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Research on the Innovation of Demand-Oriented Vocational Education Teaching Models in the Smart Building Industry

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Abstract: The fast growth of intelligent construction has brought about a new requirement for technology and skills, as well as a growing gap between conventional VET patterns and industrial requirements. Based on the needs of the profession, this article analyses the competence structure and key work needs of the Intelligent Architecture Division, points out the deficiencies of existing VET courses, practices and methods, and suggests new ways of teaching by reconfiguring courses, work-based learning, developing teachers, and evaluating changes. All these ideas can be used to improve the training quality of intelligent construction projects and to realize the synchronous development of VET.

Keywords: Smart buildings; Industry demands; Vocational education; Teaching model innovation

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1. Introduction

The Intelligent Architecture industry is expanding at a rapid pace, with an increasing demand for specialists in areas such as Smart Surveillance, BIM Applications, IoT Operations & Maintenance and Green Energy Efficiency. As the primary source of technological and technological development, the education model is determined by the professional education model, which meets the needs of the industry. Nowadays, some institutions have some problems in developing smart construction programs, for example, outdated curriculum, insufficient in-service training, and insufficient collaboration with academia, resulting in a shortage of talent that can't be used on the frontline. To address these issues, this research explores Intelligent Architecture Professional Learning's innovation model, which aims at building a Workforce Development System that fits better with industry advances.

2. The orientation of the smart building industry's vocational education talent development

2.1. Intelligent building industry job competency requirements

The characteristic of intelligence building is that it is technically complex, practical and comprehensive. In addition to

traditional construction and management skills, the trainee will also need to master a broad array of competences, including intelligent equipment operation and maintenance, IoT deployment, BIM technology and data handling. With the continuous testing of intelligent equipment and platforms, the firm's expectations of on-site problem-solving, comprehensive system thinking, and continuous technological learning have grown significantly. Demand for jobs is shifting from personal management to sophisticated, collaborative, and creative, a shift that has also paved the way for VET staff development.

The Intelligent Architecture Sector has continued to expand with Smart Safety, Energy Management, Device Integration and Intelligent Indoor Design with more complex functionalities. When hiring, companies pay more attention to their actual competence, adherence to discipline, and teamwork. Usually, they want the graduates to be independent and capable of doing the work themselves. Accurately identifying these skills will enable them to identify their education priorities, refine their training programs, and increase their relevance and effectiveness.

2.2. Vocational education talent development objectives and align with industry needs

The Smart Building Plan for Vocational Education aims primarily at developing a front line of technical professionals who are broadly aligned with industry requirements. However, there is still a lack of consistency in the clarification of objectives and the allocation of powers. Although there are many organizations that focus on talented people, there is no in-depth research on the industrial situation in the area and on the workforce. This results in confusion regarding competency requirements, unclear training priorities, and inadequate matching of actual business skills.

The focus on aligning training objectives with departmental requirements is Level Alignment, Job Matching and Development Alignment. Objectives should be coherent with the VET focus, respond to specific labour requirements, and consider learners' future. It is only when the requirements of the department are translated into measurable, feasible, and evaluated training objectives that are defined in a 3-D framework that includes knowledge, skills, and capabilities.

2.3. The core meaning of the industry-demand-oriented teaching model

The industry-driven VET education model is founded on industry labour standards, with real-world labour as its main instrument. It integrates industrial technologies, processes, and professionalism throughout the entire learning process to ensure that it meets the requirements of the workplace, and that it is in line with reality, and that there is a link between skills and professional norms. The program's core values are pragmatic, openness and cooperation, emphasizing that schools and enterprises work together to develop talent [1].

The mode is a departure from the closed and unitary tradition of education, which focuses on the study of applied knowledge and the improvement of techniques by practice. It incorporates the most up-to-date industrial techniques, typical programs, and changing industrial norms to ensure that the students' knowledge is aligned with the needs of the enterprise. At the same time, it focuses on developing professional competence and the craftsman spirit, achieving simultaneous improvement in both specialist skills and general literacy.

3. Analysis of existing issues in the vocational education teaching model for smart buildings

3.1. The curriculum system is not synchronized with industrial technology development

At present, a number of organizations' Intelligent Building Programme Courses are still based on a conventional architectural design framework. The share of smart and digital courses is still very small, and there is a lack of content updates that keep up with the fast pace of technology in the sector. The lack of integration of new technologies like IoT, Big Data, Smart Control, and Digital Twins has led to a marked difference in curriculum content from practical use. Because of its excessive theory and the lack of practice, the importance of module and project-based classes is not sufficient, and the development of cross-disciplinary competence is very difficult.

