

Received: November 5, 2017

Revision received: June 25, 2018

Accepted: July 4, 2018

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DOI 10.12738/estp.2018.6.218 • December 2018 • 18(6) • 3154-3159

Research Article

Teaching Exploration of Hydraulic Structure Model Experiment Course*

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Abstract

This paper deepens the teaching mode, teaching method and teaching content of the reform experimental model of hydraulic structure model, aiming to mobilize the enthusiasm and creativity of students to participate in teaching and research activities, and comprehensively developing the innovative spirits of students. The article comprehensively sorts out the teaching content, experimental teaching links and teaching objects of the hydraulic structure model experiment, and improves the experimental practice teaching system by exploring experimental teaching cases and experimental teaching methods. The article explores new experimental teaching methods combining scientific research with teaching experiments. This article strengthens the construction of multimedia courseware, network platform and digital teaching methods through the study of experimental textbooks and experimental teaching, and improves teaching methods.

Keywords

Hydraulic Structure Model Experiment • Water Conservancy and Hydropower Engineering • Teaching Reform

* The author wishes to thank for providing support by National Natural Science Foundation of China as project no 51609087, Key project of Scientific Research in Colleges and Universities of Henan Province (15B570001, 17A570004), Collaborative Innovation Center of Water Resources Efficient Utilization and Protection Engineering, Henan Province, and 2017 Famous Teacher Training Program of NCWU.

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The water conservancy and hydropower engineering specialty is to train senior engineers who have knowledge of survey, design, construction, scientific research and management of water conservancy and hydropower projects. Students mainly study the basic theories and basic knowledge of mathematics, mechanics and building structure necessary for the construction of water conservancy and hydropower projects, so that students can get the basic training of necessary engineering design methods, construction management methods and scientific research methods (Xu and Wang, 2012; Dong *et al.*, 2014).

"Hydraulic Model Experiment" is a professional elective course for water conservancy and hydropower engineering. Its task is to introduce the basic testing techniques and testing methods of the hydraulic structure model experiment, so that students can acquire the basic skills necessary for the professional experiment, and improve the ability to solve the structural tests and other tests encountered in the general hydraulic structure design and construction. The training of students in scientific research and testing is part of the basic training necessary for senior technical personnel in water conservancy and hydropower engineering. Through experiments, students can grasp the experimental theory and methods better, consolidate and enrich the teaching effect, improve the test level, and lay the foundation for scientific research and structural inspection in the future.

However, the hydraulic structural model experiment is always in the scope of teacher's explanation and demonstration in the teaching (Wang, 2008). The experimental content is limited and lacks new ideas. The instruments are old. Students can only use old equipment or visit existing scientific research equipment. The number of instruments is small compared with the number of students. There are fewer opportunities for hands-on operation. Therefore, the reform of the hydraulic structure model experiment course is imperative, and the premise of this system construction is to have relatively perfect experimental teaching content, experimental purpose, experimental teaching conditions and so on.

Teaching content of hydraulic structure model experiment course

For students majoring in water conservancy and hydropower engineering, the practicality of engineering construction is significant. Compared with other conventional engineering specialties such as civil engineering, hydraulic engineering buildings are not familiar to students. In the teaching process, teachers can not more realistically point out the characteristics and functions of the building. The hydraulic model experiment course is a very important professional basic course in the hydraulic engineering specialty. It is also a theoretical and practical course. It adapts to innovative teaching requirements and better cultivates students' independent thinking ability, innovation ability and engineering practice ability. So the hydraulic model experiment course was carried out in many water conservancy institutions.

The hydraulic structure model is to model the prototype structure of the hydraulic structure according to the similar principle. The model not only simulates the actual working conditions of the building and its foundation, but also contains multiple load combinations and complex boundary conditions. According to the data of stress, strain and displacement observed and collected by the model experiment, it is easy to obtain the mechanical

characteristics of the prototype building, so as to solve the complex structural problems raised in the engineering design (Sun, 2003; Yang *et al.*, 2002).

The hydraulic structure model experiment course mainly relies on the water conservancy and hydropower engineering laboratory, combined with laboratory teaching and scientific research projects for experimental teaching, and cultivates students' professional interest and experimental ability from theoretical and experimental cognition. According to the main research directions of the laboratory and the contents of scientific research projects, the course offered three types of experiments: hydraulic materials experiments, hydraulic structure experiments and hydraulics experiments. There are 8 special experiments: Engineering material destruction experiment, concrete material property experiment, cemented sand gravel material property experiment, hydraulic structure model experiment, geomechanical simulation experiment, hydraulic turbine model experiment, hydropower station operation model experiment, etc. The teaching content is divided into 2 parts: theory learning and operational learning.

