
Innovative Talent Cultivation Practice of “Research Feedback into Teaching” in Civil Engineering Major under the Background of New Engineering Education

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Abstract: Under the backdrop of the new engineering discipline and the “Double First-Class” construction, the civil engineering industry is undergoing a transformation towards intelligence, greenness, and industrialization. The contradiction between the traditional talent cultivation model and the industry’s demands has become prominent. The new engineering discipline requires breaking through disciplinary boundaries, strengthening cross-disciplinary integration, and focusing on the cultivation of innovation and practical abilities. This study constructs a cultivation mechanism centered on “research supporting teaching”: in the curriculum system, a diversified teaching method is adopted, and a three-level practical system is established, with the “Concrete Structure and Masonry Structure Design” course achieving the integration of theory and practice; in the construction of the teaching staff, stratified training, academic exchanges, and the establishment of interdisciplinary teams are carried out to promote “research and teaching integration”. This mechanism creates a four-dimensional interactive education system, providing a model for cultivating high-quality interdisciplinary civil engineering talents, and requires the establishment of a dynamic optimization mechanism to support disciplinary development and national construction.

Keywords: New Engineering Discipline; Civil Engineering; Research Supporting Teaching; Innovation Talent Cultivation

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1. Introduction

Under the dual-drive of the new engineering disciplines and the “Double First-Class” construction, China’s higher engineering education is undergoing a transformation from knowledge imparting to ability cultivation. Civil engineering, as a core engineering discipline that supports national infrastructure construction, needs to actively respond to major demands such as the “carbon neutrality” strategy and new urbanization, adapt to the development trends of industry digitalization, intelligence, and greenness, and break through the limitations of traditional training models. It is necessary to establish a talent cultivation model centered on innovation ability. The “research to support teaching” approach integrates cutting-edge research achievements, problem-oriented research methods, and interdisciplinary thinking into the entire process of talent cultivation^[1, 2], providing a feasible path for the innovation of the talent cultivation model in the civil engineering discipline. This study focuses on the innovative talent cultivation mechanism of “research to support

teaching” in the civil engineering discipline under the new engineering context. It conducts a systematic research from the dimensions of curriculum system, teaching methods, practical platforms, and evaluation systems, aiming to provide theoretical references and practical models for cultivating high-quality professionals with innovative thinking, engineering practice ability, and patriotism, and to promote the precise alignment of professional education with national strategies and industry demands.

2. New Requirements for the Cultivation of Civil Engineering Professionals under the New Engineering Discipline Background

2.1. Changes in the Demand for Talents in the Industry

Driven by the continuous advancement of infrastructure construction and the accelerated urbanization process in our country, the civil engineering industry is undergoing a structural transformation centered on intelligence, greenness, and industrialization. The rapid rise of emerging fields such as intelligent construction, smart cities, and green buildings has placed higher demands on the adaptability of the knowledge system, innovative thinking activity, and engineering practice competence of civil engineering professionals. However, the traditional training model for civil engineering professionals mainly focuses on the systematic imparting of theoretical knowledge, leaving significant shortcomings in stimulating students’ innovation ability and cultivating their practical skills. The mismatch between the supply of talents and the actual needs of high-quality development of the industry has become increasingly prominent^[3,4].

2.2. Core Concepts of New Engineering Education

The construction of new engineering education is fundamentally guided by the principle of “cultivating moral character and promoting education”, and it adheres to the core concept of “responding to changes and shaping the future”. It takes “inheritance and innovation, cross-disciplinary integration and fusion, coordination and sharing” as the key implementation paths, aiming to cultivate diversified and innovative outstanding engineering talents for the future. In this context, the training of civil engineering professionals needs to break through the boundaries of traditional disciplines, strengthen the cross-disciplinary integration and infiltration of knowledge, focus on the systematic stimulation of students’ innovative thinking and the progressive cultivation of their engineering practical abilities, deepen the collaborative cooperation mechanism of all links including research, industry, education and application, and ultimately build a high-quality professional training system that can adapt to and lead the development of future engineering fields^[5].

3. Construction of the “Research Backing Teaching” Innovative Talent Cultivation Mechanism in Civil Engineering

3.1. Reform of Curriculum System and Teaching Methods

3.1.1. Innovation of Teaching Methods to Cultivate Students’ Innovation Ability

Reconstruct the classroom ecology by adopting diversified teaching methods such as problem-oriented, project-based, and case-based. Stimulate the desire for exploration through problem chains, strengthen knowledge application through project carriers, and refine the ability to solve complex engineering problems through real cases, achieving a transformation from “passive acceptance” to “active construction” in the learning paradigm^[6].

