

Practice and Effect Analysis of Integrated Teaching of Building Equipment in Architecture Major

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Abstract

The building equipment course occupies a core position in architecture education, aiming to cultivate students' mastery of basic skills such as building water supply and drainage, HVAC, electrical engineering, and emphasize the safety, comfort, and energy efficiency of buildings. However, traditional teaching methods suffer from limitations in textbook selection, limited professional backgrounds of teachers, and insufficient integration between curriculum and architecture. To address these challenges, this article proposes the necessity and path of reforming the construction equipment curriculum. The reform path includes selecting high-quality textbooks that meet the needs of the architecture profession, optimizing the curriculum teaching team, and achieving integrated teaching of architectural equipment and architectural design courses. Through a highly integrated path of teaching content, teaching progress, and process evaluation, based on the uniqueness and differences of student projects, the learning effectiveness of students throughout the semester is comprehensively measured in stages. Finally, through the final unified examination, the basic fairness and consistency of the evaluation process are reflected, which quantitatively evaluates students' mastery of knowledge and comprehensive application ability in a relatively fair and just manner while realizing the importance of teaching integration.

Keywords

Integration of teaching content; integration of teaching progress; integration of process evaluation; final unified examination; comprehensive ability.

1. Introduction

The course of building equipment is crucial in architecture teaching, as it concerns the functionality, safety, comfort, and energy efficiency of buildings. Through the study of this course, students can master the basic principles and design of systems such as water supply and drainage, HVAC, electrical lighting, etc. At the same time, it also emphasizes the safety of buildings, such as fire protection systems and electrical safety design, providing safety guarantees for residents. In addition, the building equipment course also advocates environmental protection and energy conservation, promoting the development of green buildings. Therefore, the course of architectural equipment is an indispensable part of architectural education and teaching, laying a solid foundation for cultivating architects with comprehensive abilities. However, during the implementation process, some obstacles inevitably arose.

2. Difficulties in Teaching Construction Equipment

The difficulties encountered in the teaching process of building equipment courses are roughly as follows:

2.1. The selection of textbooks is relatively limited

Our school's engineering cost, engineering management, civil engineering, and architecture majors all offer the course of building equipment. Most textbooks focus on the basic principles and theoretical knowledge of building equipment to increase market demand, in order to meet the needs of all majors as much as possible. But each major has its own emphasis, and if a set of textbooks wants to meet the teaching needs of engineering cost, engineering management, civil engineering, and architecture, it will only focus on one aspect and lose the other. This type of textbook emphasizes textual description, with content mostly focused on basic principles and theories, and has low relevance to architectural design. It lacks auxiliary visual and intuitive content, and engineering and design cases are seriously inadequate, making it difficult to closely align with the teaching objectives of the architecture profession. In addition, architectural design students, due to their professional characteristics, are better able to understand intuitive graphic expressions [2]. Moreover, most textbooks lack ideological and political case studies. In daily classroom teaching, ideological and political education should be integrated to guide students to improve their moral character and thinking ability, and thus form good moral and behavioral habits. This helps cultivate students' socialist core values, improve their comprehensive quality and sense of social responsibility. Therefore, the primary task of this course is to find a textbook that meets both the basic principles and theoretical knowledge of building equipment in the field of architecture, as well as the professional standards and design content of building equipment and ideological and political cases.

2.2. The teaching staff has a single professional background

Teaching architectural equipment requires teachers with both profound theoretical knowledge and rich practical experience. However, the professional background of our school's construction equipment teachers is single, and some teachers lack practical work experience, making it difficult to closely integrate theory with practice, which affects the quality of teaching.

2.3. Insufficient integration between curriculum and architecture major

Practical teaching is an indispensable part of architectural equipment teaching in the field of architecture. However, the current single subject examination method limits its integration with other courses, so its relevance to professional practical teaching is not high. Due to the lack of practical opportunities, students find it difficult to effectively transform theoretical knowledge into practical abilities, which in turn hinders the comprehensive improvement of their overall quality. For example, there is a close relationship between building equipment and architectural design courses. In teaching, architectural design needs to reserve space for the building equipment room and complete the design of the technical equipment room. But when students are completing the design results of high-rise building complexes, the building equipment course has not yet covered this part of the content. When the construction equipment covers this aspect and students have mastered its theoretical and practical applications, the design sketch of the high-rise building complex has been finalized. This has led to the formation of two isolated systems in terms of content and time arrangement between the building equipment course and the architectural design course, which are independent of each other and lack interaction and promotion.

3. The Necessity of Teaching Reform in Construction Equipment

The building equipment course aims to cultivate students' global perspective on architectural design, and to master the basic theories, knowledge, and skills of building water supply and drainage, heating and ventilation, air conditioning, and electrical engineering through learning[1]. Students will be able to coordinate the relationships between various majors such as water, electricity, and heating, and have the ability to read relevant construction drawings.

