Exploration of Teaching Method Reforms in the "Planning CAD" Course: A Case Study of the Human Geography and Urban-Rural Planning Major

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Abstract. Computer-Aided Design (CAD) is a crucial tool for students specializing in Human Geography and Urban-Rural Planning, with broad applications in areas like architectural design, urban development, and landscape planning. As specialized courses advance, the "Planning CAD" course has gradually become central to cultivating students' professional skills. However, traditional CAD teaching methods have revealed certain issues, such as a lack of student motivation for independent learning and insufficient mastery of skills. Therefore, optimizing the teaching methods of the "Planning CAD" course has become urgent. This paper uses the Human Geography and Urban-Rural Planning program at Yunnan Normal University as an example, exploring how measures such as enriching the course case library, optimizing teaching content, improving teaching methods, expanding teaching tools, and strengthening course evaluations can comprehensively enhance the teaching quality of the "Planning CAD" course. These efforts aim to better meet the complex professional skill requirements and diverse learning needs of students.

Keywords: Planning CAD, teaching methods, teaching quality, talent cultivation quality.

1 Introduction

As urban and rural development continues to advance in China, the Urban and Rural Planning major has become a crucial foundation for universities in fostering innovative and application-oriented professionals. This field combines engineering technology with design arts and encompasses a wide range of disciplines, such as urban design, architecture, environment, and transportation. Due to the complexity of the curriculum, most universities offer it as a five-year undergraduate program. In contrast, the four-year Human Geography and Urban-Rural Planning program is more focused and practical, integrating geography, urban planning, and environmental protection. This program emphasizes hands-on experience and technological application, aiming to produce versatile professionals with skills in spatial analysis, planning design, and

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sustainable development, thus meeting diverse employment demands and attracting strong enrollment interest.At Yunnan Normal University, the Human Geography and Urban-Rural Planning major is dedicated to developing both "research-oriented" and "application-oriented" professionals with expertise in human geography, physical geography, and geographic information science and technology. One of the core courses in this program, "Planning CAD," plays a pivotal role in cultivating students’ planning and design skills. The course covers CAD software applications, professional standards, and planning practices, with a strong emphasis on interdisciplinary, practical, and hands-on learning, making it a critical element of training for compound talents. However, the current "Planning CAD" course faces challenges in enhancing students' innovation, practical skills, and ability to address real-world engineering problems. This paper explores the teaching practices of the Human Geography and Urban-Rural Planning program at Yunnan Normal University and proposes potential teaching reforms to improve the effectiveness of the course, thereby enhancing both the quality of education and talent development.

2 Evolution of the Course and Problems with Traditional Teaching Methods

2.1 Evolution of Course Teaching

As the core foundational course in the Human Geography and Urban-Rural Planning program, "Planning CAD" aims not only to equip students with CAD-based professional skills but also to develop their ability to actively acquire, analyze, and process information, fostering their engineering application capabilities. Historically, the course has focused primarily on teaching CAD software, often using small case studies to demonstrate its functionality. While students become proficient in operating the software, they may lack the ability to use it to integrate and design comprehensive urban and rural planning cases effectively.With the evolving concepts in urban planning, new ideas, methods, and requirements are increasingly dependent on the use of computers. More advanced and integrated professional case training is needed, such as collaborative design across multiple software platforms. The future direction of teaching reforms should focus on using small-scale integrated projects as practical training methods, emphasizing comprehensive, multi-software collaboration to better reflect the evolving needs of urban planning education.

2.2 Problems with Traditional Teaching Methods

The traditional teaching method for the "Planning CAD" course primarily relies on a combination of teacher explanations and student practice. While this approach has certain advantages in imparting foundational knowledge, it has significant limitations in developing practical application skills and professional expertise. With the rapid advancement of technology, CAD software is frequently updated, becoming increasingly powerful, while the course content often fails to keep pace with these developments. As a result, the knowledge students acquire can become disconnected from real-world job requirements. The course tends to focus more on software tool operations and lacks a close connection to real planning projects, leaving students with insufficient practical experience in applying CAD to actual projects.Additionally, the traditional "theory lectures + chapter exercises" model often lacks smooth transitions in practice[1]. Some students lose interest, struggle to keep up with the pace, and experience "gaps" in their operation processes, which hinders their effective mastery of the skills. These issues highlight that the current teaching methods are unable to meet the evolving demands of practical application and require optimization to better equip students with the skills needed in real planning projects.

