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Establishing the Architectural Talents Cultivating System of Practice and Innovation Ability Under the Background of New Engineering

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Abstract

As BIM (Building information modeling) comprehensive advantages in the field of engineering, it develops rapidly in the international building industry including China. In the face of new technology and new methods of innovation, architecture teaching also needs to adjust. BIM as new design tool is very necessary. But how to perfectly combine BIM with building teaching to make students truly apply is the key point.

Keywords: BIM, the new engineering, architecture teaching

1. Introduction

In recent years, the qualitative development of architectural specialty is affecting every aspect of architectural design education. The traditional education system has been unable to cope with the rapid changes in vocational communication, building technology, building materials, design tools and various working methods. In this case, the innovation of contemporary digital architecture technology and architectural information model that brought by highly intelligent software and network communication promoted the development of digital acquisition technology, as an important chapter in the field of science technology and culture, they are pushing architectural education to a new direction.

The BIM based working mode includes the whole process of architectural design, including various data parameters in the context of architecture, geography, society and economy. These data are seen as a collection of building components that assist the design process. The design process of BIM is not an abstract or fragmented presentation, but a real, all-round intelligent simulation. These data are equivalent to the intelligent simulation of various real elements in the construction process, which can promote communication and collaboration, make the designer more clearly browse the whole complex building integrated system, and lead the architectural design to a new direction. It is recognized that BIM has started to fully utilize 3Dgraphic data first, and then to expands the usage into an ND environment. It is encouraging that this expansion is moving towards more engineering analyses and various construction business functions (Jung & Joo, 2011).

The concept, advantages, effects of BIM to grasp the key link of the process of architectural design, and how to fundamentally conception and teaching, has a unique role in terms of promotion. In the face of the virtual building model in the new comprehensive practice appears as a major means of communication and expression, architectural education should show the receptive attitude and position, teaching method and standard of architectural education should be rethink.

Digitization drives the process of architectural design, and how to architectural education will cope with this huge change that is taking place. Its thinking and influence will be far-reaching. Academia, education must be to take a hard look at the present situation, thoroughly realize now the disadvantages of present education mode of school teaching of “what to do” and “how to do” (Holzer, 2014), actively cope with changes in the field of design caused by a digital revolution and well prepare for students to deal with the advent of the era of digital driven design in the comprehensive practice.

2. Significance of Training New Engineering Architecture Talents

Architecture is a traditional engineering major which focuses on innovation and engineering practice. Faced with the increasingly complex problems of urban and architectural development, its connotation and extension have undergone profound changes. From Thirteen Five-Year Plan for the Development of the Construction Industry recently issued by The Ministry of Housing and Urban-Rural Development, as you can see, the development of building industry is facing a new transformation and upgrading, living environment and sustainable development put forward new requirements to architectural design industry. Green technology, BIM technology and building industrialization emerging new hot spot of scientific and technological innovation as the center of modern building industry become a driving force for the development of the industry. Therefore, it is an inevitable trend of talent cultivation to integrate resources and form an educational system that combines the advantages of colleges and universities more closely with social practice (Li, 2017).

Therefore, colleges and universities must fully combine the needs of industrial development in the development of talent training system, focus on the corresponding reform of the curriculum system structure, talent training mode and other aspects, construction of supporting facilities, so that talent training can meet the needs of new engineering development. In order to take the initiative to adapt to the characteristics of the development and change of the architecture industry and improve the overall quality of the employed army, it is of great significance and urgent to explore the training mechanism of architectural application compound talents under the background of new engineering (Wu et al., 2018).

3. Construction of Talent Cultivation Mechanism

3.1 Optimize the Course Architecture

1) Break the knowledge-based subject curriculum framework of "emphasizing theory over practice" and construct the curriculum system structure centering on the cultivation of professional and technical ability.

According to the characteristics of the demands for professional and technical talent in the development of building industry, the professional course should be optimized, adjusted and comprehensive reformed, the abilities' training of the digital design technology, virtual simulation technology, green building performance simulation technology and so on should be strengthen (Ambrose, 2009). Updating teaching content timely, focusing on introducing the frontier and new achievements in the field of automotive science, increasing the proportion of practical courses for experimental training, increasing the number of design, comprehensive and innovative content, and developing new practical training and teaching projects to strengthen innovation capabilities and practical abilities.

2) To build a curriculum system of multi-disciplinary cross-integration

With the rapid development of BIM technology, Assembly building, green building, VR and AR technology, it is difficult for a single discipline of architecture to support the development needs of a variety of technologies. It is necessary to integrate disciplines such as artificial intelligence, computer and intelligent construction. In order to meet the technical requirements for the development of the new engineering department of architecture, it is a key part of optimizing the curriculum architecture to deeply cross the knowledge of other necessary disciplines on the basis of the original curriculum of the architectural discipline.

