

Research on Teaching Integration Paths of Soil and Water Conservation Planning and Hydraulic and Hydroelectric Engineering

Hao Yan^{1,*}, Shaodong Liu¹, Weili Wang², Tingqi Yan¹, Jiashuo Chen¹

¹College of Civil Engineering and Water Resources, Heilongjiang Bayi Agricultural University, Daqing, Heilongjiang, China

²Heilongjiang Bayi Agricultural University Library, Heilongjiang Bayi Agricultural University, Daqing, Heilongjiang, China

*Corresponding Author

Abstract: China ecological civilization construction and smart water conservancy strategy have been vigorously promoted. Higher standards for ecological protection and soil and water conservation are imposed on hydraulic and hydroelectric engineering construction. In current university teaching for hydraulic and hydroelectric engineering majors, soil and water conservation planning is separated from mainstream engineering courses. This separation weakens students' comprehensive practical capabilities and fails to meet the industry's demand for interdisciplinary talents. This paper adopts the emerging engineering education concept and the OBE teaching model. It systematically analyzes the necessity and feasibility of integrating the two courses. Based on literature review, current situation analysis and practical case references, this study constructs an integrated teaching framework. The framework covers curriculum system reconstruction, innovative teaching methods, teaching resource integration and improved evaluation mechanisms. Corresponding supporting measures for implementation are also put forward. The results provide theoretical support and practical references for teaching reform of hydraulic and hydroelectric engineering majors. They also help cultivate high-caliber talents with ecological awareness and comprehensive engineering capabilities.

Keywords: Teaching Integration; OBE Concept; Soil and Water Conservation Planning; Hydraulic and Hydroelectric Engineering

1. Introduction

China water conservancy industry has entered a high-quality development phase. The coordinated promotion of river basin strategies, smart water conservancy construction and rural revitalization has raised stricter ecological standards for hydraulic and hydroelectric projects [1]. Hydraulic and hydroelectric projects greatly reshape natural environments [2]. Their construction and operation generate soil and water conservation risks that directly affect regional ecological security and sustainable development [3]. Traditional hydraulic education focuses excessively on engineering technologies. It pays insufficient attention to soil and water conservation planning, creating gaps between teaching content and industrial demands.

Meanwhile, the deepened reform of emerging engineering education requires engineering disciplines to break disciplinary boundaries. It highlights interdisciplinary integration to cultivate innovative talents with comprehensive literacy. Soil and water conservation planning is an interdisciplinary subject combining hydraulic engineering and environmental engineering [4]. Its organic integration with hydraulic and hydroelectric teaching becomes a core approach to improve talent training quality.

Domestic and foreign scholars have explored reforms of hydraulic engineering education. Some researchers propose a training mode for postgraduate hydraulic students driven by industry-education integration in two directions [5]. They stress the value of collaborative education between universities and enterprises. Other studies point out two prominent teaching problems: disconnection between course content and industrial demands, and single teaching modes [6]. Additional research explores methods to integrate ideological and political education into hydraulic courses based on the OBE

concept.

Nevertheless, existing research has obvious limitations. First, few systematic studies focus on the integration of soil and water conservation planning and hydraulic and hydroelectric teaching. Second, most integration paths lack specific design and operability. Third, a complete evaluation system for integrated teaching has not been established. This paper addresses core challenges in cross-disciplinary teaching integration. It designs systematic integration paths to guide practical teaching work.

This study sorts out theoretical connections between soil and water conservation planning and hydraulic and hydroelectric engineering. It builds a theoretical framework for their teaching integration and enriches the theoretical system of hydraulic engineering education. The OBE concept and industry-education integration model are applied to design integration paths. They offer new theoretical perspectives for interdisciplinary engineering education.

2. Analysis of Current Teaching Status

2.1 Status of Curriculum Arrangement

The curriculum system is fragmented. Most universities set Soil and Water Conservation or Soil and Water Conservation Planning as an optional course with limited class hours. This course lacks effective connections with core courses such as Hydraulic Structures, Hydraulic Engineering Construction and Hydropower Station Design. Independent courses cannot form a systematic integrated teaching system.

Teaching content fails to keep up with industrial updates. Smart and ecological water conservancy widely applies GIS, RS, BIM and other new technologies in soil and water conservation planning. However, many universities still teach traditional theories and methods without incorporating updated technologies and industrial standards. This creates a disconnect between classroom knowledge and industrial progress.

