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Innovation and Practice of Cultivating High-quality Technical and Skilled Personnel in Civil Engineering

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Abstract: With the sustainable development of global economy and the deepening of urbanization, the civil engineering field is facing unprecedented challenges and opportunities. Based on the significance of cultivating high-quality talents in civil engineering, this study puts forward the strategies of strengthening school-enterprise cooperation, actively applying simulation experiment and virtual reality technology, and deepening international exchanges and cooperation, aiming at the problems of theory and practice disconnection, lack of technical skills training and the gap with the international advanced level in the cultivation of high-quality technical talents in civil engineering. Combined with relevant cases, the effectiveness of the proposed strategy is proved, in order to provide ideas for civil engineering education in China, and also provide some reference for relevant policy formulation.

Keywords: Civil Engineering Technical Skills; Personnel Training; Innovation and Practice

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Introduction

With the development of global economy and the continuous advancement of urbanization, the civil engineering industry plays a vital role, especially in China, after

decades of rapid development of reform and opening up, civil engineering has penetrated into all aspects[1]of people's daily life. From urban skyscrapers to rural infrastructure construction, civil engineering, as one of the pillars of economic development, plays an irreplaceable role in the modernization of the country. In this context, high-quality technical and skilled personnel of civil engineering have become the core elements of the development of the industry. These talents are not only the inheritors of modern construction technology and management concepts, but also the key[2]to the success of engineering projects. However, with the continuous progress of technology and the deepening of international exchanges, the traditional methods of civil engineering education and training have gradually exposed their limitations. For the modern society, simply relying on the accumulation of experience and traditional skills can no longer meet the diversified and complex needs of the current civil engineering industry. Modern requirements such as technological innovation, cross-domain communication and multi-disciplinary integration make the training of high-quality technical and skilled personnel particularly critical. Facing the dual challenges of global competition and technological innovation, how to effectively train high-quality technical and skilled personnel of civil engineering to adapt to the 21st century has become a common concern of the[3]industry and academia.

The purpose of this study is to point out the existing problems through the analysis of the current training mode of civil engineering talents in China, and further explore the path of innovation and practice, in order to provide new ideas and directions for the sustainable development of civil engineering industry.

1. The Significance of Training High-Quality Technical and Skilled Personnel in Civil Engineering

1.1 Requirements for Accelerating Economic Development and Urbanization

With the continuous growth of China's economy and the change of development mode, economic development and urbanization have become the two core engines of China's current and future development. This development model not only brings huge

economic opportunities, but also puts forward higher requirements[4]for infrastructure construction. Civil engineering, as the material basis of modern society and the key support of economic growth, has been paid more and more attention from all sides. In economic development, civil engineering not only provides the infrastructure needed for production and life, but also plays an indispensable role in absorbing employment, creating value and promoting the development of related industrial chains. From subway, highway to large-scale complex and business center, the success of every civil engineering project can not be separated from the deep participation of technical and skilled personnel. They ensure the quality of the project, realize the design vision, and endow the city with form and life. With the acceleration of urbanization, the demand for civil engineering in densely populated urban areas is more prominent. New residential areas, commercial centers, transportation hubs and public facilities have sprung up like mushrooms after a spring rain, and the technical difficulties and complexity behind them have also increased. This not only requires skilled personnel with rich experience and excellent skills, but also requires them to keep up with the pace of the times, master new processes and technologies, and meet the complex and changeable needs in the process of urbanization. More noteworthy is that with the advancement of economic globalization and technological innovation, the scope and depth of civil engineering in China are also expanding, which is no longer limited to traditional construction and construction, but extends to a wider range of fields, involving more complex engineering technology and cross-domain cooperation. This undoubtedly poses a new challenge to the training of civil engineering technical and skilled personnel in China. Therefore, the cultivation of high-quality technical and skilled personnel in civil engineering has become a realistic demand and long-term strategy to meet the needs of China's economic development and the acceleration of urbanization.

1.2 The Need to Ensure the Quality, Safety, and Innovation of Civil Engineering

In recent years, the quality, safety and innovation of civil engineering have gradually become the focus of heated discussion both inside and outside the industry. Behind this,

the significance of training high-quality technical and skilled personnel is particularly prominent.

From the perspective of quality and safety, the success of any civil engineering project can not be separated from the deep participation and fine construction of technical and skilled personnel. As an infrastructure directly serving the public, the safety and quality of civil engineering are directly related to the safety of people's lives and property. Once quality problems or safety accidents occur, it will not only cause huge economic losses, but also lead to irreparable social impact. To ensure the quality and safety of civil engineering, it is necessary for technical and skilled personnel to have a rigorous attitude, profound professional knowledge and rich practical experience. They play the role of "guardian" in the project. Through precise construction and strict quality inspection, they build a solid safety barrier[5]for each project. In addition, with the rapid progress of science and technology and the change of social needs, innovation in the field of civil engineering has been paid more and more attention. Innovation is not only the adoption of new building materials and construction methods, but also the comprehensive innovation of the whole process of building design, construction and management. This innovative requirement undoubtedly brings new opportunities and challenges to the training of technical and skilled personnel. Only those with extensive knowledge system, open thinking and continuous learning ability can lead civil engineering to the forefront of innovation in this era of change, and meet the needs of society for more environmentally friendly, energy-saving, intelligent and humane civil engineering.