The curriculum was not systematically integrated, with the theory and practice classes working separately, while

the basic and core curriculum did not develop the process of developing work skills. In addition, the curriculum is not sufficiently tailored to the needs of local intelligent construction companies in terms of employment; there is too much general content and there is a lack of specific training. This leads to a longer adjustment time after entry into the labour force, which has an effect on the training of talented people and the competitive ability of employment.

3.2. The learning element is separated from the real world of work

Hands-On education is an essential part of developing talented people for intelligent construction projects. But many organizations are still confronted with the problems of obsolete training facilities, limitations in the function of the training platform, and obsolete technology. This prevents realistic simulations of the real world, such as the Smart Building, the Intelligent Building, and the Integrated Control System. On-The-Job training mainly concentrates on the validation of basic activities, without complex, design or engineering-based exercises.

Work-Based learning in school and business partnerships is still very shallow, mainly based on short stays and scattered traineeships. Because of the insufficient development of the deeply cooperative educational system, the effective integration of the actual business program and the typical job assignment into the teaching content. While they are in college, they are not able to master the key skills of smart equipment, operating and maintaining the system, and diagnosing failures. Their practical skills and occupational adaptation were poor, and they did not reach the company's expectations that they would be able to work immediately and be ready to work, which would also weaken the societal acceptance of VET [2].

3.3. Educational organisation and assessment techniques are not compatible with the development of competences

Traditional educational institutions are mainly based on classroom theory, and there is not enough use of the new modes of integration, such as online, project-based, and task-driven. Students' core functions are still under-utilized, and an environment that encourages autonomy, inquiry and cooperation is not enough, which hampers the development of creative thinking and practice. The curriculum emphasizes the provision of theoretical knowledge before the ability development, the emphasis is on the result evaluation, not the process, and there is a marked mismatch with the industry's competence training framework.

Existing educational assessment techniques are still rather simple and mainly depend on the final paper test as their primary standard. This method does not adequately evaluate practice, expertise, teamwork, and innovation, so the performance of the assessment does not adequately represent the performance of the student. Moreover, there is a shortage of multiple assessment mechanisms that include in-depth involvement of enterprises, and the assessment criteria do not correspond to the needs of the profession.

4. Innovation paths for vocational education teaching models oriented by industrial demand

4.1. A modular curriculum system reconstructed based on job competencies

To meet the needs of the Intelligent Architecture profession, we have set up an incremental course system consisting of "Basic Module + Core Module + Extension Module". Appropriate improvements have been made in the IT curriculum, with BIM, Smart Safety, Device Integration, Power Measurement, Digital Twin Systems, and Smart Control to make the curriculum more practical and relevant. The tradition of the discipline has been discarded, replaced with a new curriculum based on the classic job assignment, incorporating theory, operation techniques, security norms, and occupational morality.

Create a dynamic curriculum renewal system, work together with industry companies to set curriculum criteria, and integrate the latest techniques, procedures, and norms into the curriculum to keep the curriculum in line with the needs of the industry. Reinforce the logic of the curriculum, and incorporate the VTA into the curriculum in a systematic

way, including work requirements, courses, contests, and certificates. This strengthens the system and orientation of the Curriculum Framework, which offers a holistic, consistent and effective approach to the development of vocational skills, as well as a firm basis for future work, career progression and long-term development.

4.2. A virtual-physical integrated practical teaching system for students

Create an Intelligent Architecture Learning Platform, which combines Virtual Modeling, Hands-On Learning, and Engineering Practice. Using VR/AR and Digital Twins, the Platform greatly improves the depth and efficiency of hands-on training by using VR/AR and Digital Twin Systems to simulate complicated operations, failures, and field environments. Create a holistic, engineering-based training program that emphasizes the key functions of the facility, the commissioning of the system, the failure diagnosis, the service, and the solution optimization. This method builds up the practical skills, problem-solving capabilities, and the engineering attitude, and the systematic improvement of the practical competence of the engineering profession.

Enhance the cooperation between the school and the business community through the introduction of the actual business program on the campus and the specialized classes, and the establishment of a permanent system to jointly build and share the learning basis, to form teachers' groups, and to develop curricula jointly [3]. Combine in-office placements, rotating placements, and project-based placements so that the students can become familiar with the processes, follow the norms, and improve their skills in the real world.

4.3. Project-based teaching organization methods and task-driven innovation

Our comprehensive implementation of the Task-Oriented, Project-Based, and Case-Oriented Learning is an innovative approach. Taking an example of intelligent construction as a vehicle, the course is divided into real-life tasks that lead to active acquisition of knowledge, refinement of skills, and improvement of general expertise. Through the combination of online and offline instruction, the integration of high-quality digital education resources, and the expansion of the temporal and spatial dimensions of the study, the flexible adjustment of the pace of study can be used to arouse the active, active and inquiring attitude of the learners.

