Education Reform of Construction Specialty in the Context of Upgrading of Intelligent Construction Industry

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Abstract. Traditional architectural education in Colleges and universities pays more attention to theoretical knowledge, and the correlation between professional courses and engineering practice is low. Therefore, the paper puts forward the education reform of construction specialty under the background of intelligent construction industry upgrading. First of all, combining the teaching characteristics of architecture specialty and the related contents of the intelligent buildings involved in the teaching of universities, it sums up from different aspects; integrates the concept of intelligent architecture into architecture education, adds new knowledge points in all grades of architectural majors, and cuts down old knowledge points, and finally, regulates the teaching methods of teachers, and collates the framework of the reform curriculum system, so as to complete this task. Under the background of the upgrading of intelligent construction industry, the education reform and design of construction specialty was carried out. The research results show that the scores of students on the degree of relevance between the reformed professional courses and engineering practice are relatively high. Therefore, it can be proved that the reform on the education of Architectural Specialty in the context of upgrading the intelligent construction industry plays a certain role in improving the degree of relevance between the architectural courses and engineering practice.

Keywords: Smart building · Education reform · Knowledge system · Teaching method

1 Introduction

Human society has successively experienced the Stone Age, Agricultural Age, and Industrial Age. The development process has always been accompanied by the progress of technology and civilization. The history of human development is not only the history of civilization progress, but also the history of continuous evolution of human tools. The development of buildings is the same. From earthen pits and cave dwellings to brick buildings and reinforced concrete high-rise buildings, the functions and quality are also

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more perfect, including the development of intelligent buildings and intelligent buildings with networked, integrated security and fire protection. As a result, living environments are becoming safer, more comfortable and more convenient. With the increase of population and technological progress, the negative impact of construction is also increasing [1]. Land occupation, green space reduction, energy consumption increase, environmental damage and other issues are urgent to be solved. Architectural scientists around the world are also constantly exploring the development direction of future architecture. At present, the construction industry is also a labor-intensive industry. In order to better cultivate more managerial and compound building technical talents, the Ministry of education and the Ministry of housing and urban rural development jointly pointed out that the education concept oriented by employment should establish the comprehensive quality standard and ability standard: vigorously implement the construction orientation, the combination of work and learning, and highlight the cultivation of practical ability [2].

The traditional education of architectural majors in colleges and universities pays more attention to theoretical knowledge, and the correlation between professional courses and engineering practice is low. To this end, the reform of the education of architectural professionals in the context of the upgrading of the intelligent building industry is proposed. First of all, comb the relevant knowledge system of intelligent buildings, summarize the domestic and foreign intelligent building evaluation systems, combine the teaching characteristics of architectural majors, and the related content of intelligent buildings involved in teaching in different universities. Aspects are summarized; in architecture education, we should integrate the concept of intelligent architecture, add new knowledge points and delete old knowledge points in all grades of architectural majors, finally adjust the teaching methods of teachers, and sort out the framework of the reform curriculum system, thus completing the design reform of Architectural Education in the context of smart building industry upgrading.

2 The Reform of Architectural Education Under the Background of the Upgrade of Smart Construction Industry

The research on the theory of intelligent architecture has gradually attracted people's attention to the problems existing in the way of architectural education. For a long time, the strict division of different courses in architectural education has resulted in the separation of design, technology and theory, making the final design results pay more attention to art forms and ignore the technical elements and design intent of Architecture [3]. This thesis is based on the study and data collation of the development background of domestic and foreign architectural education, the theory of intelligent architectural education at home and abroad, the relevant contents of intelligent architectural education of various colleges and universities at home and abroad, and socially relevant scholars and architects. The second chapter summarizes the current curriculum adjustments and teaching reforms adopted by universities at home and abroad for the reform of smart building education, and analyzes them in a classified manner. It selects a suitable reform method that achieves good teaching results. The integration of smart building concepts into the education of architecture professionals provides good practice teaching methods.