3) Strengthening the innovation and entrepreneurship education curriculum module

This module was developed by relevant professional teachers and business and industry experts who were organized by the School of Innovation and Entrepreneurship. The course was taught by professional teachers and business lecturers specializing in innovation and entrepreneurship education. Through carrying out innovative entrepreneurship simulation training, innovative ability training practical teaching, innovative entrepreneurship lectures and other content (Cheng & Chen, 2018), students' awareness of innovation and entrepreneurship and professional literacy were developed.

4) Optimizing the practice and innovation ability to develop course module

In the elective courses, adding practice and innovation training courses, carrying out practice and innovation training activities, and conducting science and technology competitions. Construct the practice courses' structure of "Two-tier three-level progressive mode", and develop parametric design, digital construction, collaborative design and other courses (Lopes et al., 2014).

3.2 Construct Multiple Cultivation Mode

1) Promoting "three entry" training model for undergraduates

In order to provide students with a good training environment of practice and innovative ability, we establish a "three entry" training mechanism and system for undergraduates who enter scientific research teams, science and technology clubs and competition teams, and fully encourage and organize undergraduates to participate in competition activities and science and technology innovative training. According to their own abilities and interests, students can choose to join the scientific research team of teachers assisting them in the work of teaching and research projects, thereby cultivating their innovation and academic research capabilities(Lin, 2018), to join the Student Science and Technology League and develop practical and innovative skills through regular extracurricular science and technology training, activities and innovative training projects, such as BIM competitions, challenge cups and GuYu Cup competitions. The school has organized professional competitions in the field of architecture, formed the GuYu Cup competition team, the EVLVX competition team and the graphic competition team. It has carried out competition-related activities and actively prepared for the competition work all the year round. Joining the competition team, students' professional interests and hands-on skills can be enhanced through participating in professional competitions.

2) Establish a scientific research and teaching mechanism

Encourage and guide teachers to integrate textbook research projects into teaching and personnel training. Specific approaches: (a) Teacher, combining their own teaching reforms and research projects, extract some research content as a subject and actively organize students to participate in. Making students carry out research on relevant subjects according to their interests and abilities, and then exercise their comprehensive abilities and improve their professional skills. (b)Taking the graduation design thesis as an opportunity, we will further combine the development of educational reform research projects with the guidance of graduation design, and achieve better training results through the form of tutors bringing students. (c)Relying on the development of the project, we will guide students to write professional papers, apply for patents and so on, trying to enhance students' academic research ability and comprehensive quality.

3) Vigorously carry out the school-enterprise collaborative education model

On the one hand, it fully relies on the established cooperation base of industry, university and research institutions to further deepen the construction of substantive cooperation content, focusing on production practice courses, scientific and technological development, experimental analysis, professional internships, project planning, etc., promoting actively students' extracurricular scientific and technological innovation activities, effectively organizing and selecting students to participate in the research of productive research subject in the industry-university research base, and letting them follow the teachers to participate in relevant research projects to improve innovative and practical ability. On the other hand, it actively promotes the integrated cultivation of talents with enterprises' production and education, and through the in-depth participation of enterprises, such as undertaking professional courses and practical teaching and practical training, we will share professional core courses' teaching work in proportion, undertake two-semester fixed-term internships, and jointly tutor graduation design (thesis) etc., so that students can effectively learn and experience the actual production of company to cultivate students' new engineering thinking and ability through enterprise's education (Trento et al., 2014).

3.3 Enrich Teaching Patterns and Methods

1) Constructing a virtual and real integrated teaching environment

Using "Internet+" and modern information technology, and relying on the built virtual simulation teaching platform of mechanics and safety, we will build a virtual and solid collaborative synergy environment with complete teaching functions and carry out virtual and real integrated teaching. The virtual and real integrated teaching platform built by the building physics laboratory, green building performance simulation software, cognitive teaching system platform, control and management teaching software, computers, remote control and communication equipment, teaching resources, etc., provides good conditions for the in-depth development of building new technologies' applications and intensive practical teaching. It can break the restrictions on venues, equipment, time and costs, and ensure the practical operation opportunities for every student, so that it is easier to mobilize students' enthusiasm and improve the quality of teaching. While teaching theoretical knowledge interspersed with practical operations, the two teaching links are deeply combined and mutually promoted, so that students can obtain theoretical knowledge and acquire enhanced training of technical skills to effectively enhance the teaching effect.

