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Research on Hydraulic Teaching Reform Based on the Background of Emerging Engineering Education

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Abstract: ***This study explores the necessity and specific approaches of hydraulic teaching reform in the context of emerging engineering education, providing references for improving the quality of hydraulic engineering education. The reform of hydraulic teaching based on the emerging engineering background helps to meet the diverse needs of water conservancy talents in the new era. By optimizing curriculum settings, introducing interdisciplinary courses and cutting-edge technologies, strengthening practical teaching, and innovative teaching methods, the comprehensive quality and practical ability of students are enhanced. Through the construction of laboratories and cooperation with off-campus practice bases, a rich practice platform can be provided for students, cultivating innovative hydraulic engineering talents.***

Keywords: Emerging engineering, Hydraulic engineering, Teaching reform, Approaches**.**

1. Introduction

With the progress of science and technology and the changes in social needs, the concept of emerging engineering has emerged, posing new requirements for engineering education. Hydraulic engineering, as a traditional engineering discipline, faces the challenge of cultivating high-quality talents to meet the needs of the new era. Traditional hydraulic engineering education focuses on the transmission of theoretical knowledge, lacking systematic cultivation of innovation and practical abilities. Therefore, this article analyzes the necessity of hydraulic teaching reform from the perspective of emerging engineering and proposes specific reform approaches to enhance students' comprehensive quality and practical abilities, cultivating innovative hydraulic engineering talents that meet the needs of the new era.

2. Analysis of the Demand for Hydraulic Teaching Reform based on Emerging Engineering Background

2.1 Requirements of Emerging Engineering for Hydraulic Talents

With the development of the social economy and technological progress, the concept of emerging engineering has gradually become popular, posing new requirements for talents in the field of hydraulic engineering. Although traditional hydraulic engineering education emphasizes the transmission of theoretical knowledge and basic skills, it cannot fully meet the needs of the new era when faced with complex and changeable real-world problems and technical challenges. Therefore, emerging engineering poses higher requirements for hydraulic talents, mainly in the following aspects: Firstly, emerging engineering emphasizes interdisciplinary integration capabilities. Traditional hydraulic engineering education is often overly specialized, lacking interdisciplinary integration. Emerging engineering requires hydraulic talents to have a broad knowledge background and interdisciplinary comprehensive capabilities, coordinating various resources in complex engineering projects to solve interdisciplinary problems. Secondly, emerging engineering focuses on innovation and practical abilities. Unlike the traditional emphasis on theory and experience, emerging engineering places more emphasis on innovative thinking and practical operation abilities. In the field of hydraulic engineering, this means that students not only need to master traditional design and calculation methods but also need to have the ability to develop new technologies and solve real-world problems, improving engineering efficiency and sustainability through innovation. Thirdly, emerging engineering requires more comprehensive qualities for hydraulic talents. In addition to technical capabilities, it emphasizes social responsibility, teamwork spirit, and cross-cultural communication abilities, which not only help improve the success rate of engineering projects but also enable engineering personnel to adapt and integrate more easily in the new era.

2.2 Goals and Directions of Hydraulic Teaching Reform

The goal of hydraulic teaching reform is to adjust the education system and teaching methods to meet the new requirements for talents in the context of emerging engineering, thereby cultivating hydraulic engineering talents that better meet the needs of modern social development. Specifically, the directions of hydraulic teaching reform should include:

Firstly, cultivating innovative hydraulic talents. Traditional hydraulic engineering education focuses on imparting basic theories and engineering practice skills, but with social development and technological progress, single knowledge and skills are no longer sufficient to address complex and changing engineering challenges and social needs. Therefore, cultivating innovative hydraulic talents has become one of the core aspects of current education reform. Innovative hydraulic talents should not only be disseminators and applicators of technology but also possess innovative thinking and capabilities, able to propose new solutions to problems, and promote technological progress and development in the field of hydraulic engineering. To achieve this goal, hydraulic teaching reform needs to adjust curriculum settings and teaching methods to stimulate students' creativity and innovation awareness. For example, introducing cutting-edge technology and engineering cases, conducting interdisciplinary teaching activities, and organizing

innovation competitions and project practices can effectively cultivate students' innovative spirit and abilities.