1.3 The Only Way to Improve China's Civil Engineering Level and Comprehensive Competitiveness

Under the background of globalization, the competition between countries is gradually manifested as a contest of comprehensive national strength, in which the level of civil engineering is undoubtedly one of the key evaluation indicators. Improving the level of civil engineering is not only related to the national image, but also directly reflects the scientific, technological, economic and social progress of a country. In this process, the

importance of high-quality technical and skilled personnel is self-evident.

China has a long history of civil engineering, from the ancient Great Wall to the modern super high-rise buildings, bridges across the sea, highway network, all of which are the glorious course and practical proof of China's civil engineering technology. However, with the progress of the times, relying solely on quantitative expansion can no longer meet China's competitive position in the world, and it needs to be deepened and promoted at the qualitative level. Among them, technical and skilled personnel are the core force. It is worth noting that this improvement is not only reflected in the specific architectural practice, but also in the overall progress of architectural concept, design philosophy, material selection and so on. In the current field of civil engineering, it is not only to pursue a single function, but also to take into account multiple factors such as environmental friendliness, humanistic care, sustainability and so on. Behind this transformation is the deep accumulation and unremitting efforts[6]of high-quality technical and skilled personnel. At the same time, high-quality technical and skilled personnel are also the key factors to promote China's civil engineering industry to be in line with international standards. Under the background of global exchange and cooperation, China's civil engineering industry should not only learn from foreign advanced technology and management experience, but also have the ability to show the unique charm and value of China's civil engineering on the international stage, as well as its contribution and influence to global civil engineering.

2. Problems Faced by the Training of High-Quality Technical and Skilled Personnel in Civil Engineering

2.1 There is a Disconnect Between Theoretical Education and Engineering Practice

In the field of civil engineering education, theoretical education has always occupied the core position. With the rapid development of civil engineering technology and theory, the knowledge imparting in the classroom is becoming more and more abundant and in-depth. Teachers are committed to teaching students the latest theoretical

knowledge, the most advanced design ideas and the most modern technical methods to ensure that they have a solid professional foundation. But at the same time, an increasingly obvious problem has gradually surfaced, that is, the disconnection[7]between this in-depth theoretical education and practical engineering practice has begun to appear.

Students are inculcated with a great deal of theoretical knowledge on campus, covering from basic theory to advanced application. However, when they graduate and enter the actual working environment, especially in large-scale civil engineering sites, they often find themselves facing a series of puzzles and challenges. First of all, the field environment of engineering practice is quite different from the educational background in schools, and it is difficult for students to directly apply the theoretical knowledge they have learned to specific projects. For example, some design concepts may be perfect in theory, but in practical applications, due to various practical limitations and challenges, these theories may no longer be applicable. At the same time, the problems in engineering practice are often multiple and comprehensive, involving knowledge and skills in many fields. However, the education that students receive in school is often one-sided and fragmented, which leads to their lack of overall and systematic thinking ability when facing practical problems, and it is difficult for them to make appropriate judgments and decisions.

2.2 Inadequate Training in Technical Skills in the Current Education System

In today's civil engineering education, the curriculum tends to focus on theoretical teaching, while the training of practical skills is relatively small. Students are immersed in formulas and theories all the year round in school, but there is little in-depth guidance and training on how to apply these theoretical knowledge to practical engineering. In the classroom, students may be taught how to calculate the load of a structure or how to analyze the performance of a material, but they seldom dabble in how to operate on the actual site, how to deal with emergencies, or how to work with other professional workers. From a deeper point of view, the training of technical skills is not only the proficiency of operation, but also the training of soft skills such as how to face practical

problems, how to make decisions according to the specific engineering situation, and how to communicate effectively with team members. However, in China's civil engineering education system, there are many shortcomings in this training. In addition, with the development of technology, the civil engineering industry is constantly introducing new equipment and processes, which require practitioners to have new skills and knowledge. However, due to the lagging update of the education system, many new skills and knowledge are not included in the teaching content, which makes students feel at a loss when facing these new technologies after graduation. This not only limits the career development of students, but also affects the technological progress and development of the whole civil engineering industry.

2.3 There is Still a Gap Between the Educational Concept and Mode and Advanced Countries in Civil Engineering

China's civil engineering education has a long history, but in its development process, it has been influenced by the traditional education model for a long time, which makes a certain gap with the international frontier education concept and model in some aspects. This gap is not only reflected in the content and methods of education, but also in the focus on the development of students'abilities and the overall structure of the education system.