At present, the teaching model is largely teacher-centered, with students mostly in a passive role, merely receiving operational skills without engaging in active exploration of multi-software integration. This results in low learning motivation and a lack of initiative in developing interdisciplinary capabilities. The course still primarily focuses on software operations and neglects the integration with actual projects[2]. As a result, students often lack a clear understanding of how to apply CAD to real-world projects, leading to quick forgetfulness after class and, ultimately, lower classroom efficiency and knowledge retention. Moreover, the course assessment mainly relies on in-class tests, which fail to comprehensively evaluate students' performance throughout the entire learning process. This single evaluation method overlooks students' creativity and practical abilities, making it difficult to fully reflect their overall competencies[3]. Therefore, there is an urgent need for reform in both teaching methods and assessment systems.

2.3 Key Issues for Teaching Reform

Modern educational models can adopt blended teaching approaches, such as modular, project-based, and goal-driven methods, to promote the integration of ideological and political education, improve faculty teams, and encourage school-enterprise cooperation. These strategies contribute to forming a systematic teaching reform. The reform should focus on various aspects, including teaching content, methods, and assessment, using reverse education techniques to establish dynamic teaching approaches. Additionally, real-world projects should be introduced to cultivate students' comprehensive abilities and enhance their employability[4]. The integration of interdisciplinary content can foster teamwork and knowledge innovation. Furthermore, incorporating new technologies, such as 3D modeling, can advance the application of cutting-edge technologies in teaching, thereby improving students' competitiveness in the job market[5]. In the context of Planning CAD education, instructors need to teach both planning knowledge and the basics of multi-software operation, balancing students' professional knowledge, practical computer skills, and project operations. This places higher demands on teachers. However, students often overlook basic CAD operation commands during their learning, leading to frequent issues in real-world applications and relatively weak practical abilities. Therefore, the focus of teaching reform should be on enhancing the integration of CAD-based practical skills with in-depth professional knowledge, ultimately improving students' engineering practice capabilities.

3 Measures for Course Teaching Reform

The core of the curriculum reform is the development of students' comprehensive qualities, focusing on improvements in teaching philosophy, content, and methods. At the same time, it emphasizes the cultivation of students' fundamental skills and professional literacy, aiming to produce talent better suited to meet the evolving needs of the industry. In the "Planning CAD" course, the curriculum will revolve around residential building design, residential area planning, detailed planning (both regulatory and construction), and urban master planning[6]. CAD software will serve as the primary platform, integrated with other professional software such as Tianzheng, SketchUp, and Photoshop. This multi-software collaborative approach will help students complete various aspects of urban and rural planning design, such as architectural drawings, urban master plans, and regulatory plans. Students will be required to proficiently master the software related to each section of the curriculum.The course content of Planning CAD will be structured into two primary teaching systems: theoretical teaching and practical teaching, both forming a complete educational framework. The theoretical teaching system will consist of three modules: basic software instruction, professional design instruction, and theoretical coursework practice. Correspondingly, the course requirements for Planning CAD can be summarized into three categories: basic software operation skills, software operation extension skills related to the profession, and engineering practice skills[7]. These three modules are interconnected, and the teaching process will progressively advance in alignment with them. Zhang Bo, in his exploration of the "Electronic CAD Technology" course, proposed the concept of "learning by doing, doing by learning" and promoted an integrated teaching model that combines theory with practice. His teaching objectives focus on guiding students from imitation to creativity, using project-based learning, which has received positive feedback on teaching outcomes. In the theoretical teaching phase, the focus is on basic software skills, emphasizing the foundation of students' practical abilities. The practical teaching framework divides the course into three modules: basic software operation practice, professional design ability practice, and comprehensive project practice. This structure helps students master drawing skills related to urban and rural planning and enhances their ability to solve real engineering problems.

This stage of instruction is particularly crucial. To streamline theoretical classroom content, online course resources will be used, integrating theory with design practice. During the explanation of key concepts, close connections with design courses will be made to stimulate students' initiative. In addition, multimedia tools such as videos, CAD, and SketchUp will be used for interactive teaching from multiple angles, enhancing the learning experience [8].