At present, foreign architecture colleges begin to pay attention to the integration of design, technology and theory, integrate the theory and technical knowledge of intelligent building into the design, change the traditional architectural education mode, and explore the new mode of Architectural Education for the needs of social development. Aiming at the reform of architectural education, the following technical routes are designed: (Fig. 1)

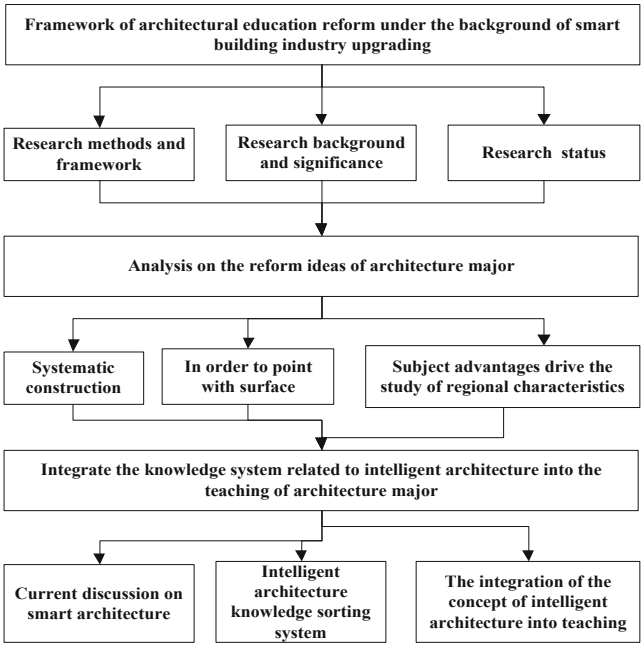

Fig. 1. Technical roadmap for education reform

According to the above route, the reform of Architectural Education in China is designed.

2.1 Review the Knowledge System of Smart Buildings

Through the understanding of the relevant theories and practices of smart building and the summary analysis of the evaluation system of smart building in various countries [4], we have a whole understanding of the relevant contents of smart building. See the following table for the contents of domestic and foreign smart building evaluation system (Table 1):

We can understand that the assessment contents of smart buildings in different countries are basically the same, but different countries have different emphases on the specific contents of the assessment items. In general, the assessment contents generally include: site planning and land use, health and comfort of indoor environment, energy utilization, utilization and transportation of materials and resources (including water resources),

Table 1. Contents of smart building assessment systems in various countries

Name	Evaluation index	Range of application
England BREEAM	Management, health and comfort – indoor and outdoor environments, energy, transportation, water, raw materials, land use, regional ecology, pollution	Office buildings, residential buildings, retail buildings, campus buildings
The United StatesLEED	Site conditions, efficient use of water resources, energy and atmosphere, materials and resources, indoor environmental quality	New building, commercial interior decoration, residential, community planning and development
JapanCASBEE	Indoor and outdoor environment, service environment, energy and materials, building environment	New construction, existing construction, renovation and operation, temporary construction
Other countriesGBTool	Resource consumption, environmental load, environmental equipment quality, cost, operation management	Office buildings, congregations, school buildings

and later operation management [5]. Different countries have set up different versions of targeted evaluation systems for different types of intelligent buildings.

Combining the teaching characteristics of architecture majors and the relevant contents of smart buildings involved in teaching in universities, the intellectual architecture knowledge system is sorted out from four parts: the basic theory part of smart architecture, the ontology part of smart building specialty, the technical discipline part of smart building, and Part of smart building practice method system [6]. Intelligent architecture involves a wide range of related technical disciplines, from materials to structures, from structures to equipment and so on. It includes the basic knowledge of physical control of building environment (architectural acoustics, optics, thermology), intelligent building materials (new materials, local materials), intelligent building structure, intelligent building structure, intelligent building equipment (water, heating, electricity, power supply), as well as the expanded knowledge of building energy saving technology, intelligent building technology, intelligent building construction technology, intelligent building operation management, etc. The smart building practice methods mainly include: research and design of smart building actual projects (focus on the practical issues of smart building design, design cooperation and communication ability training, data collection and smart building technology application ability), smart building construction site learning, and building performance evaluation (understand the index items in the smart building evaluation standards from practice), maintenance and operation management of built smart buildings, etc. The practice of intelligent building can not only stay in the practical design part, but also in the design, construction, operation and

demolition of intelligent building, experience the whole process of the whole life cycle, better understand and feel what is intelligent building.

