

# *Exploration of Mixed Teaching Modes of Civil Engineering Materials Course Based on Engineering Education Accreditation*

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**Abstract:** Based on the accreditation of engineering education and the focus on advancing the educational reform of information technology, combining the characteristics of the civil engineering materials course around the student-centered, we preliminarily explore the mixed teaching design combining online and offline teaching, and we reform teaching models and teaching methods, which can improve the teaching effectiveness of courses, enhance students' independent learning ability, and strengthen students' ability to analyze and solve problems.

## 1. Introduction

Engineering education certification has become the main trend in the professional construction of universities, under the guidance of engineering education certification, the curriculum in the university's undergraduate professional talent training program is set up with "result-oriented, student-centered, continuous improvement" as the main line for general design [1], and the students' graduation requirements in the humanities, social and scientific literacy, social responsibility, and other aspects have put forward clear general standards.

Engineering education accreditation concepts advocate organizing the whole process of educational activities around the achievement of expected learning outcomes and emphasize student active learning. Feedback is driven to put more emphasis on the learn results, and teaching and learning processes reflect sustainable improvement through a variety of measures. It has realistic significance to guide the reform of engineering education in our country's higher education schools with engineering education accreditation concepts [2, 3].

The mixed teaching mode is not only a reform of teaching modes but also an upgrade of teaching concepts. Teaching mode, teaching strategy, teaching role, and students' cognitive mode will be changed by the promotion. In recent years, the exploration of mixed teaching modes at home and abroad has shown an obvious accelerated growth trend. And the design and development of mixed education systems also showed the trend of diversification and specialization, the application of mixed teaching modes has been widely considered in colleges and universities for the systematic reform of the curriculum [4].

The Civil Engineering Materials Course is a course that introduces the engineering application, functional requirements, types and specifications, performance and composition, and test and detection technology of civil engineering materials. It is a compulsory and professional-level basic course for civil engineering, construction engineering, engineering management, engineering cost, and other relevant majors. The course aims at “application practice”, so that students can understand the specific engineering applications and performance requirements of civil engineering materials on the basis of solid mastery of the basic theory and knowledge, cultivate the ability of students to apply material knowledge to solve actual engineering problems, train students to select the appropriate materials according to different engineering requirements, and understand the relationship between material performance and engineering design and construction. The implementation of mixed teaching not only solves the problem of the previous insufficient class hours, but also allows teachers to spend more time and energy on the understanding of difficult and key knowledge points and to conduct deeper interpretation and excavation of teaching materials. Secondly, it is also possible to use group discussion to enable students to discover problems and solve them in mutual communication, break the traditional customary cognitive patterns, and give them the courage to question and dare to innovate. Under the background of engineering education certification and student-centered, this article introduces the mixed teaching model, explores the mixed learning design, reforms the teaching models and teaching methods, adopts the standards for engineering educational certification as the basic guidelines, and actively promotes the construction of civil engineering materials course teaching to meet the training requirements of professional accreditation.

## **2. Characteristics and Matters of Civil Engineering Materials Course**

The content of Civil Engineering Materials course is complex; it has wide coverage but poor logic, and lacks continuity, effective connectivity, and logic in each chapter, as well as a connection with real-life production; meanwhile, there is a high demand for the practical skills of students. In current teaching, full-blown traditional teaching methods are still adopted, ignoring the main status of students, leading to reduced learning effects [5]. So, the teaching modes of civil engineering materials courses are researched in depth in many universities. Zhao Liang [6] proposes reforms and innovations of civil engineering materials experiment courses under the new engineering background; Chen Jing [7] proposes multidimensional combination modes for civil engineering materials courses; and Zhang Wuman [8] proposes a diversified personnel training system based on design, comprehensive and innovative experiments, and verification experiments are complementary. Shen Yan [9] proposes an experimental teaching reform mode for civil engineering materials based on the cultivation of innovation capabilities.