Secondly, emphasizing the cultivation of practical abilities and comprehensive qualities. In hydraulic teaching, practical ability is not only the application of theoretical knowledge but more importantly, the ability of students to think independently, solve problems, and communicate and collaborate in actual projects. Therefore, teaching reform should increase practical teaching links, including experimental courses, project internships, and off-campus practice, through which students can enhance their practical operation abilities and actual application abilities in engineering projects. Comprehensive quality cultivation is also an important direction of hydraulic teaching reform. In addition to professional skills, students need to have good communication skills, teamwork spirit, and leadership abilities. These qualities not only enhance students' competitiveness in the workplace but also help them better adapt to the diversity and complexity of society.

3. Approaches to Hydraulic Teaching Reform in the Context of Emerging Engineering

3.1 Reform of Curriculum System and Teaching Content

In the context of emerging engineering, the reform of the curriculum system and teaching content in hydraulic engineering majors is a primary concern. By optimizing curriculum settings, adding interdisciplinary courses, and introducing cutting-edge technologies and engineering cases, students' comprehensive abilities and ability to cope with real-world challenges can be enhanced. Specifically:

(1) Optimizing Curriculum Settings: Traditional hydraulic engineering curricula are usually fixed and traditional, mainly focusing on the transmission of basic theories and professional skills, lacking a comprehensive consideration of modern engineering practice and comprehensive ability cultivation. Therefore, optimizing curriculum settings is one of the primary tasks of hydraulic teaching reform. It should include updating existing curriculum content, combining the latest engineering practices and technological developments, ensuring that students can master the core knowledge and skills in the current and future hydraulic engineering fields. Additionally, flexible and diverse elective courses should be introduced to allow students to choose relevant professional directions or interdisciplinary courses based on their interests and career development needs. (2) Adding Interdisciplinary Courses: Emerging engineering education emphasizes interdisciplinary integration and innovation. Hydraulic education should actively respond to this trend by adding interdisciplinary courses related to other fields (such as information technology, environmental science, economic management, etc.). These courses can help students understand the intersections between different disciplines, broadening their horizons and ways of thinking, and cultivating their ability to solve complex problems. The introduction of interdisciplinary courses can enrich students' academic backgrounds and promote cross-disciplinary cooperation and innovation, enabling them to better coordinate resources and tackle challenges in actual engineering projects. (3) Introducing Cutting-edge Technologies and Engineering Cases: With continuous technological advancement, hydraulic engineering faces the emergence of new technologies and diversification of engineering cases. Therefore, hydraulic teaching reform needs to introduce cutting-edge technologies and the latest engineering cases so that students can understand and apply the latest engineering methods and technologies. By introducing cutting-edge technologies, such as exploring the application of artificial intelligence, big data analysis, and cloud computing in hydraulic engineering, students can better understand and master advanced tools and methods in engineering design, management, and decision-making. Additionally, by analyzing and discussing actual engineering cases, students can learn from both successful and unsuccessful experiences, enhancing their problem-solving and innovative capabilities.