3.1 Course Resource Preparation Reform

3.1.1. Development of the Engineering Project Case Library.

To enhance the practicality of the "Planning CAD" course, a comprehensive engineering project case library should be established. This library will include a range of planning cases, from residential area designs to large-scale urban planning projects, supported by CAD resource databases. These cases will be carefully categorized by type, scale, and complexity, ensuring they cover various planning challenges [9]. By integrating these resources into classroom activities, students will gain direct exposure to real-world projects, bridging the gap between theoretical knowledge and practical application. Additionally, related courses like "National Spatial Planning" and "Regional Planning" can contribute shared resources to further enrich the library and provide students with an interdisciplinary perspective.

3.1.2. Enhanced Learning Support and Evaluation Mechanisms.

Upgrading teaching facilities and establishing robust evaluation systems are essential for successful implementation. Meanwhile, evaluation methods will combine technical skill assessments, creativity, and problem-solving in realistic planning scenarios. This includes requiring students to complete capstone projects derived from the case library, fostering comprehensive learning outcomes. By incorporating feedback loops from both instructors and students, the system will evolve to better align with industry practices and educational objectives.

3.2 CAD System Practice Education

3.2.1 Foundational Training in Planning Drawings.

Given that students in this program may lack prior exposure to courses such as "Descriptive Geometry and Engineering Drawing," this training focuses on equipping them with the essential skills required for planning drawings. Students are taught the correct use of drawing tools, fundamental drawing techniques, and national standards and regulations relevant to urban and rural planning. Through practical exercises, they develop spatial awareness and creative thinking. Case studies, including tasks such as roof plans, industrial zone layouts, and residential community site plans, allow students to build their drawing skills progressively—from simpler exercises to more complex challenges—enhancing their ability to interpret and produce technical drawings while reinforcing their theoretical knowledge.

3.2.2 CAD Operations Training.

This section aims to familiarize students with the basic commands and operational techniques of CAD software. Under instructor guidance, students learn to interpret, create, and modify drawings using 2D CAD tools, gradually transitioning to 3D CAD systems. Training emphasizes tasks such as design, simulation, and analysis, providing hands-on experience with advanced CAD applications widely used in urban planning. By integrating practical exercises, students gain proficiency in producing standardized and visually intuitive planning documents. This training not only builds software expertise but also prepares students to adapt to technological advancements in the field, improving the efficiency and accuracy of planning workflows.

3.3 Tianzheng Integrated Architectural Construction Drawing Practice and Training

In the curriculum of the Human Geography and Urban-Rural Planning program, there is no prerequisite course like "Descriptive Geometry and Engineering Drawing." Therefore, after students acquire basic CAD skills, they need to further study architectural drawing software, such as Tianzheng Architecture, with the goal of developing their ability to design and interpret architectural construction drawings. The teaching process involves practical training using real engineering cases. Students will not only learn about architectural structures, materials, and design processes but will also use Tianzheng Architecture software to create a complete set of architectural construction drawings. The teaching method is based on group collaboration, where 5 to 6 students form a "project team." The team first agrees on the overall design plan, and then each member is assigned different tasks, such as creating floor plans, elevations, sections, and detail drawings.

Throughout this process, team members work together to resolve various challenges that arise during the design phase. This group-based teaching approach not only effectively enhances students' practical skills but also fosters teamwork and communication abilities, better preparing them to meet the demands of real-world projects in their future careers.

3.4 Multi-Software System Integration in Planning Practice

3.4.1 Comprehensive Analysis and Optimization in Urban Planning.

Urban master planning involves a multidisciplinary approach requiring students to analyze relationships among terrain, transportation, landscape, geological hazards, and other factors. The CAD portion of the course focuses on tasks such as land evaluation, plan assessment, and auxiliary calculations [10]. Students process and store existing data, incorporating various influencing factors to create land use plans and optimize site layouts. They also use computational tools for tasks like population forecasting, land area measurements, and land balance assessments. These efforts culminate in the integration of plans using evaluation software, enabling students to propose systematic, optimized solutions for urban planning.

3.4.2 Project-Based Design and 3D Modeling Integration.

Task-driven and project-based teaching methods engage students in practical design exercises, such as urban master plans, detailed plans, and building layouts [11]. Working in groups aligned with their interests, students independently explore and develop project proposals for small-town or village layouts. Tools like SketchUp enable students to produce detailed 3D models, landscape renderings, and shadow analyses, while Photoshop is used to refine designs and highlight landscape features. The integration of various software systems, including animation simulation in SketchUp, provides a realistic representation of planned areas, connecting theoretical knowledge with practical application in design processes.