2.2 Status of Teaching Methods

Most universities adopt single traditional lecture-based teaching. Such modes lack interaction and practical links. Case teaching and project-driven teaching are rarely used, which cannot stimulate students' interest and innovative thinking.

Modern technologies are underutilized in classrooms. AI, BIM and other technologies are widely adopted in hydraulic engineering industries, yet their classroom application remains limited. Insufficient digital teaching resources restrict the improvement of teaching efficiency via information technology.

Ideological and political elements are not deeply integrated. Hydraulic engineering contains rich educational elements including engineering ethics, ecological protection and national mission. Current teaching only embeds these elements superficially without deep combination with professional knowledge [7]. It cannot achieve the fundamental goal of fostering virtue through education.

3. Necessity and Feasibility of Teaching Integration

3.1 Necessity of Integration

The water conservancy industry attaches growing importance to ecological protection. It demands more interdisciplinary talents with solid soil and water conservation expertise and hydraulic engineering capabilities. In-depth curriculum integration improves students' comprehensive literacy and matches industrial talent demands. Integrated teaching solves existing educational drawbacks including separated curricula, disconnected teaching content and weak practical training. It forms a logical, hierarchical teaching framework and improves overall teaching quality.

Emerging engineering education advocates interdisciplinary penetration and innovative talent cultivation. Integrating soil and water conservation planning with hydraulic teaching serves as a practical way to implement emerging engineering concepts. It cultivates high-quality engineering talents meeting modern standards. In addition, cross-disciplinary teaching strengthens students' ecological protection awareness. It guides future practitioners to implement soil and water conservation measures throughout all project stages. This balances engineering development and ecological protection and promotes China's ecological civilization construction.

3.2 Feasibility of Integration

Soil and water conservation planning and hydraulic and hydroelectric engineering share consistent training objectives. Their teaching

contents complement each other, and their practical engineering scenarios connect closely. These conditions lay a solid disciplinary foundation for cross-disciplinary teaching integration. Classic educational theories including the OBE concept and collaborative education theory provide standardized theoretical guidance. They guarantee the rationality of integrated teaching systems and optimized teaching paths.

Many domestic universities have carried out extensive interdisciplinary teaching reforms for hydraulic majors. They have built diversified curriculum systems and innovative practical platforms [8]. Rich experience in curriculum integration, teaching reform and practical education provides mature references and operable frameworks. It helps avoid various risks in new teaching model implementation [9]. Digital technologies such as GIS, RS, BIM and AI have been widely popularized. They break the single theoretical limitations of traditional hydraulic courses. These advanced technical tools enrich teaching content with stronger intuition, practicality and innovation [10]. They support efficient implementation of cross-disciplinary integrated teaching and verify the practical value and promotion potential of this integration model.

4. Objectives and Principles of Teaching Integration

Integrated teaching requires the construction of a multi-level, unified training objective system. Through curriculum integration, students systematically master basic theories, technical tools and analysis methods of hydraulic engineering and soil and water conservation planning. They clarify internal logical links between the two disciplines and build a complete professional knowledge framework. Students also strengthen their ability to solve practical hydraulic problems using soil and water conservation theories and technologies. Their comprehensive abilities are improved, including engineering design, field practice, innovative thinking and team cooperation.

Students' comprehensive literacy is continuously cultivated. They form strong awareness of ecological protection, engineering ethics and social responsibility, and establish a sustainable development mindset. This realizes deep integration of knowledge transmission, ability cultivation and value guidance. The ultimate

goal of curriculum integration is to cultivate interdisciplinary and innovative engineering talents. These talents master dual capabilities in hydraulic and hydroelectric engineering and soil and water conservation planning. They can engage in hydraulic project design, construction, operation, management and soil and water conservation related work to match high-quality industrial development.

Several core principles should be followed in integrated teaching reform. Systematic thinking guides integrated design covering curriculum systems, teaching content, teaching methods, teaching staff and evaluation mechanisms. All teaching links coordinate and support each other to form a complete integrated teaching system. The practicality principle requires teaching to closely match hydraulic project construction demands. It centers on solving soil and water conservation problems in real projects and highlights targeted, practical teaching content.

All integrated teaching activities must comply with scientific rules of education and student development. The OBE concept and constructivist learning theory guide the whole teaching process to ensure stable training effects. The innovation principle encourages the introduction of emerging technologies and advanced teaching methods. Updated teaching and assessment modes fully activate students' initiative and cultivate their innovative thinking and practical skills. The coordination principle promotes multi-party cooperation among universities, enterprises and industry associations. Integrated high-quality educational resources form joint educational strength and improve the training quality of interdisciplinary hydraulic talents.

