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Original Paper

Research on Architectural Design Course Teaching Reform under the New Engineering Talent Training Concept - Taking Architectural Design V as an Example

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Abstract

In recent years, the development of technologies such as big data, artificial intelligence, and the Internet of Things has drastically changed the architectural market, raising the demands on architects by enterprises and institutions. The traditional teaching model of architecture majors struggles to meet the market's demand for professionally applied talents, necessitating reform. With the introduction of the new engineering talent training model by the Ministry of Education, the goal of educating students has shifted from a focus on theory and professional techniques to nurturing engineering talents with innovative spirit and practical skills. The cultivation of these qualities requires profound contemplation by architectural educators on how to train architectural talents who can meet societal needs, and put these ideas into action. Based on the concept of new engineering construction, this article first analyzes the problems students face in actual teaching and practical work. It then proposes suggestions for teaching reform specific to Architectural Design V, applying these reform measures to the education of senior students. This approach is beneficial in enhancing students' professional design abilities and innovative thinking, thereby improving the quality of applied talent training and teaching standards. This holds significant guidance value for the practical teaching reform of architectural courses.

Keywords

New Engineering, Talent Training, Architectural Design, Teaching Reform

1. Introduction

The course "Architectural Design V" is offered to senior students majoring in architecture at our school. It is one of the core courses of the undergraduate program. In February 2017, the Ministry of Education issued the "Notice on Carrying Out New Engineering Research and Practice", signaling the arrival of a new round of technological revolution represented by new technologies, new business formats, new models, and new industries. The future of new industries and the new economy requires "new engineering" talents with strong engineering practice abilities, a strong sense of innovation and entrepreneurship, digital thinking, and interdisciplinary integration capabilities. These demands pose higher requirements for traditional engineering professionals (Dong & Zhang, 2019). There is an urgent need for reform in architectural education. As senior students are about to face internships, how can we help them transition smoothly from school to enterprises? How can we ensure a seamless connection for architecture students from school to their professional roles? These are key issues that need to be considered in our teaching.

2. Current Status of Architectural Design Teaching

2.1 Through the Teaching and Research of Senior Architecture Students at our School in Recent Years, the Current State of Architectural Education is Found to be as Follows

(1) The design briefs are disconnected from real projects, resulting in "fake problems, fake solutions." Teachers create hypothetical sites and conditions, making design conditions too idealized and disconnected from actual projects.

(2) The design briefs are not updated for years and fail to align with the latest industry needs and realities. The content lacks connection with current architectural technology developments and actual project requirements, leading to impractical and unrealistic designs that do not foster students' engineering practice skills.

(3) The traditional multimedia teaching method is limited and ineffective. After the design briefs are distributed, students passively work on designs, lacking the initiative to identify and solve problems and a sense of independent learning. Moreover, traditional classroom teaching models are flat, with insufficient emphasis on practicality and innovation, leaving students in a predominantly passive state of receiving information.

(4) There is insufficient correlation between design courses and other courses; there is no permeation or integration. Theory courses and design courses lack interconnection.

(5) The teaching process lacks the assistance of modern, digital, and intelligent technologies.

2.2 Based on the Employment Statistics of Our School's Graduates in Recent Years, Feedback from Architectural-related Enterprises Reveals some Issues with Architecture Graduates in Practical Work

(1) Students have weak engineering practice abilities, remain theoretical, and their design solutions are impractical, such as neglecting costs, structural considerations, and specific client requirements in their designs.

(2) Lack of communication skills, working in isolation without actively engaging with colleagues and leaders.

(3) Team collaboration skills need improvement.

(4) Weak in innovation and competitiveness.

3. Research on Architectural Education Reform

Based on the issues observed in our senior students majoring in architecture, the Architectural Design V teaching team, through years of teaching experience and numerous educational research discussions, has gradually adjusted the teaching methods in architectural education, achieving some positive results.