Has a professional and scientific knowledge reserve for the reasonable layout of building equipment rooms and pipelines.

Architectural design is one of the core courses in architecture, mainly focusing on high-rise comprehensive buildings as the teaching content. Through specific architectural design, students can master the engineering process, standards, methods, and skills of actual engineering planning and design, as well as the design concepts, spatial processing, and expression methods of comprehensive high-rise public buildings.

Based on the traditional teaching mode, the teachers of architectural equipment courses often have little understanding of architectural design, and the teachers of architectural design majors do not have enough understanding of architectural equipment, resulting in a disconnect between the current teaching content and form of architectural equipment and architectural design courses. As a result, students are unable to integrate the knowledge of the two courses after completing them, reducing the feasibility of implementation. Students are unable to integrate the technical knowledge learned from construction equipment into the architectural design course, leading to a characteristic of "emphasizing performance over technology" in architectural design, resulting in a general lack of knowledge in architectural technology among students. This obviously cannot meet the current new requirements.

Therefore, in teaching, it is necessary to organically combine the knowledge of architectural design courses with the knowledge of building equipment engineering, integrate research and application, continuously broaden students' knowledge and work scope, and enable students to apply the building equipment knowledge they have learned to their own architectural design [2], thereby improving their comprehensive design ability. Therefore, it is necessary to carry out the reform of building equipment courses.

4. Reform Path and Implementation of Building Equipment Course

4.1. Selection of textbooks

In terms of textbook selection, we have considered two options. Firstly, we are looking for a textbook on the market that meets the basic principles and theoretical knowledge of building equipment in the field of architecture, as well as the professional specifications and design content of building equipment and ideological and political cases. Secondly, we cannot find a textbook that is suitable for our teaching objectives in the market. Our teaching team plans to work together to develop a textbook that meets our teaching objectives in the field of architecture. So we searched through the official website of the publishing house and recommended high-quality textbooks to peers who have already offered courses on construction equipment. Based on user evaluations and feedback, combined with our comparison with physical textbooks, we have finally determined the "14th Five Year Plan" textbook "Building Equipment" recommended by the China Higher Education Architecture Professional Guidance Committee for architecture majors. The textbook is edited by Wu Xiaohu and others from Xi'an University of Architecture and Technology and published by China Architecture Industry Press[4].

The textbook is divided into five sections, each chapter containing case studies of ideological and political education in the course. The first article examines and analyzes the built environment from the perspective of environmental ecology. Articles 2-4 mainly introduce the tasks, composition, types, and relationship with building design of building water supply and drainage, HVAC, and building electrical systems, and describe design cases, achieving the integration of theory and design practice. The fifth article focuses on green buildings and introduces various aspects related to water conservation, energy efficiency, and environmental protection related to building equipment knowledge, so that students can integrate the concept of green buildings into the design process and promote the development of green buildings.

4.2. Optimize the course teaching team

To solve the problem of teachers with a single professional background and enhance students' comprehensive design ability, curriculum teaching reform has put forward the following requirements for teachers:

4.2.1. Requirements for teachers teaching construction equipment

Building equipment instructors need to possess profound professional knowledge, keep up with the latest technologies and industry standards in the field of building equipment, and be able to organically integrate building equipment courses with architectural design courses. From the perspective of overall building design, they should deeply explain equipment design concepts and requirements.

4.2.2. Requirements for Architectural Design Teachers

Architectural design teachers need to have comprehensive design abilities, be able to comprehensively consider the functionality, aesthetics, and economy of buildings, and develop practical and feasible design plans. At the same time, there should be a sense of collaboration and coordination with the building equipment course to ensure that equipment requirements are fully considered in the design process, guaranteeing the feasibility and practicality of the design.

4.2.3. Collaboration mechanism among teachers

Teachers of building equipment and architectural design courses should strengthen communication to ensure the coherence and complementarity of course content. Both teachers communicate with each other about the weekly teaching content and progress, in order to better connect

4.2.4. Team optimization construction and implementation communication

Based on the above requirements and course teaching objectives, we have formed a teaching team in a diverse and integrated manner. There are currently three architecture teachers in this educational reform project, including one associate professor, one senior engineer, and one young teacher, mainly responsible for teaching and guiding architectural design courses. One teacher specializing in water supply and drainage, one teacher specializing in engineering management, including one senior engineer, mainly responsible for teaching courses on building equipment. The teacher team holds regular teaching and research activities every week to exchange teaching progress and discuss problems encountered in the teaching process, exchange teaching experience and areas for improvement, jointly develop curriculum teaching plans, outlines, etc., adjust progress conflicts in real time, and lay a more mature integration plan for the next academic year's teaching integration.