Analysis of teaching objects

The hydraulic structural model experiment is mainly for juniors in Water Resources and Hydropower Engineering specialty. During this period, students have a certain theoretical knowledge foundation. However, their understanding of the specialty is extremely limited. They have a strong interest in their majors and development, and their professional learning desire is strong. Through the study of the hydraulic structural model experiment course, students have a more detailed cognition of the hydraulic structure and the operation process and working principle of the hydraulic structure. In the classroom, students learn theoretical principles, experimental content, experimental procedures, experimental equipment and so on through theoretical study. In the laboratory, students learn more through the operation of various hydraulic building structural model experiments.

On the basis of the traditional hydraulic structure model experiment, the new dam model, the new technical equipment model, the development direction of water conservancy research, etc. are selected as the subject expansion, and the students are guided to acquire a certain understanding of the development of water conservancy projects (Zhang and Jin, 2014; Zhu *et al.*, 2013).

For some students who have spare time, after the end of the experimental course, they can choose topics that they are interested in, join the laboratory research group, conduct more in-depth experimental research work, or apply to participate in the National College Students Water Conservancy Innovation Competition and the "Challenge Cup" competition. Etc. They can cultivate their own comprehensive research capabilities.

Experimental teaching content optimization

Experiments are the source of scientific theory and the foundation of engineering technology. The content of experimental teaching should be transformed from the content of purely theoretical foundation to the content of application, interest and pioneering. Therefore, the experimental teaching content of the hydraulic structure

model should be optimized as a three-step teaching mode in which the teacher explains the basic experimental knowledge, the student independently designs the experimental topic, and the scientific research results are combined with the scientific research project (Zhang and Chen, 2008; Zhang *et al.*, 2013).

(1) In the process of teaching, teachers should reasonably arrange the teaching plan by using multimedia, numerical simulation, theoretical teaching and other lectures to explain the basic knowledge of similarity laws, test equipment, test techniques, model fabrication and installation and test operation techniques for hydraulic structural models. The course content should also include engineering case explanations. Professors should select typical projects and special projects. Among them, typical projects should be able to reflect the typical working characteristics and operation modes of hydraulic structures; special projects should highlight special engineering problems. Through the model experiment, students are able to analyze the problem, solve the problem and propose the corresponding engineering processing method (Mu, 2014; Huang *et al.*, 2007).

(2) Cultivate students' practical ability and innovative ability. The traditional teaching mode is not appealing to students' active learning and development of students' individuality. Therefore, in the course of teaching experiments, professors should encourage students to develop experimental projects based on current major water conservancy projects, and independently design experimental protocols and experimental procedures, and finally complete the research projects independently. It is important that students conduct innovative experiments under the guidance of professors. Professors should encourage students to participate in research projects and acquire the basic knowledge of scientific research such as applications.

(3) Develop comprehensive and innovative experimental projects. Professors should constantly enrich the topics that need experimental verification and analysis into the content of experimental teaching, and build an open and dynamic practical teaching system (Ji, 2007).

It is also important to advocate students to conduct exploratory and innovative experiments, highlight the students' scientific thinking ability, basic experimental operation skills, comprehensive experimental ability and scientific research development and application quality. For example, a model of a cemented gravel dam has been introduced into the model experiment teaching (Fu and Wang, 2007; Hao, 2014).

Experimental teaching equipment optimization

Develop modular and numerical hydraulic structure model teaching equipment

Develop a hydraulic structural model test platform with independent loading system, modular model system and numerical feedback measurement system. The independent loading system facilitates students' group operations and improves students' enthusiasm; The modular model system can be applied to a variety of building types and has a wide range of applications; The numerical feedback of the measured data can be used to find the structural force changes during the model test and visually reflect the test problems.

Establish a new media teaching model

In the experimental teaching, make full use of modern teaching methods such as information technology and multimedia to strengthen the construction of multimedia courseware and network platform. Use the new media platform such as Weibo and WeChat to create a public account, publish information related to teaching topics, and use the Internet to show students experimental process and engineering examples so that students can understand and master the knowledge.

Establish a digital teaching model

The virtual experimental teaching software based on Web technology and VR virtual reality technology is introduced. Through the establishment of 3D model software library of hydraulic structures, 3D model software library of water conservancy construction. Combined with VR virtual simulation cognitive training system, the digital teaching of hydraulic structure model experiment is explored.

Optimization of experimental teaching assessment methods

For the assessment and evaluation of students, professors must pay attention to the discovery and development of students' potential while paying attention to their achievements. The experimental evaluation method of hydraulic structure model should aim at educating students to improve themselves and develop themselves. Actively cultivate students' practical ability and innovation consciousness is possible. Therefore, the experimental course of hydraulic structure model should explore various forms of assessment and flexible content to strengthen the quality of students' water conservancy projects and scientifically evaluate students' abilities.

The evaluation of the results of the hydraulic structure model experiment course can not only be based on the experimental report, but also should be multi-form. The course work can be a model work, an experimental design, or a model experiment technique, a method of discussing papers, etc. While ensuring the diversity of forms, students are also required to complete experimental design, theoretical calculations and data analysis independently and seriously.

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