Pisco Med Publishing

Learning & Education
ISSN：2251-2802

Innovation and Practice of Talent Training Mode in Architectural College Education in the Era of Intelligence

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Abstract: With the widespread penetration of intelligent technology in the construction industry, architectural college education is facing a systematic transformation from traditional craftsman-type skill training to compound technical talent training. This paper deeply analyzes the new requirements of architectural intelligence on the ability structure of college talents, clarifies the current practical difficulties of the education system in curriculum setting, practical teaching, faculty and industry-education integration, and proposes innovative paths such as "reconstruction of curriculum system", "double-loop driven practical training mechanism", "compound faculty construction" and "open collaborative platform" on this basis. It aims to provide theoretical support and practical reference for the high-quality connotation development of architectural higher vocational education.

Keywords: Intelligent Construction; College Education; Talent Training Mode; BIM Teaching; Industry-Education Integration

Introduction

The rapid intelligent transformation of the construction industry has put forward higher standards for the ability structure of architectural technical talents. The traditional college architectural education model can no longer meet the industry's demand for compound skilled talents who "understand technology, can manage, and can collaborate". Especially in the fields of intelligent construction, digital modeling, green construction, etc., enterprises are eager for college talents to have stronger on-site adaptability and technical integration. Therefore, promoting the systematic innovation of the talent training model of architectural colleges and universities and building a new teaching and practice system that fits the development trend of the industry has become a key proposition for improving the quality of education and serving the development of the industry.

1. The need to reshape the ability structure of architectural college talents under the intelligent transformation

1.1 The need for a leap in comprehensive technical capabilities for digital construction

With the widespread application of emerging technologies such as BIM (building information modeling), digital surveying and mapping, construction robots, and smart construction site platforms, the construction industry has deeply transformed from the traditional "experience-oriented" to "data-driven, etc." This development trend requires that graduates of architectural colleges and universities should not be limited to the mastery of basic construction skills, but should have a strong understanding of digital construction and technical operation capabilities. The traditional curriculum system, which mainly focuses on drawing reading and manual drawing, can no longer meet the actual needs of enterprises to establish building data models, construction progress simulation, and construction organization simulation. To this end, college students need to have major capabilities such as BIM modeling, digital construction site management, and information visualization to promote students' systematic understanding of the construction informationization process. At the same time, facing the new demand for data collaboration throughout the construction process, students need to have digital thinking ability throughout the process from "drawing design-virtual construction-intelligent construction-completion and delivery for use". It is not only an upgrade of technical requirements, but also a leap in the core competence of architectural vocational education.

1.2 Adapting to the cross-integration capability requirements of multiple trades in industrial collaboration

A notable feature of the development of intelligent construction is the continuous improvement of the degree of collaboration between industrial chains. The traditional phase separation stage of "design-construction-operation and maintenance" is gradually being replaced by the integrated engineering model of "full-cycle collaboration, etc.". Especially for prefabricated buildings, full-process consulting, green construction and intelligent integrated systems, the cooperation between many trades such as electrical, HVAC, structure, construction and intelligent control is getting closer and closer. This requires college students to have cross-professional knowledge understanding, communication and coordination skills and team collaboration skills while mastering the technical capabilities of the subject. However, the current talent training model for architectural talents in most colleges and universities still remains at the "professional ability of a single trade", lacking a systematic mechanism for cultivating cross-professional collaboration capabilities. Therefore, in terms of reshaping the ability structure, it is necessary to break through the constraints of traditional work boundaries and lead students to develop a focus on "system integration thinking", such as mastering cross-knowledge such as construction organization and intelligent system deployment, understanding the logical relationship between various professional information in the BIM model, and being able to complete the dispatch and coordination of multiple work sites to meet the needs of future complex technical management positions.

1.3 Leading the rapid adaptation and problem-solving ability requirements of the project site

The uncertainty and complexity faced by the construction site of intelligent building projects have increased significantly, sudden technical problems are prominent, equipment systems are abnormal, and collaborative links are interrupted. These problems frequently occur, requiring on-site personnel to respond quickly and have strong problem-solving capabilities. Especially in the scenario of applying intelligent equipment, automated monitoring, construction robots and on-site information collection terminals, students must not only "understand tools", but also "understand systems, understand diagnosis, and understand optimization". This proposes a new ability combination structure of "practical logic plus technical integration plus dynamic judgment" for the cultivation of college talents. However, most current vocational college students often lack system analysis and processing capabilities when facing non-standard construction problems and sudden quality risks. The main reason is that the traditional teaching model focuses on "standardized procedures" but not "cultivation of complex situations". To this end, the education system needs to introduce the "problem-centered project-based teaching" model through practical training that simulates actual on-site situations, so that students can form on-site leadership and technical response capabilities in dynamic scenarios of "finding out the problem - analyzing the root cause - making quick decisions - organizing and coordinating". The construction of this ability is a direct manifestation of the ability reconstruction of technical talents in the front-line positions in the intelligent era, and it is also a key development direction that college education needs to actively adapt to.