4.3. Integration Path Practice

4.3.1. Integration of teaching content

Effectively integrating the teaching content of Architectural Design (VI) and Building Equipment courses to form an interdisciplinary curriculum system, enabling students to simultaneously consider relevant building equipment design while learning architectural design, including building equipment system schemes, equipment room area layout, reserved space for pipelines, and green energy-saving measures. This puts students in a situation of solving practical problems, effectively stimulating their subjective initiative. They only need to 'understand' the equipment knowledge required in architectural design and 'master' the relationship between equipment and architectural design, thereby deepening their understanding and application of building equipment knowledge. Enhance students' subconscious consideration of technical issues such as building equipment in architectural design[3].

4.3.2. Integration of teaching progress

The teaching team has developed a reasonable teaching plan in advance: based on the teaching content and difficulty level of architectural design and equipment, the teaching schedule and class hours are reasonably arranged. Ensure that architectural design courses are prioritized or synchronized with building equipment courses, so that students can lay a solid foundation in architectural design before delving into equipment design. The main approach adopted is to jointly develop a teaching plan with the architectural design teacher. When teaching concepts in the early stages of architectural design, basic knowledge such as green building will be introduced into building equipment; When architectural design is in the process of scheme design, the introduction of basic knowledge and technical knowledge of various specialties into building equipment is taught; When architectural design integrates and produces plans, the content of architectural equipment design is integrated into the architectural design; Complete synchronous teaching and achieve progress integration. The following figure shows the teaching plan jointly developed by the teacher team during the implementation process:

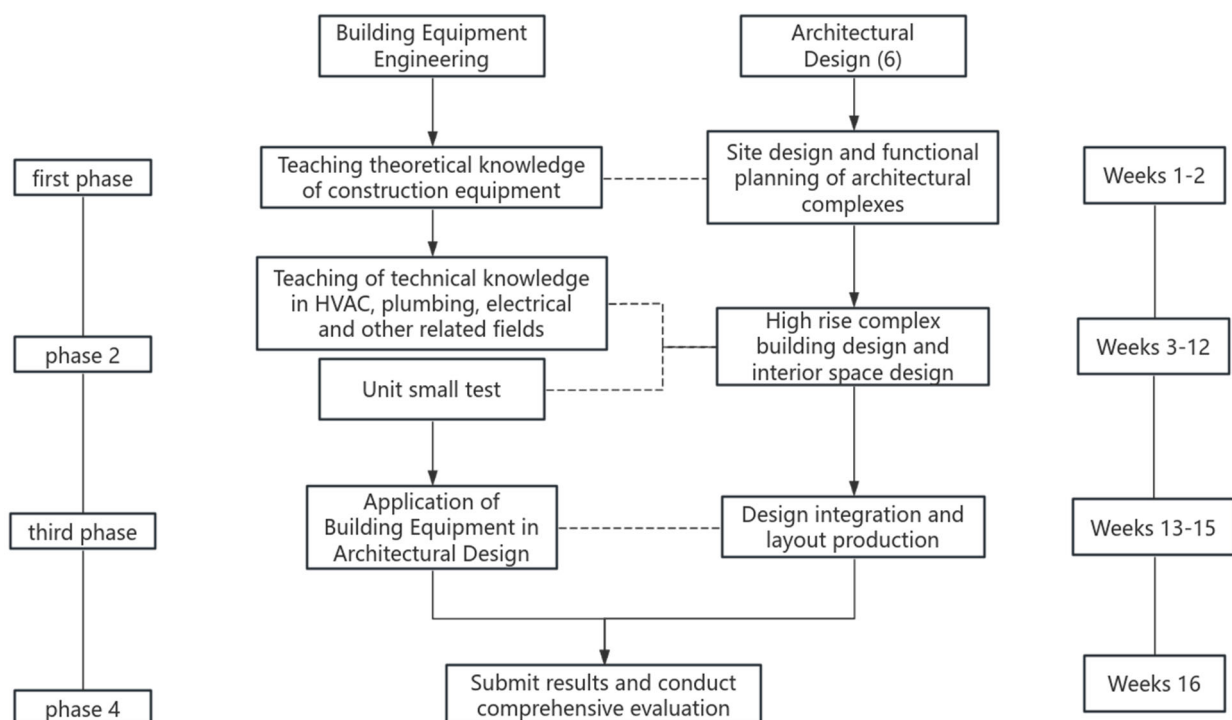


Figure 1. Integration of Progress and Content in Building Equipment and Design (VI)

4.3.3. Integration of assessment and evaluation

(1) Increase the intensity of process assessment

We will implement a process based assessment and closely integrate this assessment model with the architectural design course. Specifically, we will implement assessments in stages based on students' design progress and completion status. At each design stage, students are required to submit corresponding design results, which will serve as an important component of their learning outcomes. Through this approach, we can gain a more comprehensive understanding of students' performance throughout the entire learning process, as well as their level of understanding of the integration and application of building equipment and architectural design.