3.1 Interdisciplinary and Cross-disciplinary Integration

(1) Cross-disciplinary integration, establishing a multi-disciplinary cooperation mechanism

As a comprehensive discipline, architectural design requires knowledge and skills from multiple disciplines. For instance, architectural design is related to disciplines like structure, water and electricity, heating and ventilation, electrical engineering, landscape, and planning. The Architectural Design V course can integrate with other majors such as civil engineering and transportation engineering at our school. Inviting teachers from these related disciplines to join the architectural education as course consultants can help ensure that relevant knowledge is reflected in the design outcomes.

(2) Interdisciplinary Integration

Interdisciplinary collaboration can lead to more innovative design concepts. People from different disciplines bring varied backgrounds and experiences, leading to diverse ways of thinking and innovation capabilities. Through interdisciplinary cooperation, different specialties can inspire and learn from each other, leading to more diverse and innovative design concepts. However, traditional architectural design education often focuses solely on developing students' architectural design skills, overlooking the potential of cross-disciplinary collaboration.

The architectural design course can integrate with courses like structural selection, building materials, and site design. In our school, senior architecture students spend the first half of the semester in the Architectural Design V course, where they need to complete two design projects. The first project is the design of an external space for a commercial street, and the second is the design of a high-rise office building with retail on the ground floor. The high-rise office building design involves considerations of structural selection and building materials. Students need to understand common structural forms for high-rises and decide which to use in their design. Some students, despite having good design ideas and creativity, face significant issues with structure and are unclear about which materials to use to achieve the desired design effect, mainly due to unfamiliarity with materials. Both the commercial street design and high-rise design in Architectural Design V involve site design, considering how to plan the relationship between buildings, roads, plazas, landscapes, and parking lots, all part of site design. Teachers of Architectural Design V can actively communicate with teachers of related disciplines to

ensure that theoretical knowledge is applied in architectural design, and also assist teachers of related subjects in clarifying teaching difficulties and focal points. Teachers can jointly develop teaching plans, consulting with teachers of related courses when formulating Architectural Design V lesson plans, especially regarding specific design content. This approach ensures that next year's Architectural Design V students can complete their course designs more efficiently, avoid detours, and improve the quality of their outcomes.

(3) Cross-regional Practical Integration, Building an Open Teaching Platform

Students are often required to design according to established norms and examples, which lacks opportunities for challenge and creation. This traditional method of teaching limits the development of students' thinking, making it difficult for them to develop unique design thinking and independent thinking abilities (Lang, 2022).

By relying on excellent design institutions as platforms and attracting outstanding alumni to return to school to share industry insights, a combination of online and offline methods can be employed. Based on the course progress and design direction, invite outstanding architects from the industry to teach senior students. For instance, when discussing the design of commercial streets, invite professionals skilled in this area to share real case studies with the students. This approach helps students understand the various considerations in actual commercial street design, moving beyond theoretical discussions. When it comes to high-rise building design, invite experienced designers to share insights, such as how to select structures for specific situations, how to resolve structural issues under special circumstances, and fire safety requirements in actual project design. This method aims to change the current situation where students design according to set norms and lack innovation. Real case studies in projects can also enhance students' interest in learning.

3.2 Introducing Competition Mode into the Course

During the semester, select competition categories that are high in value and align with the teaching content of Architectural Design V. The competition themes should be closely related to current social hot topics, actively engaging students in participation. For example, students participating in competitions can receive bonus points in their course grades, and winning awards can contribute to their grade point average, increasing their competitiveness for scholarships. Prize money also serves as an incentive. Moreover, competing on a national scale with architectural works from other universities helps to evaluate the effectiveness of the teaching and the students' learning outcomes. Currently, our senior students actively participate in architectural competitions annually, including high-value provincial and national contests, and have won many awards. This not only affirms the efforts of the teaching team and the quality of the students' work but also greatly enhances the teachers' enthusiasm and inspires student motivation.