2. The main problems existing in current college education in architecture

2.1 Teaching content lags behind industry needs

At present, the course content of college architecture majors is generally not synchronized with the development of industry technology, especially in the frontier fields of intelligent construction, digital construction and green design. Some colleges and universities still use the textbook system of ten years ago, and the focus of teaching is on traditional brick-concrete structures, manual drawing and conventional construction processes, which is seriously out of touch with new trends such as intelligent construction, building industrialization and BIM collaboration. The more critical thing is the lack of a course update mechanism and the teachers' inadequate grasp of the latest industry standards, digital modeling tools and intelligent management platforms, which makes the course design unable to keep up with the actual needs of enterprises. In addition, there is a knowledge gap between courses, and it is difficult to form an integrated structure of "technology-management-cooperation". Students often encounter the embarrassing situation of "disconnection between learning and application" when they graduate, and need to go to the enterprise for technical remedial courses before they can be competent for work. The backward teaching content not only weakens the education service industry, but also reduces the efficiency of talent training, and directly affects the overall quality and social reputation of architectural college education.

2.2 Practical teaching is weakened, and the phenomenon of disconnection between engineering and learning is prominent

Although architectural majors naturally emphasize "practice orientation", in actual teaching, the practical teaching of many colleges and universities is still formalistic and cannot truly achieve the educational goal of "learning by doing". At present, many universities still limit practical training courses to "simulated operation" or "in-class experiments", and their content is far away from the real construction site equipment, process, rhythm, etc., and lacks data and problem situations based on actual enterprise projects, resulting in students only having the experience of "operation fragments" and lacking the cognition of "engineering as a whole". At the same time, the phenomenon of disconnection between work and study is also very common: the internships arranged by some universities are less time-consuming, the tasks are vague, and the guidance is weak, which often becomes "going through the process" rather than "strengthening ability". Due to the lack of real integration of enterprise projects and teaching tasks, students are not competent for challenging on-site work, and practical teaching is in vain. This weakened practical training model greatly affects students' key professional abilities such as on-site decision-making, team collaboration and technical solutions, and has become a core bottleneck in the cultivation of high-quality talents.

2.3 Lack of teaching resources and professional teaching teams under the background of intelligent construction

The continuous development and change of intelligent construction technology has brought new challenges to teaching resources and teacher structure. However, most colleges and universities are still at the level of "traditional teaching aids plus basic teachers", lacking systematic teaching resources based on digital platforms such as BIM, Internet of Things, and construction simulation. On the one hand, the hardware update is backward, and many universities do not have important means such as intelligent projection, 3D modeling workstations and virtual simulation equipment, so it is difficult for courses to cover the entire process of building intelligence. On the other hand, the teacher structure is simple, with a large number of "lecture-type" teachers, and a serious shortage of "double-teacher" talents with rich industry experience. Many teachers themselves have limited knowledge of intelligent construction, and are unable to guide students to operate advanced systems, nor are they able to impart the latest on-site technologies and project processes, forming a vicious cycle of "teachers don't know, students don't know". In addition, the mechanism for teacher training and school-enterprise joint training is not sound, causing the educational content to remain static for a long time and missing the window for talent upgrading due to rapid technological updates.

2.4 Insufficient depth of school-enterprise cooperation, and lagging behind in the construction of practical training platforms

Although the integration of industry and education has been included in many policy documents, in the field of college education in the field of architecture, the cooperation between schools and enterprises is still mainly limited to superficial exchanges and sporadic practical activities. Most colleges and universities lack a co-construction and sharing mechanism with enterprises, and enterprises are not highly involved in professional construction, curriculum design, talent evaluation, etc., resulting in the inability of teaching content to accurately connect with job standards. At the same time, the construction of on-campus practical training platforms is also seriously lagging behind, with insufficient venues, simple equipment, and simple functions, making it difficult to simulate a real engineering environment. Due to the small number of cooperative enterprises, relatively low difficulty of tasks, and short training cycles, it is difficult for off-campus practical training bases to provide students with comprehensive and systematic practical training. Some cooperation is just a formality, such as "visiting" or "assembly line internship", which cannot effectively inspire students to do actual operations and solve on-site problems. The lack of a "real project, real task, real result" practice system carried out in collaboration with enterprises has made students lack both "engineering perception" and "technical challenges", which seriously restricts their effective growth into front-line technical backbones.

3. Innovative paths for talent cultivation in architectural colleges and universities in the era of intelligence

3.1 Reconstruct the curriculum system and build a frontier-oriented teaching content ecology

In order to effectively cope with the challenges brought by the lagging of teaching content behind industrial development, it is necessary to build a modular curriculum system based on intelligent construction on the basis of the top-level design of the curriculum system. Curriculum reform should break the linear structure dominated by traditional construction technology, and form a three-layer nested content ecology of “professional foundation-technology integration-job application” with BIM modeling, green building, construction robot and construction information management as the core frontier. The teaching goal is no longer to cultivate the ability of readers to read drawings, but to guide students to systematically understand the digital construction process and make technical expressions. In actual operation, the architectural majors of some higher education institutions have adopted the reform strategy of “task-based course groups, etc.”, integrating courses such as “Architectural Structure”, “BIM Modeling Practice” and “Intelligent Construction Technology” into a unified project module. The technical experts of the enterprise and the teachers in the school jointly design the task book, so that students can learn theory and modeling operations while doing simulation projects. For example, students need to independently complete BIM construction, component disassembly, construction organization optimization and energy consumption analysis based on the real office building design drawings, and directly transform the results of the course into project works recognized by the enterprise, realizing the deep integration of “course is project, learning is practice”. This kind of course reconstruction not only updates the knowledge structure, but also improves students’ system technical ability and engineering expression ability, and truly achieves the “industry-oriented” teaching ecological transformation.