## **3. Mixed Teaching Design of Course**

### **3.1. Teaching Objectives Design**

Based on the certification standards of engineering education, the teaching objectives of the Civil Engineering Materials course are broken down into knowledge objectives, capability objectives, and ideological and political objectives (as shown in Figure 1) to meet the requirements of applied, composite, and innovative talent training. In the course of teaching, with engineering practice as the background and engineering technology as the main line, the knowledge goals, capacity goals, ideological goals, and political goals are organically combined to enhance the student's engineering practical ability, engineering skill, and engineering innovation ability, so that students have the

comprehensive ability to solve complex problems in civil engineering and the ability to think engineering [10].

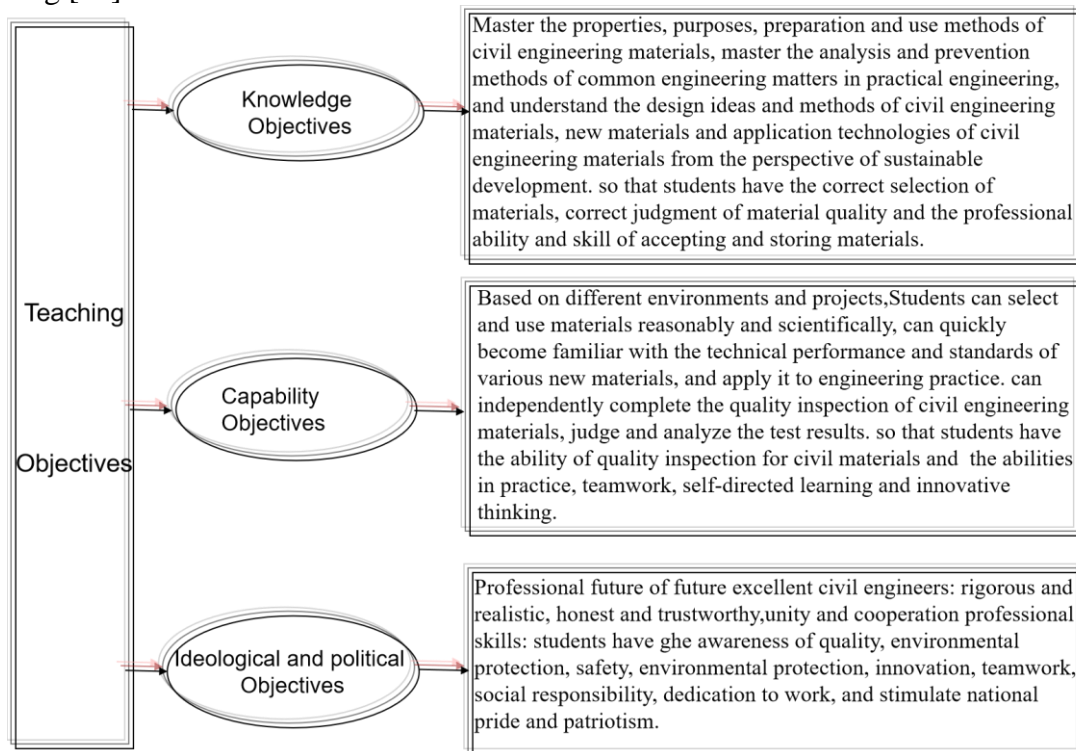


Figure 1: Teaching objectives of civil engineering materials course

### 3.2. Teaching Design Ideas

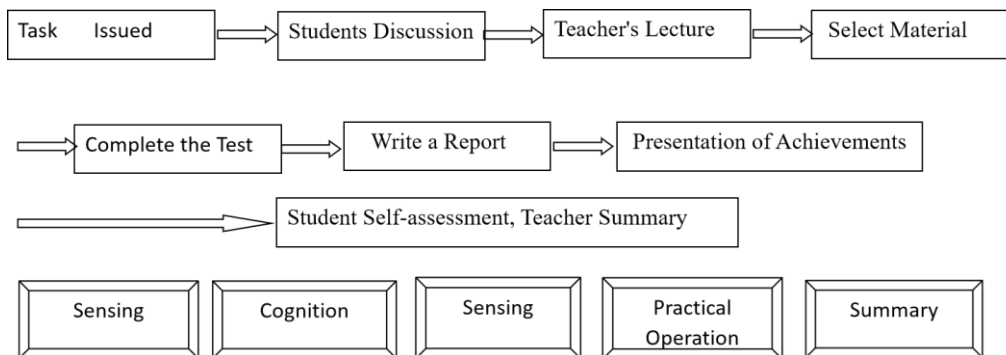


Figure 2: Teaching design idea of civil engineering materials course

In order to achieve the above-mentioned course objectives, based on the concept of engineering education accreditation, the theoretical lessons are based on the principle of moderation and sufficient use, highlighting the performance, technical characteristics, and application of civil engineering materials. The practice course should be based on professional job competence analysis with students as the main body and professional competence training as the main line. The technical requirements of civil engineering materials, sampling methods, inspection methods, acceptance and storage materials, and so on, which suit the practical needs of materials officers, quality inspectors, constructors and testers. Students should be required to be familiar with the quality standards and technical performance of civil engineering materials. Students can prepare the testing scheme for common civil engineering materials, can implement testing under environmental and safety

conditions, and have the professional ability to correctly judge the quality of materials according to the results of the testing, and make the correct selection, acceptance, and storage of materials. The course teaching design ideas are as shown in Figure 2:

## **4. Reform of Teaching Modes**

### **4.1. Reform of Teaching Methods**

Make full use of the advantages of information technology to carry out the following reforms.

#### **4.1.1. Modular Teaching Projects**

The Civil Engineering Materials course emphasizes the fundamentals and practicability, which mainly includes the basic knowledge and testing contents of civil engineering materials. In the teaching course, the modular teaching project design is implemented with the main contents of cement performance and testing, concrete performance and testing, steel performance and testing, wall material performance and testing, and waterproof material performance and testing.

