing solutions, and finally expressing the outcomes. They effectively combined design thinking with software operations. Following the instructional pace and requirements, students gradually and meticulously conveyed their design concepts, ensuring clarity and adherence to standards in their final results. This approach facilitated the permeation and integration of software instruction with professional teaching, effectively stimulating students' interest in learning and autonomy. As a result, commendable teaching outcomes were achieved.

Secondly, considering the continuous development of the curriculum, there is a focus on learning fundamental concepts and cultivating students' thinking abilities and self-directed lifelong learning skills. With the rapid advancement of computer technology, the development of CAD software has also been progressing rapidly. For instance, software like AutoCAD introduces new versions almost every year, to the point where it is not uncommon for a semester to end while the software version has already been updated, leaving students feeling overwhelmed by the abundance of constantly evolving programs. In classroom instruction, it is important not only to acquaint students with cutting-edge information in the field but also to make them realize that computer software serves as tools and means to aid designers' expression. While various software programs undergo continuous updates, the core principles and operational patterns of drafting remain unchanged. Therefore, teaching should not be limited to a specific software or version, nor should it blindly pursue the latest version. Students can choose a software version that suits their computer's hardware configuration and personal needs. The emphasis should be on explaining the principles and techniques of drafting, training students' drawing thinking. Only by mastering the core principles can one adapt to various changes, allowing for quick adaptation even when encountering new versions or programs.

Thirdly, in the teaching process, there is a proactive integration of theoretical knowledge with thinking methods and value-oriented education. The focus is not only on students' acquisition of professional knowledge but also on the cultivation of their comprehensive qualities. Through subtle integration in classroom instruction, students' sense of social responsibility towards the nation and the people, their spirit of innovative exploration, and their problem-solving abilities are enhanced. The classroom instruction serves as a vital conduit for nurturing students and fully unleashes its role in shaping their character.

3.3 Teaching Methods and Approaches

The course CAD actively implements the O-AMAS instructional model, which incorporates various modules of instructional activities such as rapid activation, multi-learning, effective evaluation, and brief summarization, while integrating them with the teaching contents[10]. Considering the practical nature of this course, a combination of teaching methods is employed, including visual instruction, project-based learning,

Games-based learning, and cooperative learning. This creates a classroom environment centered around student development, fostering real-time and effective interaction between teachers and students, and stimulates students' interest and autonomy in learning.

To stimulate students' learning motivation, students are encouraged to form learning groups consisting of 3 to 6 members. The teacher assigns group learning tasks and invites each group to present their findings in class. Group members engage in discussions and exchanges, encouraging each other to pursue independent learning and practice. Students who study well can guide other members, propelling the overall progress of the group. Through inter-group communication and learning, the progress of all students is effectively promoted. This collaborative learning approach facilitates meaningful interactions and communication between teachers and students, as well as among peers.

In teaching, personalized instruction is implemented based on the individual circumstances of the students. The classroom exercises are designed with a moderate level of difficulty, and for common issues that arise during the exercises, timely summaries and unified explanations are provided. For students who have a good grasp of the subject matter, the teacher offers supplementary materials for self-study outside of class. On the other hand, for students who are facing difficulties in learning, targeted guidance and support are provided based on their specific needs. For example, a student is struggling with computer skills, the teacher provides step-by-step guidance on tasks such as accessing computer information, downloading software, installing software, and using command operations, ensuring that they successfully complete their learning assignments.

3.4 Construction of Online + Offline Teaching Platforms

In response to the school's requirements, there has been a proactive implementation of modern information tools, such as the inclusion of the Chaoxing Platform. This has resulted in the development of a comprehensive "in-class + out-of-class", "online + offline" learning resource repository. By fully utilizing information technology in teaching, the flexibility of learning is enhanced, and students' active learning motivation and innovative abilities are stimulated. Seizing the opportunity presented by online teaching, the teaching team has conducted a detailed breakdown of the original teaching contents. Furthermore, focusing on the curriculum's knowledge system and key challenging topics, they have integrated courseware, videos, online resources, and more, to further enhance the construction of the online teaching platform.

The teaching team has provided over 300 minutes of self-produced video resources, along with related cases, graphic design standards, teaching videos, and other electronic materials on the Chaoxing Platform, offering students opportunities for self-directed learning and application expansion both inside and outside the classroom. Since the adoption of the Platform in the 2018 academic year, the cumulative number of students who have engaged in learning has exceeded 700,000. This initiative has received widespread acclaim from students.

3.5 Assessment Methods

The assessment method is a crucial aspect of cultivating applied talents. The course employs a diversified assessment and evaluation approach, which encompasses various dimensions such as theory and practice, process and outcomes, group and individual work. This enables the assessment of students' software operation and applied practical abilities [11]. The specific evaluation requirements are detailed in Table 1.

Table 1. List of Course Assessment Methods

Assessment Methods	Assessment Contents	Weight	Assessment Requirements
Regular Performance	Class attendance	10%	Formative assessment Stimulative evaluation Individual assessment Team assessment
	Classroom activities	10%	
	Assignments	20%	
Final examination	Comprehensive practice	48%	Comprehensive evaluation Individual assessment
	Computer-based operations	12%	

4. Conclusions

Through the reforms and practices in this teaching process, the CAD course has achieved a diverse integration of software applications, professional practices, and standard specifications learning. It has formed a multidimensional teaching model of "in-class + out-of-class", "online + offline", and "academic knowledge + applied extensions". This has effectively enhanced students' enthusiasm for learning, improved their software application skills, and elevated their overall competence.

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