ATLANTIS PRESS

Advances in Social Science, Education and Humanities Research, volume 569

Proceedings of the 2021 International Conference on

Diversified Education and Social Development (DESD 2021)

Exploration on the Integrated Teaching Reform of Civil Engineering Experiment Teaching Based on Multi-objective

Huiyan Jia, Jiansheng Shen[1,*], Wei Chen and Jian Geng[1]

[1] *School of Civil Engineering and Architecture, Ningbo Tech University,1 Qianhu road, Ningbo 315100, China.*
Email: huiyanj@nit.zju.edu.cn
[*]*Corresponding author. Email: sjs@nit.zju.edu.cn*

ABSTRACT

The experimental teaching is an important part of the talent cultivation program of civil engineering in Colleges and universities, and is one of the most important links to cultivate students' comprehensive ability. Based on the experimental teaching objectives of civil engineering specialty, this paper analyzes the current situation and existing problems of the experimental teaching of civil engineering specialty. Taking multi-objective integration of the experimental teaching research as the background, this paper analyzes and constructs the experimental teaching system of civil engineering from four aspects of multi curriculum integration, theory and Practice integration, industry university research integration and multi-objective training integration, so as to promote the development of the experimental teaching system and to improve the experimental teaching system of civil engineering.

Keywords: *Multi-objective, Civil engineering experiment course, Integrated teaching.*

1. INTRODUCTION

In the 21st century, with the acceleration of China's urbanization process and the promotion of infrastructure construction, China's civil engineering industry has achieved unprecedented development. The higher education of civil engineering has been greatly developed while training a large number of talents for the national infrastructure construction field [1]. Civil engineering is an applied subject which combines theory with practice closely and has strong practicality [2]. Experimental teaching is an important part of civil engineering teaching, and it is a key link to cultivate students' engineering consciousness, practical ability and innovative spirit. Its teaching effect directly affect the quality of professional personnel cultivation, professional ability and post adaptability [2-5]. Civil engineering experiment course (including basic course experiment and professional experiment) plays an important role in the teaching of civil engineering, and is an indispensable part of cultivating innovative and applied talents in civil engineering [4].

How to build a practical teaching system to meet the actual needs and cultivate civil engineering professionals with solid theoretical foundation, broad professional knowledge, strong engineering practice ability and innovation ability has become an important research topic of teaching reform of Civil Engineering Specialty in Colleges and universities. In view of this topic, educational scholars have done a lot of research on the concept of practical education reform, educational objectives, teaching content and teaching mode [6]. Although scholars have done a lot of research and practice in civil engineering experiment teaching, through the analysis of the actual situation, there are still many problems in civil engineering experiment teaching, which need further research and exploration.

Although scholars have done a lot of research and practice in civil engineering experiment teaching, through the analysis of the actual situation, there are still many problems in civil engineering experiment teaching, which need further research and exploration.

This paper analyzes the problems existing in the current practical teaching of civil engineering, and discusses the reform of the experimental teaching mode of civil engineering in colleges and universities combined with the compilation of the new cultivation plan of civil engineering in Ningbo Tech University.

Copyright © 2021 The Authors. Published by Atlantis Press SARL.
This is an open access article distributed under the CC BY-NC 4.0 license -http://creativecommons.org/licenses/by-nc/4.0/.

2. PRESENT SITUATION AND EXISTING PROBLEMS OF EXPERIMENTAL TEACHING IN CIVIL ENGINEERING SPECIALTY

2.1 Weak Systematic Characteristic of the Experimental Curriculum Set

In the past, the experimental courses were arranged after the theoretical content was taught, and the experimental projects of each course were completed separately. Therefore, the experimental links between different courses and different experimental projects of the same course were independent and not connected with each other, as a result, acquisition of professional knowledge is poor systematic, and could not form a complete professional knowledge system. So that, students can't acquire professional knowledge before and after [6].