Make learning more practical and interactive through the use of team cooperation, field training, special workshops, and project defence. This approach is designed to emulate the real world's business model and the process of managing the project, with emphasis on developing the team, communicating, solving problems, and taking responsibility. Instead of merely transmitting knowledge, teachers are transformed into task planners, process mediators, and result assessors, with emphasis on the core role of the students in enhancing the relevance and validity of the teaching.

5. Support system for implementing innovative teaching models

5.1. Building a "dual-qualified" teaching innovation team

Set up the system of recruiting and sharing among colleges and corporations, and invite professionals in the field, company engineers, and project managers to be part-time teachers. This has improved the composition of the faculty, solved the lack of actual instruction, and improved the ability of teachers to apply engineering skills and their professional vision. Regular placement of specialist staff at the front line of Intelligent Building Companies will allow them to take part in the whole life cycle of the project - from design, development, commissioning, operating and maintaining, as well as technical improvements. This immersion enables them to grasp the latest techniques, operating criteria, project management methods, and the latest developments in the field of engineering, engineering instruction, and technological services.

Setting up an innovative group of teachers to carry out periodic group study and reformation talks with emphasis on the development of courses, innovative teaching methods, practice programs, and compiling textbooks, thus improving the teaching abilities of the teachers as well as their specialized skills. Create an integrated system for assessing the competence of the teachers, developing their careers, and motivating them to participate in CSR, certification and

evaluation. It will train a highly skilled “double qualification” group with good theory and practice, able to give lectures in class and give in-person direction.

5.2. Collaborative education between schools and business building long-term mechanism

The establishment of an integrated cooperation system in which the colleges and businesses are involved in the formulation of the training program, the development of the courses, the implementation of the educational activities, and the quality assessment. Make clear the roles, areas of collaboration, and operating patterns of each other so that we can build a solid, deep, mutual benefit, and lasting partnership. An Industry Expert Advisory Committee is set up to carry out regular industrial needs surveys, job competence analyses, and educational quality evaluations to continuously monitor the technical developments in the sector, the evolving needs of the workforce, and the need for human resources. The board is a permanent, genuine, accurate front line of business feedback and decision support for the reform of the educational model.

Universities should work together to set up educational resources storage facilities, practice training sites, and technological innovation centres so that they can be used in both ways to facilitate the mutual exchange of training facilities, projects, technological norms, and teachers. The company is encouraged to engage in the whole course of education by offering real examples of the project, typically assigned tasks, operating criteria for the post, and the new techniques and procedures that are leading the industry. This will make it possible to maintain a close link between learning and real industry, by offering a steady outside environment and by creating a real world in which to innovate learning patterns so as to continually improve the relevance, usability and adaptability of people to training [4].

5.3. Setting up a multifaceted teaching quality evaluation system with multiple dimensions

Set up a multi-tiered assessment frame that includes schools, businesses, students, and professional organisations that goes beyond the conventional single school assessment. Full integration of work competence, professionalism, practice, and teamwork standards to make sure that the results of the assessment are more in line with the real needs of the sector and the key work demands. The implementation of a multi-dimensional appraisal method, which combines both formative and final evaluations, focuses more on actual performance, project results, specialty criteria, and innovation, thus offering an overall and objective measurement of students’ overall competence and their ability to develop.

It includes key metrics like VET qualification, work-related, adaptability, and corporate satisfaction, which can be quantified, compared and improved. It is possible to identify the shortcomings in education on time, to improve the course content, to reform the teaching methodology and to improve the management criteria. This creates a closed-loop management system of “evaluation – feedback – improvement – enhancement,” providing robust institutional guarantees and scientific support for the continual refinement and effective operation of an industry-demand education model.

6. Conclusion

With the rapid development of intelligent construction, a higher requirement for the educational mode of vocational education is put forward. The establishment of an innovation-oriented educational mode that is in line with the demand of the profession is the key to improving the training of talented persons. Existing teaching practices remain disconnected from the demands of the profession in terms of course design, practice elements and teaching approaches, thus impeding the development of relevant personnel. Through the reorganization of the module courses, the development of the integration of virtual and physics practice systems, the creation of innovative teaching methods, the enhancement of dual qualifications of teachers, the cooperation between school and business, and the diversity of assessment mechanisms, it is possible to effectively transform the teaching mode. Continuing to strengthen the integration of industry and education, as well as keeping pace with technological progress in industry, is crucial to continually enhance the learning efficiency of intelligent construction projects, thus providing high-quality technicians for high-quality development in the sector.

Disclosure statement

The author declares no conflict of interest.

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