2.2 The Integration of the Concept of Intelligent Architecture into the Education of Architecture

In the future, the intelligent building is not a single building, but a building cluster, even the building ecology. The change of data quantity and data type of intelligent building will be beyond imagination. In the big data environment, it is not only necessary to create real-time data, but also need to process the data in real-time flow, and feed back the data analysis results to the user in real time [7]. Perform deep and complex analysis through data analysis, data mining, machine learning and other technologies to mine the potential value of data. The traditional data storage and processing technology can no longer meet the new requirements. Therefore, data collection, storage, mining analysis, processing and use will be realized through cloud computing and big data technologies. Data is maximized through sharing and cross-reuse. Cross professional or even cross industry data platform is the development trend of data processing in the future, which will play a huge role in the value-added of the construction industry.

In the course system, the architecture education integrating the concept of intelligent architecture still adheres to the teaching system with architecture design as the main axis and technology, theory and practice as the auxiliary courses. The learning of architecture professional knowledge is a step-by-step process. The cultivation of the concept of intelligent architecture also follows the principle of step-by-step, from the understanding and understanding of intelligent architecture to the learning and design of intelligent architecture technology, as well as the application of intelligent architecture analysis tools, and finally the practical learning and knowledge expansion of intelligent architecture. In the architecture professional knowledge system, based on the learning characteristics and professional education methods of students, a systematic and comprehensive intelligent building knowledge system is gradually integrated into the architecture teaching system, and the original architecture teaching system is improved, focusing on architecture and landscape. Multi-disciplinary studies in planning, technology, etc., expand the knowledge on the basis of learning basic knowledge, and encourage special research and comprehensive use [8].

On the basis of the original architectural design course, adjust the architectural design course, expand the knowledge of intelligent architectural design in the design course, increase the knowledge lectures and design task requirements related to intelligent architecture, and add related design topics, such as intelligent architectural design, ecological architectural design, solar architectural design, and old architecture design According to the teaching resources, choose the appropriate design topics to train the students in the design of intelligent buildings, focus on the cultivation of students' design awareness of intelligent buildings, and establish the concept of sustainable development. See the following table for the knowledge points of intelligent architecture design in the architecture design course integrated with the concept of Intelligent Architecture (Table 2):

In recent years, under the guidance of relevant national policies, the construction of smart city has been developed rapidly and comprehensively, and smart building will be the specific application and important component of smart city, which plays an important

Table 2. Smart building design knowledge points that need to be added in each grade

Grade	Need to add knowledge
Grade1	Understand the basic concept of intelligent architecture and set up a correct view of the built environment
Grade2	Master the rational use of main and passive design measures in smart architecture design, and understand the tools of smart architecture function analysis and environment analysis
Grade3	Master the design principles, strategies and concepts of smart architecture, design the indoor and outdoor environment of smart architecture, and test the "wisdom" of smart architecture. And further improve and adjust the design of smart buildings
Grade4	Pay attention to sustainable development issues in urban design and residential planning and design, understand the performance analysis of smart buildings, expand the understanding of smart buildings, sustainable development, ecological buildings and other design
Grade5	The related contents of smart architecture are applied comprehensively

role in human life and work. Facing the future development of smart city, we should also develop a smart complex based on the urban Internet of things and cloud architecture. The development of smart cities requires smarter buildings and the implementation of smart buildings and their Internet technologies.