2.2 Experimental Teaching Lagging Behind Theoretical Teaching Seriously

Some instructors who are engaged in experimental teaching go straight to the teaching jobs in post graduation. They have been engaged in theoretical research or simple teaching work, often with deep theoretical foundation, but lack of practical experience and ability. They often have not enough cognition about the whole process of the project, and do not know enough about the new specifications, new calculation methods and new construction technologies. In the process of experimental teaching, it is difficult for teachers to give students correct guidance, and the experimental teaching content is also difficult to combine with the actual situation of the project. In addition, the content of the experimental project lags behind the social needs, students can 't master the new technology and new methods, and their knowledge reserve can't guarantee the effective connection from the school to the work unit.

2.3 Paying Attention to Experimental Data and Despising Theoretical Analysis

At present, there is a general phenomenon of "emphasizing theory over practice" in professional education, and "emphasizing data over theory" in experimental class.

In order to obtain data and complete experimental tasks, teachers and students attach great importance to the operation steps and experimental data acquisition, and often ignore the further understanding and grasp of theoretical knowledge in the experimental process. Due to the lack of theoretical guidance in experimental teaching, engineering practice is seriously out of touch with theoretical teaching, and the experimental teaching can't meet the requirements of cultivation objectives. The experimental course should not only exercise students' practical ability, but also deepen the understanding of theoretical knowledge, so as to better learn the corresponding courses.

2.4 Emphasis on Experimental Tasks, Neglect Ability Cultivation

Due to the limitation of course hours and experimental resources, the experimental content is often compressed, and the experimental class hours are reduced or even cancelled. As a result, some basic experiments that should be operated by students can only be presented in the form of demonstration experiments. Teachers also pay more attention to the completion of experimental teaching tasks, and ignore the cultivation of various abilities in experimental links. Not only students' comprehensive ability and innovation ability can't cultivate, and even students' practical ability can't be effectively exercised and improved, so that the experimental course becomes a mere formality, and the teaching effect is not ideal.

2.5 Lack of Experimental Teaching Resources

Insufficient investment in teaching resources has always been a prominent problem faced by colleges and universities, and the experimental teaching link is particularly obvious. The purchase of experimental instruments and equipment, the consumption of experimental materials and the construction of experimental site all need a lot of capital investment. Many schools are unable to carry out experiments of new technology and new method due to outdated experimental instruments and equipment. The number of experimental instruments is seriously insufficient due to the untimely update of equipment, even unable to meet the needs of students' grouping experiments. The lack of experimental sites leads to students' inability to carry out self-designed experimental projects. Therefore, the lack of practical teaching resources has seriously affected the quality of experimental teaching.

3. CONSTRUCTION AND IMPLEMENTATION OF INTEGRATED EXPERIMENTAL TEACHING SYSTEM FOR CIVIL ENGINEERING SPECIALTY

In view of the above mentioned, The Civil Engineering Department of Ningbo Tech University, according to the characteristics of the knowledge system of experimental courses, combined with the objectives and teaching mode of experimental course, and based on the analysis of the cultivation objectives of engineering practice and innovative talents in civil engineering, puts forward the "Four Integration" experimental teaching scheme, and constructs a multi-objective experimental teaching system of civil engineering curriculum integration. This is shown in Figure 1.

3.1 Integration of Multiple Courses

At present, scholars at home and abroad have made a variety of efforts and attempts in experimental teaching. Although the experiments of various courses in experimental teaching have also made great innovations, the relationship between experimental projects and between courses is basically isolated. The experimental teaching setting is the same as the curriculum teaching setting, and there is also a sequence before and after Therefore, it is necessary to establish a continuous integrated experimental content system covering multiple courses.