3.3 Incorporating Research into Design Projects

Architectural Design V is a design course for our senior students in their first semester, consisting of two designs: the external space design of a commercial street and the design of a high-rise office

building, to be completed over 16 weeks. As these students are approaching the stage of working on their final year projects, writing their theses, and undertaking internships, the course begins with a research component. Students are encouraged to extensively read literature and contemplate research themes, integrating their research direction into their design work. The research findings should be reflected in the architecture, demonstrating how the design validates the conclusions of the theoretical research. This approach, already incorporated into Architectural Design V, helps students think more deeply about their design projects, moving beyond mechanically completing course tasks. It also helps students become familiar with the methods of writing academic papers and conducting research, preparing them for their final year projects. This addition has significantly improved the quality and depth of students' designs and research.

3.4 Cross-Class, Cross-Grade Critiques

(1) Traditional critiques in Architectural Design V involve students presenting their design outcomes through multimedia presentations, with teachers evaluating and scoring based on the presentation, animations, and physical outputs like drawings and texts. This method does not fully reflect the students' learning progress. With multiple classes and teachers in a grade, standardization issues and subjective biases can occur during critiques. Thus, cross-class critiques can offer a fairer reflection of students' performance. Such critiques also allow teachers to exchange teaching insights based on students' performances and encourage students from different classes to learn from each other's work, identify their shortcomings, and strive to improve in subsequent designs.

(2) An annual cross-grade critique and exhibition allows lower-grade students to observe the work of upper-grade students, setting learning goals early and aiding their future design work. Our school's architecture department already conducts cross-grade exhibitions of student work each year, both online and offline, inviting school leaders, teachers, and industry experts for on-site evaluations. Students from all grades actively participate in observing these exhibitions. In the future, it's worth considering awarding grades and rankings to outstanding works from each grade and providing rewards to the selected students. This approach could significantly enhance student motivation and engagement in their studies.

3.5 Team Collaboration

Practical experience is the key to true knowledge. Cultivating teamwork and interactive communication skills not only enhances knowledge but also helps students recognize the core characteristics of the architecture industry. It facilitates harmonious interpersonal relationships, fosters team spirit during the learning process, and prepares students for future professional collaborative work. This approach enables students to adapt to a professional work environment and practice various collaborative models (Shi & Dong, 2022).

At our school, the Architectural Design V course involves students working in pairs to complete their design projects. They are encouraged to divide tasks appropriately and fully leverage each team member's strengths. For instance, some students may excel at model making, while others may be

strong in generating creative design ideas. This format effectively hones students' teamwork abilities. As senior students are on the verge of graduation, internships, and employment, it is essential at this stage to simulate real-world projects to cultivate their team collaboration skills.

Table 1. Architectural Design V Teaching Process

Architectural Design V Teaching Process	**Content**	**Student Activities**	**Teacher Activities**
Design Stage	Content	Student Activities	Teacher Activities
Preliminary Concept	Students conduct independent research, divided into online and offline parts: 1. Offline group research, analyzing case studies and site survey results, preparing research report PPT; 2. Online search for similar cases, analyzing them, and developing preliminary concepts and plans for the design brief.	Group division for research, collaborative analysis, preparation of PPT, and class presentation.	Distribute design briefs, explain design theory knowledge.
Scheme Design	Students primarily carry out the scheme design, with teachers providing periodic one-on-one reviews.	Sketching designs, each team member creates a draft for comparison.	Review designs, select the best options.
Effect Expression	During the drawing phase, express the design scheme content based on previous concepts and designs.	Group discussion, division of drawing tasks.	Review and evaluate drawings.
Review and Presentation	During the review and presentation phase, students showcase and report on their design outcomes; there is interaction between teachers and students, as well as among students.	Team presentation of design outcomes, inter-team communication.	Score and comment on the strengths and weaknesses of the designs.

