



## Research Article

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# Exploration of Experimental Teaching Reform in Civil Engineering Materials Course Based on OBE Concept

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## Abstract

Based on the OBE concept, reform and exploration are carried out from three aspects: adjusting experimental content, arranging experimental sequence, and evaluating experimental methods, implementing a three-in one training model, and designing civil engineering material experiments with the aim of cultivating students' practical abilities. This helps to enhance students' ability to learn independently, practice, analyze and solve complex engineering problems.

**Keywords:** OBE concept; Civil engineering materials; Experimental teaching reform

## Introduction

The OBE philosophy, also known as outcome based education or outcomes-based education, focuses on what abilities and skills students can acquire and do after receiving education. OBE educational philosophy advocates the entire process of educational activities around achieving expected learning outcomes, emphasizing students' active learning; Driven by student feedback, emphasizing learning outcomes; The teaching and learning process reflects sustainable improvement through various evaluation methods. As the most internationalized and complete international mutual recognition agreement for undergraduate engineering education, the Washington Accord fully accepts the OBE education philosophy and integrates it into the professional accreditation of engineering education. Since China was admitted as a signatory of the Washington Accord in June 2013, it has practical significance to guide the reform of engineering education in Chinese higher education institutions with the concept of results-oriented education [1-2].

Based on the OBE concept, teaching research and reform is one of the current trends in the development of higher education

in China. Significant progress has been made in macro level research and reform such as training program formulation, and related curriculum reforms have also been carried out vigorously, achieving rich results [3-4]. However, there are not many designs and explorations at the micro level of the curriculum that truly embody the OBE concept, and there are still many urgent problems that need to be solved in practice. Civil Engineering Materials "is a fundamental course for various related majors in civil engineering and architecture. The training goal of civil engineering is to cultivate high-quality applied engineering and management talents who can adapt to local construction needs, have comprehensive development in morality, intelligence, physical fitness, aesthetics, and labor, possess good humanistic and social science literacy, professional ethics, team spirit, and international vision, and can engage in survey, design, construction, testing, scientific research and other related work in the field of civil engineering for building construction and other related structures. This requires civil engineering materials courses to emphasize both theoretical learning and practical experience. The learning effectiveness of the course is directly related to whether the goal-oriented talent

cultivation can be achieved, and the Civil Engineering Materials Experiment course is crucial for achieving the talent cultivation goals. However, there are still many problems in the experimental design of civil engineering materials at present.

## Analysis of the Current Situation of Experimental Courses

### The experimental teaching objectives and content lack systematicity

The combination of teaching objectives and content in civil engineering material experiments is not highly targeted, and the design of teaching objectives is broad and vague, without considering the practical needs of majors such as civil engineering, transportation engineering, architecture, and engineering management. The experimental teaching content is simple, focusing on the basic performance testing of basic materials, and all are learned and operated according to standard testing methods. Students feel bored, lack motivation to learn, and cannot transform knowledge into the ability to solve complex engineering problems.

### Traditional experimental teaching methods and single teaching evaluation

Usually, students preview the description of the experiment in the textbook, listen to the teacher's explanation in class, and then conduct the experiment, basically imitating the steps in the textbook. At the same time, students focus on theoretical knowledge and do not have a direct understanding of experimental instruments. During class, it is difficult for students to match the descriptions in the book with the actual operation of the instrument, conduct experiments in front of the textbook, and do not think about practical applications, making it difficult to meet the requirements of OBE philosophy. The evaluation method for experiments is usually based on experimental reports, which do not reflect the differences in the process and the cultivation of practical abilities [5-7].

## Experimental Teaching Design Based on OBE

### Three in one teaching objective design

One of the training objectives of the Civil Engineering and

Pre-established experimental projects after curriculum reform

Experimental Sequence	Civil Engineering	Transportation Engineering	Engineering Management	Architecture
1st Week	Cement and admixture experiments	Cement and admixture experiments	Cement and admixture experiments	Cement and admixture experiments
2nd Week	Concrete experiment	Concrete experiment	Concrete experiment	Sand and gravel experiment
3th Week	Additive experiment	Sand and gravel experiment	Sand and gravel experiment	New Building Materials Experiment
4th Week	Sand and gravel experiment	Asphalt experiment	steel bar experiment	
5th Week	steel bar experiment	steel bar experiment		

Architecture major under the background of engineering education is to conduct research and experiments on complex engineering problems in civil engineering and architecture based on scientific principles and using scientific methods, including designing experiments, collecting, processing, analyzing and interpreting data, and obtaining reasonable and effective conclusions through information synthesis. So, in the process of designing experiments for civil engineering materials, we need to consider the cultivation of students' practical abilities, including the ability to operate experimental instruments, master new materials, equipment, and technologies.

### Experimental arrangement

The experimental content of civil engineering materials should vary according to different professional directions. Civil engineering majors should pay attention to the research and experimentation of mechanical properties, such as mechanical performance experiments of cement, concrete, and steel bars. Transportation majors should design more experiments on asphalt and asphalt mixtures. Engineering management majors should emphasize the application and construction experiments of concrete. Architecture majors should focus on the development of new materials.

In terms of scheduling, the cement mortar strength test and concrete mix ratio test can be advanced appropriately, so that the 28-day strength data can be tested before the end of the course. In addition, experiments can be arranged before the theoretical course content. Students can have a visual understanding of the instruments, equipment, and materials first, and then learn theoretical knowledge without feeling abstract, which helps to enhance their interest in learning civil engineering materials.

In terms of experimental content, some new materials can be added, such as fly ash, ground slag powder, limestone powder, lime, concrete admixtures, expansion agents, and accelerators, so that students can choose one or two of these materials and cement for experiments. In sand and gravel experiments, gradation experiments of course and fine aggregates can be designed. In concrete mix proportion experiments, students can independently choose the type and strength grade of concrete for design. Thus, cultivating students' innovative ability.

## Reform of assessment methods

The OBE concept emphasizes the evaluation of students' abilities, but in the past, most civil engineering material experiment results were mainly based on experimental reports, which did not reflect students' hands-on ability and ability to solve complex

engineering problems. So experimental evaluation should focus on the practical process and conduct process-based assessments. The experimental evaluation design can be designed in a ratio of 15% before class (preview, experimental plan design), 50% during class (practical operation, enthusiasm, team collaboration), and 35% after class (experimental report, analysis and summary).

Process based assessment plan

Evaluation Items		Score	Detailed Description
Before class	Preview	5	Check through questioning
	Experimental Plan Design	10	View the plan
During class	Experimental operation	30	Scoring based on on-site performance
	Experimental enthusiasm	10	Observe positive performance
	Team collaboration	10	Mainly depends on the efficiency of the team
After class	Experimental report	20	Check the completeness and formatting of the report
	Analysis and Summary	15	See the detailed and accurate analysis

## Conclusion

Through the "Trinity" design of civil engineering material experiments, emphasis is placed on cultivating students' practical abilities and their ability to solve complex engineering problems. The process evaluation system before, during, and after class helps to reflect the OBE concept in assessing students' learning abilities, truly putting students first and improving their enthusiasm and initiative for learning.

The design of experimental sequence and content is related to the efficiency of students' learning and their future work direction, which can lay a good foundation for their work and scientific research after graduation. The experiment of developing new materials helps cultivate students' innovation ability and interest in learning majors and has a good effect on cultivating students' independent design, comprehensive analysis ability, ability to solve complex engineering problems, and teamwork ability.

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## Conflicts of Interest

There are no conflicts of interest to declare.

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