2) Promoting the systematic curriculum's teaching reform in work progress

According to the actual production project collaborative design work mode, the teaching task is designed and then the work task is reintegrated to form the comprehensive capability needs, so as to formulate a curriculum structure of the professional course in a targeted manner(Zhang et al., 2019). The curriculum construction generally includes work process analysis, course system construction, teaching process analysis and so on, each link is closely linked, and the content and characteristics of the architecture course must be fully integrated in the curriculum development and design. Guided by this, the course learning content is reconstructed into modular learning units. Each learning unit reflects the systematic structure of the work process and is integrated the corresponding theoretical knowledge points. In this way, the combination of theory and practice is more close and targeted; the teaching results are more significant (Li, 2018).

3) Actively carry out the CDIO teaching model

The CDIO teaching model advocates the entire process of conceiving, designing, implementing and running throughout the completion of teaching (Cai & Sun, 2017). In the view of the content and structural characteristics of the core specialized courses of the new building technology, it contains more practical training projects, experimental design development and higher requirements. With the existing teaching resources, the design-driven teaching method of CDIO concept is fully applied.

3.4 Construct a New System of Practical Teaching

3.4.1 Create a Multi-Dimensional Practical Teaching Platform

Relying fully on the cognitive teaching platform, we will create a new platform for practical and innovative teaching with multiple disciplines' integration, give play to the characteristics of integration, sharing and openness, and further implement efficient teaching reforms in areas such as cross-disciplinary and professional core technologies, professional foundations and innovation training. We will build a new teaching practice and scientific and technological innovation training platform, and strengthen innovation and comprehensive ability training.

Building a student science and technology club's platform, as a creative space for science and technology innovation activities, we will take the project as the master and actively carry out student science and technology competitions, research of innovative training projects, innovative activities and entrepreneurial training, so that students' innovative and practical ability can be cultivated and improved.

Relying on the virtual simulation experimental center, we will establish an open laboratory platform and implement an open teaching management mode. Students can conduct experimental training activities at any time according to their learning needs and interests to further improve their practical ability.

3.4.2 Construct Engineering Practice Teaching System

We will implement the project as the main line through the entire process of the curriculum, and build a related curriculum system. In order to meet the requirements for technical knowledge, personal professional ability in the outline and the concept of "concept-design- implement- run", we will adjust the proportion of public basic courses and professional basic courses and cultivate comprehensive practical and applied skills, combining experimental courses, productive internships, graduation design and other links.

We will set up interdisciplinary and cross-grade study groups undertake different tasks according to students' majors. In order to meet the requirements for professional ability and interpersonal skills in the outline, each group will form a subsystem to cultivate students' ability of work together under the framework of an overall large-scale project.

Different types of practical training projects are carried out for different grades. Professional lectures are offered in the lower grades combined with courses, and academic tasks such as design or research are set up in the senior grades.

3.5 Strengthen the Construction of the Teaching Staff

The construction of the teaching staff is closely related to the quality of talents' training. To achieve the cultivation of applied talents and innovative ability, teachers must develop in the direction of "double-master multi-function type". On the one hand, in order to meet the requirements of new engineering development, professional teachers must continuously strengthen their learning and practice, keep pace with the times and improve their own capabilities. In particular, they must learn and master new technologies, new theories, new knowledge and new development trends, and they must often go deep into enterprises to understand actual production needs and carry out practical exercises. On the other hand, through the collaborative education of production and education, we will build a team of part-time teachers composed of enterprises and industry experts who have rich experience in practice. For enterprise technical talents, we will appropriately adjust the conditions for hiring teachers in colleges and universities and enable people who truly understand the innovation of technology to enter application faculty queue. From the perspective of the technical characteristics required for the development of new industries, BIM, it has the characteristics of multi-disciplinary integration of control engineering, electronic information engineering, and computer. Therefore, we can build a team of teachers with multidisciplinary cross-integration ability, the ability of solving complex engineering problems, and the ability of dealing with future problems by integrating the resources of relevant college teachers, so that they can be competent to cultivate practical talents with strong practical and innovative abilities.

4. Conclusion

This paper explores the cooperative training mode of talents suitable for the future direction of the architectural design industry and under the background of new transformation and upgrading in the building industry. Besides, this paper discusses the interactive training system of practical ability with targeted complex engineering training and taking the cultivation of engineering practice ability training as the core to build an integrated practical teaching platform of production, study and research. It is of great significance for cultivating and applying composite design students and is important to promote the regional architectural design industry.

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