3.2 Create a “double-loop drive” training mechanism to strengthen collaborative practical teaching inside and outside the school

Build a “double-loop drive” training mechanism, which includes the mutual linkage of “basic training on campus plus real projects outside the school”. The on-campus part emphasizes the consolidation of technical skills, and carries out multi-dimensional training of component production, model building and prefabricated assembly with the support of virtual simulation platform, BIM comprehensive laboratory and intelligent process simulation room; and in the off-campus part, the “task is embedded internship” is carried out based on the real project of the enterprise. Under the full guidance of the enterprise mentor, the students directly participate in the key tasks of construction management, progress coordination and quality control. During the construction engineering practice in a certain city, students joined the enterprise BIM engineering team in groups to model and detect the construction progress of residential projects. In the actual construction node report process, the model error was continuously corrected, forming a complete closed loop of “virtual model-actual construction-technical feedback”. According to the feedback from the enterprise, this student team has a stronger understanding and practical ability of the project than traditional interns, and can quickly get started and participate in problem analysis. Through the “double loop” collaboration inside and outside the school, the binary teaching malpractice of “theory belongs to theory, practice belongs to practice” has been broken, making practical training the core fulcrum for students’ ability to leap forward.

3.3 Build a composite faculty team to stimulate the vitality of professional teaching and technology integration

Irrational faculty structure and lack of intelligent technology support in teaching are one of the core problems restricting the innovative development of architectural education in my country. The solution lies in creating a trinity of composite faculty teams of “university teachers plus enterprise experts plus digital technicians”. On the one hand, we should encourage the retraining of professional skills for existing full-time teachers and set up special teacher training courses. These courses should be “practical” training around cutting-edge topics such as BIM application, intelligent construction platform and green evaluation standards. On the other hand, we should break the “closed establishment” system, establish a “corporate mentor” and “part-time professor” mechanism, and invite experienced constructors and structural designers on site into the classroom to participate in project course co-construction and student practical training guidance. In a case of smart construction site course reform, this course is taught by three types of teachers: college teachers are responsible for theoretical framework teaching; BIM engineers lead students to carry out “multi-professional collaborative modeling, etc.”; and the chief engineer of the construction company teaches how to promote BIM implementation and solve problems on site. Students need to complete a report on “construction simulation plus collision analysis, etc.” based on a multi-layer frame structure, and three teachers will jointly score it. This teaching model not only enhances the effectiveness of the course, but also greatly stimulates the vitality of the classroom, making “teaching is not needed” truly seamless, and enhancing the adaptability of professional teaching to the times and the integration of technology.

3.4 Promote the deep integration of industry and education and collaborative education, and build an open intelligent training platform

Promote the relationship between industry and education from "cooperative education" to "co-construction and co-education", and create a school-enterprise sharing, cross-border open and service industry intelligent training platform. In actual applications, some universities have cooperated with construction technology companies to build "intelligent construction experimental bases, etc.". The platform is equipped with BIM collaborative systems and building intelligent control systems, and has also introduced simulation software based on the full life cycle management of projects in advanced facilities such as prefabricated component assembly lines to achieve full-process teaching from "design to operation and maintenance, etc.". Students can complete a full set of practical training on the platform, including "bidding simulation-progress modeling-material scheduling-quality control", and automatically upload all operation data to the platform's database for enterprise mentor assessment. An "open collaborative project" requires the student team to simulate the bidding process through the platform, analyze the project plan, compile a construction plan, dynamically adjust the platform configuration of resources, and finally form a project plan package that can be submitted to the enterprise for review. The enterprise evaluation results are included in the student's grades and fed back to the school to optimize the course. This open platform not only enhances students' system operation capabilities, but also connects the education chain, talent chain and industrial chain, providing new support for the supply of high-quality talents in construction colleges.

Conclusion

Under the background of intelligence, college architectural education must be driven by industrial technological changes, with the improvement of students' abilities as the core, and comprehensively update the training concept and teaching path. Through the frontier reconstruction of course content, the diversified integration of practical teaching, the composite construction of the teaching staff, and the systematic construction of the industry-education collaboration platform, it can not only effectively respond to the talent needs of the construction industry, but also provide solid support for the quality leap of higher vocational education. In the future, we should continue to deepen the collaboration of multiple subjects, promote the continuous evolution of the integrated development of intelligent construction and education, and help my country's technical and skilled talent training system move to a higher level.

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