First of all, for the cultivation of students'abilities, the international advanced civil engineering education tends to cultivate students' comprehensive abilities in a more balanced way, not just a single professional knowledge. For example, it emphasizes interdisciplinary learning, attaches importance to the cultivation of engineering ethics and social responsibility, and cultivates students'innovative ability and critical thinking. However, civil engineering education in our country often pays too much attention to the teaching of pure professional knowledge, while neglecting the cultivation of these comprehensive abilities. Secondly, from the perspective of educational methods, many foreign first-class civil engineering professional education institutions have integrated practical teaching, such as project-driven learning, problem-based learning, into conventional teaching activities. These methods encourage students to solve problems

in a practical project environment and develop their practical ability and team spirit. In our country, the traditional teaching method is still dominant, and classroom teaching and examination are still the main means of evaluating students, which is difficult to really cultivate students' practical ability. Finally, there are differences in the goals and directions of education. In foreign countries, with the concept of sustainable development becoming more and more popular, civil engineering education has gradually turned to training engineers with sustainable development consciousness, emphasizing the responsibility for the environment and the commitment to society. In our country, this educational concept is still in its infancy, and most of the educational activities are still carried out around traditional engineering skills.

3. Innovative Path and Practice of Training High-Quality Technical and Skilled Personnel in Civil Engineering

3.1 Strengthen School-Enterprise Cooperation

School-enterprise cooperation plays an increasingly important role in the cultivation of high-quality technical talents in civil engineering, which not only provides a real working environment for students to practice, but also builds a bridge[8]between academia and industry. The purpose of school-enterprise cooperation is not only to meet the immediate needs of enterprises, but also to train students to have the ability and accomplishment needed by the future industry.

Taking a civil engineering university in Wuhan as an example, the school has reached a long-term cooperative relationship with local construction companies, including a project called "construction site classroom". This is not a simple internship or site visit project, but a complete practical teaching system. In this project, students are not just observers, they are given practical engineering tasks and participate in every construction stage with engineers and technicians. In such an environment, students can more intuitively understand and apply the knowledge they have learned in class, and at the same time, they can get timely feedback and guidance from enterprise technicians.

The success of the project lies not only in the valuable practical experience gained by

students, but also in the benefits gained by enterprises. Enterprises have the opportunity to directly participate in the training process of talents to ensure that the new generation of engineers can meet the needs of the company. At the same time, enterprises have established closer ties with universities, creating more possibilities for future technological research and development of both sides.

3.2 Actively Promote the Application of Simulation Experiment and Virtual Reality Technology

In the process of cultivating high-skilled talents, simulation experiment and virtual reality technology have gradually emerged, which provide unprecedented convenience and sense of reality for civil engineering teaching. The introduction of simulation experiment and virtual reality technology enables students to carry out high-risk and difficult field operations in a safe environment, providing them with rich practical opportunities and multi-angle observation points.

In the civil engineering laboratory of a technical college in Nanjing, virtual reality technology is used to construct a real scale bridge construction scene for students. In this virtual scene, students can simulate the construction process of bridges, from site selection, design, construction to inspection. They can personally select materials, calculate bearing capacity, and even simulate and solve unexpected problems that may arise.

This teaching mode not only improves students'interest and participation in learning, but also enables them to apply their knowledge in real scenes and deepen their understanding of professional theory. The application of virtual reality technology not only saves a lot of physical materials and site costs, but also provides students with a zero-risk practice environment, so that they can boldly try and innovate. The promotion of this mode will make civil engineering education develop in a more scientific and practical direction, and meet the needs of the society for high-tech civil engineering talents.

3.3 Actively Learn the Educational Concepts and Modes of Advanced Countries

in the Field of Civil Engineering

Under the background of globalization, international exchanges and cooperation in various fields have become an important way of innovation and development. Especially in the field of civil engineering, all countries have accumulated rich experience and advanced technology. Through exchanges and cooperation, we can learn from each other and promote the rapid development of civil engineering education in various countries.

In recent years, an engineering university in Beijing has carried out in-depth cooperation with world-renowned civil engineering universities such as Berlin Technical University in Germany and Stanford University in the United States. This cooperation includes not only the exchange of teachers and the organization of academic seminars, but also the joint development of courses, the cooperative construction of laboratories, and the joint training of postgraduates. Through this in-depth cooperation, students from an engineering university in Beijing have the opportunity to gain an in-depth understanding of the latest technologies, methods and educational concepts in the field of civil engineering in advanced countries. This international educational concept enables students to better grasp the global perspective and strengthen the docking with the international advanced level in the process of learning. Practice has proved that international exchanges and cooperation play an obvious role in promoting educational innovation and practice in the field of civil engineering. Learning from the experience of advanced countries and combining with the actual situation of our country, we can better train high-quality civil engineering technical personnel to adapt to international competition.

4. Conclusion

With the sustained growth of China's economy and the rapid advancement of urbanization, the role of civil engineering has become increasingly apparent, but also brought a series of needs for education and skills training to adapt to the times. In the process of training high-quality technical and skilled personnel in the field of civil

engineering, simple imitation and blind following can not bring real leadership and innovation. The real frontier is created in continuous learning, communication and practice, which requires civil engineering education itself to have international concepts and leading technologies, as well as deep self-reflection and innovation ability. Only in this way can we really cultivate civil engineering technicians with solid theoretical foundation and rich practical experience, and make greater contributions to the future construction of our country.

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