3.6 Application of Virtual Reality Technology in Practical Teaching of Architectural Design

In line with the requirements of the new engineering construction and the demand for training applied talents, the use of virtual reality (VR) technology enables students to engage in practical training activities within highly realistic virtual environments. This approach aims to enhance the attractiveness

and quality of practical teaching, thereby cultivating high-quality, skilled, applied talents for the nation, who possess strong professional application abilities, continuous learning capacities, and innovative awareness (Fang, 2023). Compared to traditional teaching methods, the teaching approach based on VR technology has numerous advantages. It shows its practicality and superiority in all stages of architectural design education, from conceptualization and scheme refinement to the expression and final presentation of the design projects.

(1) Conceptualization Stage

In traditional teaching during the conceptualization stage, students need to visit the site in groups for on-site research and data collection. Afterward, they analyze this data and study relevant excellent cases from the internet, such as successful commercial street projects. This involves copying drawings, viewing effect images, and studying floor plans to understand the strengths and weaknesses of these cases. However, with the application of virtual reality (VR) technology, students can use VR equipment for a remote and realistic experience of the site's surroundings and interior, saving a lot of time and offering a more direct experience. They can also experience the space of excellent cases through the equipment. For instance, they can realistically feel the scale and spatial design of a successful commercial street, which is more effective than traditional paper-based images.

(2) Scheme Refinement Stage

In traditional teaching, students usually start their preliminary design sketches by hand and use 3D modeling for further refinement. This method is slow and the experience is not intuitive, especially for students with weaker spatial awareness, presenting certain difficulties. Through VR walkthroughs, students can quickly experience spaces and identify discrepancies between their ideas and designs. They can check if the design fits the site, whether the space, circulation, and scale are reasonable, and if the materials and textures align with the design concept. This allows for the rapid identification of issues. Even students with less developed spatial awareness can quickly spot problems in their designs and make timely adjustments. Teachers can also use the equipment to identify students' issues during walkthroughs, greatly improving the efficiency compared to traditional paper or computer model reviews. This also enhances the quality of the design scheme.

(3) Expression of Results Stage

VR technology platforms offer various resources that enable students to quickly express their design outcomes, reducing the time needed for expression. The results are significantly better compared to traditional methods, with stronger presentation effects, which is more conducive for teacher evaluations. For students, it allows a comprehensive display of their design concepts and results, enhancing their learning interest.

(4) Report Stage

In traditional teaching methods, the report stage involves students printing paper texts or drawings and presenting their plans using PPT. Teachers listen to the reports, provide feedback, and score. A disadvantage of this approach is the lack of intuitive experience of space, materials, and textures,

failing to fully showcase students' achievements. For instance, the time allocated for reviewing a design is very short; students spend a long time designing, but teachers only take a few minutes to review it. Students who are not adept at expressing themselves are at a disadvantage, leading to insufficient interaction between teachers and students. However, using VR equipment for walkthroughs allows for an understanding of students' design ideas and spatial organization. It also enables a deeper experience of the material textures and patterns, making the review process more objective, fair, and just.

4. Summary and Outlook

Architectural design courses require continuous reform and innovation, breaking away from traditional teaching methods and models. It's essential to constantly improve teaching quality and standards to cultivate more outstanding talents in the field of architecture (Zhang, Wang, & Huang, 2020).

It is crucial to stay abreast of industry trends and understand industry needs, ensuring that our teaching content keeps pace with industry developments. In response to the "new engineering" trend, our school's architecture program has undergone significant reforms over the past two years, yielding notable results. These outcomes are evidenced by increasingly positive evaluations from employers and numerous awards in provincial and national architectural design competitions, bolstering our confidence. We emphasize the practical application of knowledge and focus on cultivating students' engineering practice skills, hands-on abilities, and innovation capabilities. Teachers and students closely follow the industry's development to enhance students' engineering awareness, quality, and practical skills. Our goal is to produce graduates who are innovative and capable designers, well-suited to the evolving needs of enterprises. This direction will be our continued focus in the future.

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