Based on the characteristics of the architecture major, we have increased the process assessment, and the grading criteria for students mainly include the following: water supply and drainage, fire engineering, building electrical, and HVAC engineering design assignments each account for 10%, for a total of 40%. Students' chapter tests and classroom performance each account for 10%, making a total of 20%. Process accounting for 60%. The chapter test mainly tests students' mastery of basic knowledge such as the basic principles of building equipment design, equipment types and functions, and system design processes. This can not only strengthen the memory of theoretical concepts, but also deepen the understanding and application ability of knowledge. The main focus of the design assignment results is to check whether the design ideas are accurately and clearly expressed, whether they meet the design specifications of various specialties of building equipment, and whether the drawing standards of lightweight drawings are met. This part is evaluated on the final results.

(2) Complete the phased design results of building equipment based on construction design projects

In order to more effectively integrate building equipment with architectural design teaching [5], we have adopted a new assessment model. Firstly, homework assignments should closely revolve around the architectural design course, covering core elements and deeply integrating knowledge of building equipment. For example, students can be required to simultaneously consider the layout of equipment rooms, the planning of electrical circuits, and the setting of HVAC systems when designing buildings, ensuring that the building design and equipment design achieve harmony and unity in terms of functionality and aesthetics.

(3) Synchronized fusion assessment

In order to achieve synchronous integration assessment, we will work closely with teachers of architectural design courses to jointly develop assessment and scoring standards. We will ensure that the relevant knowledge and skills of building equipment are fully reflected and examined at every design stage. For example, in the initial stage of architectural design, we will pay attention to whether students' selection of building equipment is reasonable; In the design deepening stage, we will evaluate whether students have a good understanding of the collaborative relationship between building equipment and building design; In the final design presentation stage, we will comprehensively consider students' design creativity, practicality, and the integration effect of building equipment.

4.3.4. Innovative teaching methods

Introduce flipped classroom, where individual students or groups are used as units. After teaching a design module, teachers will conduct specialized research on important theoretical knowledge points and assign tasks for students to complete sketch designs based on the tasks. For example, after teaching ventilation engineering, students will be asked to select typical locations based on the projects designed in the architectural design course for smoke control and exhaust design. Based on factors such as building use and facade composition, teachers will comprehensively consider and explain their own smoke control and exhaust design plans in accordance with relevant regulations. Reasonable design is sufficient. The methods of discussion and reporting, group peer evaluation, etc. have brought positive teaching effects to the course, not only cultivating students' interest and ability in learning, research, and innovation, but also mobilizing their enthusiasm for listening to lectures. Thus achieving student-centered approach, with teachers only playing a guiding and organizing role.

5. Analysis of the Effectiveness of Practical Teaching

Through integrated teaching, students can have a more comprehensive understanding of the status and role of building equipment in the field of architecture. In the process of completing the results, they gradually realized and appreciated that building equipment is not only a

component of buildings, but also a key factor affecting the functionality and comfort of buildings. Through course practice, students can personally experience how building equipment is combined with architectural design, thereby enhancing their practical skills and problem-solving abilities. Through integrated teaching, students' interest in learning has significantly increased, and both theoretical knowledge and practical skills have been significantly improved. Through case analysis and practical training, students can better apply theoretical knowledge to solve practical problems, stimulate their learning interest and innovative spirit, and lay a good foundation for future employment.

But in the final evaluation, each project designed by students has its uniqueness and differences. These projects involve different types of buildings, different equipment configurations, and different design requirements. The projects designed by students span various building types, from residential to commercial complexes, from low-energy buildings to smart buildings, and the design requirements are also developed from multiple dimensions such as functionality, applicability, aesthetics, and sustainability. This diversity and uniqueness pose challenges to final evaluation, making it difficult to assess every student in a comprehensive, fair, and standardized manner.

6. Conclusion

By integrating practical teaching into the curriculum and combining it with the actual situation of students, we have explored a highly integrated path for teaching content, teaching progress, and process evaluation of architectural equipment and design. We will comprehensively measure the learning effectiveness of students' projects in stages throughout the semester, taking into account the uniqueness and differences of their projects. Thus, it cultivates students' comprehensive abilities and innovative spirit of cooperation. Through the final unified examination, the basic fairness and consistency of the evaluation process are reflected, which quantitatively evaluates students' mastery and application ability of knowledge in a relatively fair and just manner while realizing the importance of teaching integration.

Finally, the practice and effectiveness research of integrated teaching of building equipment in the field of architecture is a long-term and complex process that requires us to constantly explore and practice, in order to cultivate more versatile talents who can adapt to the future development of the construction industry.

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