3.2 Innovation in Teaching Methods and Means

In the context of emerging engineering, it is necessary to focus on innovation in teaching methods and means, which can not only enhance students' learning interest and participation but also improve their practical abilities and comprehensive qualities. Specifically, this includes: (1) Adopting Project-based Teaching: Project-based teaching is a student-centered teaching model focusing on projects. By implementing actual projects, it cultivates students' comprehensive abilities and innovative thinking. In hydraulic engineering teaching, adopting project-based teaching allows students to apply their knowledge to real or simulated engineering projects, solving actual problems. The teaching advantages lie in breaking the traditional single-mode classroom teaching, providing a diversified and dynamic learning environment. In this process, students need to use theoretical knowledge, perform practical operations, and involve project design, implementation, and management. Through teamwork, students can learn how to divide work, solve conflicts, communicate, and collaborate, enhancing their comprehensive qualities and practical working abilities. (2) Utilizing Virtual Simulation Technology: Virtual simulation technology is an important part of modern educational technology, providing students with a safe and efficient learning and practice platform. In hydraulic engineering teaching, using virtual simulation technology can simulate various complex engineering environments and operational processes, allowing students to practice in a virtual environment. For example, through virtual simulation technology, students can perform river simulations, flood warnings, water resource management, and other operations, experiencing the engineering decision-making process in different scenarios, enhancing their understanding and response to complex engineering problems. Virtual simulation technology can also be used to simulate real engineering cases, enabling students to conduct case analysis and problem-solving in a virtual environment, improving their practical abilities and innovative thinking. (3) Strengthening Practical Teaching Links: In hydraulic engineering teaching, strengthening practical teaching links can be achieved through various means and methods. The proportion of experimental courses and project internships should be increased, providing students with more opportunities for practical operations and practice training. Through practical operations, students can apply theoretical knowledge to practice, enhancing their

hands-on abilities and problem-solving skills. Students should also be encouraged to participate in scientific research projects and innovative activities, allowing them to understand the latest research dynamics, master advanced research methods, and improve their research abilities and innovative thinking.

3.3 Construction of Practice Platforms

Providing students with rich practice opportunities and real engineering environments helps improve their practical operation abilities and comprehensive qualities. The construction of practice platforms mainly includes: (1) Laboratory Construction and Updating: Laboratories are important places for practice teaching and scientific research in universities, key platforms for cultivating students' practical abilities and innovative spirits. With the introduction of emerging engineering concepts, laboratory construction and updating become particularly important. Laboratory construction needs to keep pace with technological development, equipped with advanced instruments and technical tools, ensuring that students can access the latest engineering technologies and research methods. For example, in the field of hydraulic engineering, advanced hydraulics experimental equipment, environmental monitoring instruments, and computer simulation systems can be introduced, allowing students to perform high-level experimental operations and data analysis. The update of laboratories not only reflects the improvement of hardware facilities but also includes the update of experimental content and teaching modes. Experimental courses should be combined with actual engineering cases, designing comprehensive and innovative experimental projects to stimulate students' learning interest and innovation potential. Additionally, diverse experimental teaching modes, such as open experiments, autonomous experiments, and team experiments, should be adopted to cultivate students' autonomous learning abilities and teamwork spirit. (2) Cooperation with Off-campus Practice Bases: Off-campus practice bases are important ways to expand students' practical abilities by cooperating with enterprises, research institutions, and government departments to establish stable off-campus practice bases, providing students with real engineering practice opportunities. The advantage of off-campus practice bases is that they allow students to access actual engineering projects, understand the latest engineering technologies and management methods. For example, students can intern in the hydraulic engineering projects of enterprises, participating in various stages of project design, construction, and management, accumulating actual work experience and improving their engineering practice abilities and problem-solving skills. Off-campus practice bases can also provide students with research practice opportunities. Through cooperation with research institutions, students can participate in actual research projects, understand the latest research dynamics and cutting-edge technologies, enhancing their research abilities and innovative thinking. The construction of off-campus practice bases requires close collaboration between schools and partner units to jointly develop practice teaching plans and assessment standards, ensuring the quality and effectiveness of practice teaching. Additionally, a long-term cooperation mechanism should be established, regularly conducting exchanges and cooperation to continuously optimize practice teaching content and forms.

Conclusion

In summary, hydraulic teaching reform in the context of emerging engineering is an inevitable choice to adapt to the development of the times. In future development, it is necessary to continue promoting the innovation of curriculum systems and teaching methods, deepening the construction of laboratories and off-campus practice bases, and improving students' comprehensive qualities, ensuring that they demonstrate stronger talent competitiveness and innovative abilities.

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