Based on the professional experimental curriculum, starting from increasing the experimental teaching hours, according to the knowledge system of civil engineering specialty, the integrated experimental teaching system of civil engineering specialty integrate the related curriculum experimental projects, and form the integrated comprehensive experiment of multi curriculum, multi knowledge point and multi experimental project, and carry out unified design, experiment, and analysis to complete the experimental link. A primary school period is set up at the end of the fourth and sixth semester, which is called the third semester. The primary school period is short, generally four weeks. There is no theoretical teaching task in this semester, which is specially used to complete the independent experiment and practice. The integrated comprehensive experiment can be completed by the school's platform resources, or by cooperation with the enterprise's engineering projects. The instructor is composed of the course teachers and the laboratory teachers. The teacher arranges the experimental project, and the students implement the engineering project given by the teacher in groups to carry out the experiment.

3.2 Integration of Theory and Practice

Many calculation formulas and design theories of

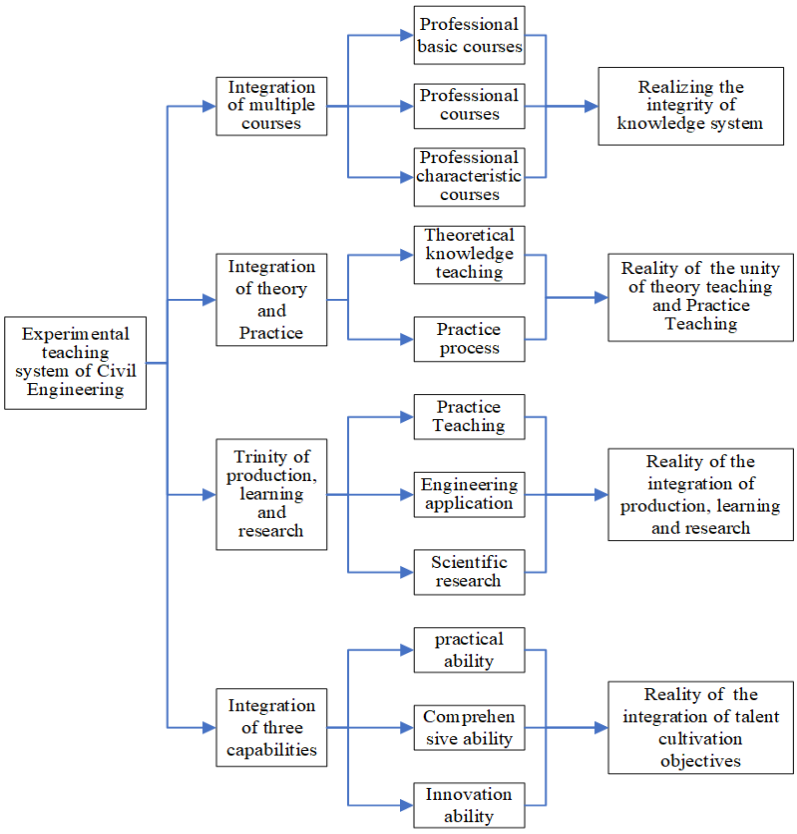

Figure 1 Integrated Experimental Teaching System of Civil Engineering Specialty

civil engineering courses are derived from experiments or engineering practice. However, in the actual teaching process, the phenomenon of theory course neglecting practice often occurs, and sometimes the wrong practice of neglecting theory analysis in experiment course occurs. In order to understanding by students, the correlation analysis between theoretical knowledge and experimental content can be carried out in the experimental class. Through the analysis of experimental phenomena, experimental data processing and experimental process simulation, such as consolidation compression phenomenon and compression curve analysis of consolidation test, the compression calculation formula can be deduced, let students deeply understand the theoretical knowledge and realize the unity of theoretical teaching and experimental teaching.

3.3 The Trinity of Production, Learning and Research

Theory comes from practice. In order to improve students' learning interest and problem-solving ability, in the process of experimental teaching, we should combine the experimental project with the actual engineering application or complete the experimental content by participating in the test link of the actual engineering project. Students are encouraged to carry out experimental teaching by combining innovation project of university students and participating in Teachers' scientific research projects. Combining experimental teaching with engineering application and scientific research, a teaching mode of integration of production, study and research is formed.