5. Path Design for Teaching Integration

5.1 Reconstruction of Curriculum System

Curriculum system reconstruction for hydraulic majors follows the OBE concept. The first task is core curriculum integration. Soil and water conservation planning knowledge points are embedded into various core courses. An overview of soil and water conservation planning is added to Introduction to Hydraulic Engineering to build students' preliminary interdisciplinary cognition. Hydraulic Structures includes design knowledge for soil and water conservation measures around hydraulic buildings. Hydraulic Engineering Construction

supplements the compilation and dynamic monitoring of construction-period soil and water conservation schemes. Hydropower Station Design adds modules of reservoir ecological protection and soil and water conservation. Hydraulic Engineering Management improves teaching content about soil and water conservation management during project operation.

Elective courses are optimized simultaneously. Interdisciplinary electives are set up, including Integrated Application of Soil and Water Conservation and Hydraulic Engineering, Ecological Design of Hydraulic Engineering and Smart Soil and Water Conservation Technology. These courses expand students' knowledge scope and consolidate cross-disciplinary theoretical foundations.

A progressive three-level practical curriculum system is established, covering basic practice, comprehensive practice and innovative practice. Basic practice includes soil and water conservation experiments and hydraulic engineering field visits. Comprehensive practice adopts curriculum design and graduation design combining hydraulic projects and soil and water conservation planning. Innovative practice encourages students to take part in discipline competitions and scientific research projects related to hydraulic engineering and soil and water conservation. Multi-level practical training strengthens students' comprehensive application capabilities and promotes deep integration of theoretical knowledge and cross-disciplinary engineering practice.

5.2 Innovation of Teaching Methods and Integration of Teaching Resources

Diversified teaching methods are continuously optimized. Case teaching adopts typical projects such as the Three Gorges Project and Xiaolangdi Project. Classroom analysis and discussions help students understand practical ways to integrate hydraulic engineering and soil and water conservation planning. Project-driven teaching takes real hydraulic projects as training carriers. Students complete small hydropower station design and supporting soil and water conservation planning schemes to exercise full-process knowledge application capabilities. Digital teaching modes are actively developed. BIM technology constructs three-dimensional models of hydraulic projects and supporting soil and water conservation facilities. Virtual

simulation dynamically demonstrates construction and soil and water conservation implementation processes to improve classroom intuition. Online learning resources are developed to carry out online-offline hybrid teaching. Ideological and political education is organically integrated into all teaching sessions. Teachers excavate ideological connotations from professional knowledge, such as the dedication of hydraulic builders, ecological civilization requirements and the strategic value of water conservancy projects, to realize full-process value guidance.

All types of teaching resources are fully integrated. Special textbooks are compiled, including Integrated Tutorial of Hydraulic and Hydroelectric Engineering and Soil and Water Conservation Planning and Case Collection of Soil and Water Conservation in Hydraulic Engineering. These textbooks connect the knowledge systems of two disciplines and standardize complete teaching content. Experimental and practical conditions are comprehensively upgraded. A comprehensive laboratory for hydraulic engineering and soil and water conservation is built, equipped with soil erosion monitoring equipment and BIM modeling software. Universities cooperate with hydraulic enterprises and soil and water conservation monitoring institutions to build off-campus training bases for real engineering practice. A digital practical platform is constructed to develop virtual simulation experiments about hydraulic soil and water conservation. This forms a three-dimensional practical teaching system with complementary online and offline resources and linked on-campus and off-campus training bases.

6. Conclusions

This study confirms that the integration of soil and water conservation planning into hydraulic and hydroelectric engineering teaching represents an inevitable developmental trend, as this educational reform responds to the high-quality development requirements of the water conservancy industry, practices the core ideas of emerging engineering education, and comprehensively elevates the overall quality of professional talent training, thereby bearing prominent theoretical significance and practical application value. The two disciplines are inherently suitable for in-depth integration due to their consistent talent cultivation goals, mutually

complementary teaching content and closely linked engineering practical scenarios, with solid theoretical underpinnings including the OBE educational philosophy and collaborative education theory to guarantee the rationality and operability of cross-disciplinary teaching integration. On this basis, the present research constructs a full set of systematic implementation approaches covering curriculum system reconstruction, innovative teaching method design and multi-dimensional teaching resource coordination. Collectively, the viewpoints and integration frameworks proposed in this research offer a complete and targeted solution to address the disconnection between soil and water conservation teaching and hydraulic engineering professional education.

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