With the progress of science and technology, people began to pay more and more attention to the close relationship between architecture and environment [9]. The changes and progress of architectural research also affect architectural education. The content and mode of architectural education can not be changed, and the knowledge system of architecture should be adjusted and expanded with the development. At the Third International Conference on intelligent building, intelligent building and building energy conservation, it was mentioned that "from the perspective of building development", its historical change has gone through five stages: the first stage is the practical building stage; the second stage is the art building stage; the third stage is the functional building stage; the fourth stage is the stage of space architecture (China is still at this stage); the fifth stage is the stage of intelligent architecture, also known as ecological architecture The stage of study. The integration of the concept of intelligent architecture into the education of architecture in this article is a preliminary exploration of China's approach to the stage of intelligent architecture. In the previous, through a comprehensive and systematic review of the knowledge system of intelligent architecture, the knowledge points of intelligent architecture I have a clearer understanding, but for the education of architecture major, it is mainly architectural design. Considering the learning ability and understanding ability of students, the relevant knowledge of smart architecture cannot be added to the education of architecture profession in disorder. It needs to be screened and considered to select relevant content that is suitable and consistent with the characteristics of architectural education. Cheng content and arrangements, the wisdom of building-related knowledge into the education of architecture in the form of both integration.

The specialized technical courses of architecture are mainly composed of a series of courses, such as building structure, building physical environment control, building material and structure, building safety, etc. To integrate the concept of intelligent architecture into the knowledge system of architecture professional technology courses, we need to adjust the content of technology courses, as shown in the following table (Table 3):

Table 3. Knowledge points to be deleted

Course	Textbook	Knowledge points to be deleted
Building structure	《Type selection of building structure》 《Architectural mechanics》	In-depth calculations of building structures
Physical environment control	《Building energy efficiency》 《Environmental control science》	Repetition of knowledge between courses
Building materials and construction	《Building materials》 《Architectural construction》	Construction equipment in the professional too strong knowledge points
Building safety	《Construction of disaster prevention》 《Building intelligence》	Explanation of materials and structures that have been rejected

The above table lists the technical knowledge points to be understood, including deleting outdated and complicated technical knowledge, integrating similar courses and adding optional courses. On the one hand, the adjustment of teaching content is the renewal of teaching materials, on the other hand, the teachers control the course content, and the renewal of teaching materials takes a relatively longer time, which requires teachers to impart new knowledge to students in time according to the current latest development, regardless of the teaching materials themselves.

2.3 Adjust Teaching Methods

How to integrate the knowledge of intelligent building design into the architectural design course requires further thinking and exploration. According to the methods adopted by the current domestic and foreign colleges and universities of architecture that have been collated and analyzed in Chapter 2, after discussion and research, several suitable and reference teaching methods are summarized. Based on the above discussion, a curriculum system framework can be established, as shown below (Fig. 2):

It mainly includes: 1. According to the different knowledge points of intelligent building design that need to be integrated into different grades, appropriate design tasks are added in the design task book. Meanwhile, in the process of design, a series of lectures (involving architectural design principles, intelligent building design knowledge,

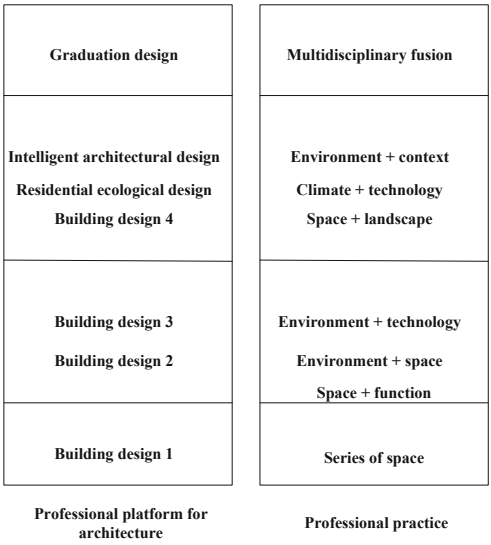

Fig. 2. Framework of the reform curriculum system

building technology, etc.), special lectures, actual visit and learning (refer to View a certain type of building, intelligent building, etc.), discussion and communication between teachers and students; 2. Design course mode is diversified, breaking the traditional teaching mode of two same class hours in a semester, and changing to "one long and one short" or "one long and many short"; 3. Introduce architectural design competition, practical projects, etc. into the senior design class, and the topic of Architectural Design Competition closely around today's society The students can understand the hot issues and take the competition as the design task in the classroom, which not only helps them better understand the hot issues of the society, but also exercises their creativity and social responsibility; 4. Advanced design courses offer a variety of optional design topics, including smart building design topics, historical cities and building protection topics, certain types of architectural design topics, regional architecture topics, etc.; 5. Breaking design courses and technical courses 3. The clear boundaries between theoretical courses, the three achieve the integration of the course content, the time schedules are interconnected, and the teachers and students communicate with each other [10].