Taking the course “Concrete Structure and Masonry Structure Design” as an example, focusing on the real engineering demand of “seismic reinforcement of the masonry structures in old residential areas”, a teaching loop of “problem definition - resource integration - scheme iteration - effect evaluation” is designed^[7]. By guiding students to investigate the current status of existing building structures, analyze the weak points of earthquake resistance, optimize the reinforcement scheme and conduct simulation verification, students can naturally complete the collaborative construction of structural design theory and engineering practice ability in the process of solving practical problems.

3.1.2. Strengthen Practical Teaching Links to Improve Students' Practical Ability

Strengthen the core position of practical teaching in the talent cultivation system and construct a three-level progressive practical teaching system of “basic experiments - comprehensive experiments - innovative experiments”. Basic experiments focus on the verification of core theories and basic skills training, laying a solid foundation for students' professional knowledge; comprehensive experiments are oriented towards complex engineering problems, integrating multidisciplinary knowledge and technical methods, cultivating students' systematic analysis and comprehensive application abilities; innovative experiments highlight the cutting-edge research frontiers and industry demands, encouraging students to independently design experimental schemes and conduct exploratory research, enhancing innovative thinking and practical innovation ability.

Take the course “Design of Concrete Structures and Masonry Structures” as an example. This course has set up characteristic teaching modules such as “Research and Development of High-performance Concrete Materials”, “Seismic Reinforcement Technology of Masonry Structures”, and “Intelligent Monitoring and Health Diagnosis”, covering cutting-edge fields such as green building materials, disaster prevention and mitigation, and intelligent construction. The course constructs a training path of “Interest-driven - Practice empowerment - Ability advancement”, by launching open experimental projects, organizing research innovation groups, and introducing virtual simulation technology, guiding students to gradually transition from basic skill training to independent innovation practice. During the experiments, the organic unity of knowledge internalization, skill improvement, and innovation ability cultivation is achieved.

3.2. Strengthen the Construction of the Teaching Staff and Enhance the Research and Teaching Capabilities of Teachers

3.2.1. Strengthen Teacher Training and Exchanges

Establish a hierarchical and categorized support system for teacher development, through regular training and academic exchange mechanisms, to systematically improve teachers' research innovation capabilities and teaching practice levels.

Encourage teachers to participate in high-level academic exchanges and research collaborations, set up special funding for academic conferences, support teachers to attend important academic conferences such as international civil engineering conferences and national structural engineering academic conferences; promote teachers to conduct joint research efforts with renowned universities and research institutions at home and abroad, through academic dialogue and collaborative innovation, to promptly grasp the latest developments in the discipline, and enhance teachers' research collaboration capabilities and academic influence.

3.2.2. Establishing a Research and Teaching Team

Build a cross-disciplinary collaborative innovation team for research and teaching, breaking down disciplinary barriers and resource isolation, and promoting the deep integration and open sharing of research resources and teaching resources. By establishing a collaboration mechanism among team members and a learning community, achieve complementary and mutually reinforcing elements such as teaching experience, research methods, and experimental resources, forming a virtuous cycle of “research promoting teaching and teaching assisting research”, and comprehensively enhancing the teaching and research capabilities of the team.

Take the teaching team of the “Design of Concrete Structures and Masonry Structures” course as an example. This team consists of teachers with backgrounds in structural engineering, materials science, and engineering mechanics. The team members closely collaborate around the goals of curriculum reform, jointly undertaking tasks such as the construction of modular curriculum systems, the development of virtual simulation experiments, and the transformation of scientific research achievements into teaching content. Through collective lesson planning, joint teaching research, and collaborative problem-solving, the team integrates the latest research results into the course teaching, innovates teaching methods and practical models, significantly improving the quality of the course and students' innovative practical abilities, and providing a feasible practical model for similar curriculum reforms.

4. Conclusion

In the context of the new engineering education, establishing an innovative talent cultivation mechanism for civil engineering professionals centered on “research feeding back to teaching” is a crucial path to meet the demands of industry transformation and upgrade and improve the quality of higher engineering education. By creating a four-dimensional interactive education system of “academic foundation - research empowerment - practical training - innovation leadership”, promoting systematic reforms in the curriculum and teaching methods, strengthening the construction of “dual-qualified” teaching staff, and improving the supporting guarantee mechanism, it is possible to achieve the deep integration of research resources and teaching resources, promote the transformation of research achievements into teaching content, teaching methods, and practical platforms, and thereby cultivate high-quality, multi-skilled civil engineering talents with solid professional foundations, innovative thinking, and engineering practice capabilities. During the implementation of this mechanism, a dynamic optimization and adjustment mechanism needs to be established. Through regular effectiveness evaluations, summarizing practical experiences, and reflecting on existing problems, the talent cultivation model can be continuously iterated and improved, providing solid talent support and intellectual guarantee for the sustainable development of civil engineering disciplines and the high-quality advancement of national infrastructure construction.

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