3.4.3 Diversified Assessment of Teaching Outcomes.

The evaluation system emphasizes both teamwork and individual creativity. Project group presentations account for 25% of the grade, allowing students to showcase how CAD and other tools contributed to their final designs. Peer evaluations make up another 25%, fostering collaboration and mutual learning. Teacher evaluations, combined with the submission of electronic deliverables such as CAD files, 3D models, and design documentation, constitute 50% of the assessment. This holistic approach ensures students are evaluated on their ability to integrate technical skills, practical problem-solving, and innovative thinking into their urban planning projects[12].

4 Reform of Course Evaluation Measures

The assessment system plays a vital role in ensuring the effectiveness of the course reforms in the "Planning CAD" course. It consists of two main components: formative assessment (ongoing assessment) and summative assessment (final assessment), each accounting for 50% of the total grade. The formative assessment evaluates students continuously throughout the course, focusing on classroom performance, regular assignments, and practical teaching. It emphasizes students' achievements in each module, particularly during the integrated practical phase. The practical outcomes and design proposals demonstrate students' abilities to operate various software tools, apply planning design theories, and solve real-world problems, providing a comprehensive view of their progress.

The summative assessment primarily consists of hands-on exercises that evaluate students' proficiency with CAD operations. These exercises consolidate the theoretical and practical learning outcomes and allow students to combine both aspects, further enhancing their technical skills. The assessment also includes feedback mechanisms, which contribute to course improvements. Instructors use both student performance and feedback to self-evaluate and adjust the course content. This feedback loop ensures that the course remains relevant to industry demands and continues to meet the evolving needs of the urban and rural planning field.

4.1 Proposed Evaluation Standard and Tool

To ensure a thorough and balanced evaluation of students' performance, the following table outlines a comprehensive set of evaluation criteria and tools as showed in Figure 1.

Evaluation Criteria	Weight	Evaluation Tools	Description
Classroom Participation	10%	Instructor observation, Peer feedback	Assess student engagement, communication skills, and contribution to discussions in the classroom.
Assignments and Homework	15%	Rubric-based grading, Peer review	Evaluate students' understanding of theory, software usage, and their ability to solve related tasks.
Practical Exercises	25%	CAD-based project submissions, Performance assessment	Assess technical skills in CAD systems and the ability to execute design tasks using various tools.
Design Proposals and Creativity	20%	Project-based evaluation, Instructor feedback	Measure the originality and feasibility of student designs, along with their application of planning concepts.
Final Project and Presentation	30%	Presentation rubric, Peer evaluation, Teacher evaluation	Evaluate the final design project based on its technical quality, creativity, presentation, and integration of software systems.

Fig. 1. Evaluation Criteria and Tools for Planning CAD Course

4.2 Explanation of Evaluation Tools

The evaluation tools used in the "Planning CAD" course are designed to provide a holistic assessment of students' skills, engagement, and ability to apply what they have learned. Instructor observation allows for an assessment of students' participation in classroom discussions and group activities, helping instructors gauge engagement and communication skills. Peer feedback encourages collaboration and teamwork, where students evaluate each other's work, promoting constructive criticism and mutual learning. Rubric-based grading offers a clear and structured method for assessing assignments, ensuring consistency and transparency in evaluating students' work based on predefined criteria such as technical accuracy and creativity. Project-based evaluation focuses on students' ability to apply theoretical knowledge to real-world scenarios, particularly in their design proposals, assessing both the quality and feasibility of their ideas. Finally, performance assessment evaluates the execution of practical tasks in CAD, assessing students' technical proficiency, ability to solve planning problems, and integration of multiple software tools. These tools together provide a comprehensive evaluation that not only measures students' technical skills but also their creativity, teamwork, and ability to communicate and present their designs effectively.

5 Conclusion

The reform of the "Planning CAD" course offers new ideas and methods for the teaching of the Human Geography and Urban-Rural Planning program. Through reforms in areas such as the preparation of teaching conditions and resources, collaboration among the teaching team, optimization of teaching facilities, and innovative design of the teaching process, the course aims to comprehensively enhance the quality of instruction. The goal is to ensure that students not only acquire a solid technical foundation but also develop the ability to flexibly apply multi-tool solutions based on

CAD to real-world problems. This will equip students with advanced technical skills and practical experience in the field of urban and rural planning, ensuring they are well-prepared for the industry's demands.

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