In the new teaching pilot, the auxiliary role of technology, theory, practice, etc. is more clear and targeted, avoiding the phenomenon that students have no use after learning the previous courses. The relevant courses of intelligent building technology are closely followed by the design courses, so as to achieve the effect of learning for use. At the same time, the courses offered by thermal energy, civil engineering and other colleges and universities are integrated with those offered by the school of urban planning and architecture to avoid repetition and achieve the effect of refinement and practicality. So far, we have completed the education reform and design of construction specialty in the context of upgrading the intelligent construction industry.

3 Investigation on Students' Learning After the Reform of Architectural Education

In order to verify the effectiveness of the education reform of construction specialty in the context of the upgrading of intelligent construction industry, a questionnaire survey is designed and the results of the survey are analyzed, which is helpful to further understand the actual situation after the reform.

3.1 Pre Research Preparation

The purpose of this survey is to examine the relationship between the reformed curriculum of construction majors and engineering practice, which can be expressed in terms of the degree of fit between the curriculum and engineering practice. The relationship between the curriculum and engineering practice can be divided into two parts: specific and general. At the general level, students are directly asked about the degree of relevance between architecture courses and engineering practice; at the specific level, students are asked whether the content ratio of theoretical courses and practical courses is balanced, if not, which category is too much or too little. The correlation formula is:

$$r_{xy} = \frac{\sum_{i=1}^{n} (x_i - \overline{x})(y_i - \overline{y})}{\sqrt{\sum_{i=1}^{n} (x_i - \overline{x})^2 \sum_{i=1}^{n} (y_i - \overline{y})^2}} \tag{1}$$

In the formula: r_{xy} represents the correlation coefficient between the course and engineering practice, $\overline{x}$ and $\overline{y}$ are the average values of the course score and the engineering practice scores x and y, x_i and y_i are the weighted values of the course score and the engineering practice. What is the effect of the implementation of the education reform in architecture, students have the most say. This study surveyed 630 four-graduate students from 6 research universities in China, and recovered 536 valid samples with an effective recovery rate of 85.08%.

3.2 Research Results and Analysis

The percentage and frequency distribution of customs clearance degree can be summarized from the obtained questionnaire (Table 4):

The scores of 6 schools for the degree of relevance between the reformed architectural courses and engineering practice are shown in the table below (Table 5):

The above table shows that the average value of the six universities is 4.18, which shows that the scores of students on the degree of relevance between the professional courses and engineering practice after the reform are relatively high, slightly higher than the "high" degree.

Table 4. Relevance distribution of architectural courses and engineering practice

Correlation	Percentage	Frequency
Very low	2%	8
Lower	5%	25
General	11%	60
Higher	44%	236
Most high	38%	206
Aggregate	100%	536

Table 5. Relevance scores of architectural courses and engineering practice

School	Mean value	N	Standard deviation
A	4.53	108	0.612
B	4.48	69	0.752
C	4.25	79	0.881
D	4.04	82	0.761
E	3.89	112	0.721
F	3.87	86	0.756
mean value	4.18	536	0.747

4 Concluding Remarks

This article analyzes the reform of the education of architectural majors in the context of the upgrade of the intelligent construction industry, introduces the concept of intelligent architecture into the education of architectural majors, adds knowledge points of emerging technologies and deletes old knowledge points to adjust the teaching methods of teachers, and completes the intelligent construction industry Reform design of architectural education under the background of upgrading. Therefore, it can be proved that the reform of the construction professional education in the context of the upgrading of the smart construction industry has improved the relevance of the construction curriculum and engineering practice.

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