3.4 Integration of Multiple Training Objectives

Civil engineering specialty is to cultivate high-quality innovative talents with solid professional basic knowledge, strong engineering practice ability, comprehensive analysis ability and innovation ability. Therefore, it is an important task for contemporary civil engineering to cultivate talents with various abilities. The implementation of the integrated experimental teaching system of civil engineering specialty can not only exercise students' practical ability and cultivate students' comprehensive analysis ability, but also stimulate students' interest in professional learning in the multi-link experimental process, so as to guide students' innovative consciousness and cultivate their innovative ability.

4. CONCLUSION

Through the analysis of the problems existing in the experimental teaching of civil engineering specialty, a multiobjective integrated experimental teaching system of civil engineering specialty is established. Through the setting of comprehensive experiments of each module, the problems of independence of experimental contents and incoherence of knowledge points in the original professional knowledge system are changed, the lack of experimental teaching resources is improved, the theoretical teaching effect is improved. The ability of practice, comprehensive analysis and innovation on student are trained.

AUTHORS' CONTRIBUTIONS

The background research for this publication was carried out by all authors. Huiyan Jia wrote this manuscript, and Jiansheng Shen translated the manuscript. and Wei Chen and Jian Geng reviewed this manuscript.

ACKNOWLEDGMENTS

The authors wish to acknowledge the financial support of the Ningbo Tech University (NITJG-201919),Zhejiang Provincial Laboratory Work Research Project(YB202132) and the cooperative education project of Zhejiang provincial (Reform and innovation of civil construction curriculum system based on "intelligent construction" under the background of new engineering).

REFERENCES

[1] Zhou Lincong, Qiu Jianhui, Current situation and improvement measures of practice teaching for civil engineering specialty [J] Journal of Architectural Education in Institutions of Higher Learning, Vol.23 No.4 2014 pp.130-132. DOI: 10.11835 / j. issn.1005-2909.2014.04.029.

[2] Zhu Xuebing, Majoring in civil engineering experiment teaching reform [J] Journal of Hunan City University (Natural Science) Vol.25 No.1 2016 pp.259-260. DOI: 10.3969/j.issn.1672-7304.2016.01. 121.

[3] Qin Heying, Xing Xinkui, Optimization of practical teaching system for civil engineering based on training of engineering and innovation ability [J] Journal of Architectural Education in Institutions of Higher Learning, Vol.26 No.3 2017 pp.86-90. DOI: 10.11835/j.issn.1005-2909.2017.03.021.

[4] Wang Cunxing, Chen Xingrui, Li Ying, The Experimental Teaching Research on the Innovation Talent Training [J] Journal of Qufu Normal University. Vol.39 No.4 2013 pp.125-128. DOI: 10. 3969/j.issn.1001-5337.2013. 4.004.

[5] Jin Shengji,Bai Quan,Xu Jinhua,Bao Wenbo.Reform and practice on training scheme of civil engineering specialty in local colleges [J]. Journal of

Architectural Education in Institutions of Higher Learning, 2013, vol.22 pp.109-113. DOI: 10.11835/j.issn. 1005-2909.2013.04.027.

[6] Zhang Min, Dong Xiaoqiang, Guo Zhaosheng, Exploration and practice of civil engineering experimental teaching with scientific research project [J] Journal of Architectural

Education in Institutions of Higher Learning, Vol.26 No.4 2017 pp.104-107. DOI: 10.11835/j.issn.1005-2909.2017.04.025.

[7] Xu Xiaohong,Li Changfeng,Du Wenxue,Yang Yue,Meng Liyan,Zuo

Jingyan.Research and practice on reform of course design integration for civil engineering specialty based on engineering ability training [J]. Journal of Architectural Education in Institutions of Higher Learning, 2014,vol.23 pp.110-113. DOI:10.11835/j.issn.1005-909.2013.04.027.