#### **4.1.2. Integration of Ideological and Political Elements**

Ideological and political education are integrated into class teaching content. Professional lessons and ideological and political lessons are closely combined. Incorporating the ideological and political elements into the professional courses can help students realize the virtue of professional classes and emphasize the value leadership in professional education. Using engineering accidents and environmental pollution examples, such as the collapse of the Chongqing Rainbow Bridge, the decoration disease brought by home renovation, which are the entry points in order to introduce the importance of the influence of material performance on the quality of engineering structure and service performance and guide students to combine knowledge and ability with labor practice and daily life in professional learning. The importance of the social value and significance of science, scientific spirit, innovation spirit, comprehensive quality, and social responsibilities are emphasized.

#### **4.1.3. Combining Theory and Practice Teaching**

We apply the integrated teaching mode of class theory teaching-experiment-engineering practical teaching-scientific research, and training to increase the interest of students to learn professional courses, and cultivate their operational ability, teamwork ability, and practical innovation ability.

Civil engineering materials and engineering are inseparable, so teachers can combine the materials into engineering. Such as the introduction of concrete carbonation, instead of the cause of carbonation and the impact of concrete on the concrete structure, teachers should be linked to practical protects and have some expansive explanation that includes how to detect the depth of carbonization of concrete in bridge engineering, why large concrete is easily cracked, and then require students to summarize the main measures for preventing temperature cracks after class.

During the course of practice, teachers change the single pattern of traditional verified materials and promote design-based and integrated experiments by combining concrete design competition to strengthen design and comprehensive experimentation, such as when students are required to complete a certain level of intensity of practical engineering in common concrete matching with design work and are required to compare with the actual matching ratio in engineering. Develop students' practical skills, team collaboration skills, comprehensive ability to analyze problems,

engineering application skills, and innovation skills. If students complete the experiment. They not only master the content of the experiment but also have the engineering application skills to analyze and solve problems.

After class, students can participate in the experimental work of the research subjects undertaken by the teacher so that they can develop their practical ability, team collaboration ability, comprehensive ability to analyze problems, and innovation ability.

## 4.2. Reform of Teaching Means

Relying on the Fanya Chaoxing platform, the online and offline mixed teaching mode is adopted to organize the teaching activities into three links (pre-class, mid-class and post-class), so as to achieve the teaching objectives of the course.

Before class: The teaching program, electronic teaching materials, textbooks, and other teaching documents will be uploaded within the platform for students to use, and important tasks and tests will be distributed at any time in class. We add the contents of animations, pictures to increase the dynamics of the curriculum, attract the attention of students, and increase teaching interest as well.

During class: We organize classroom activities, highlight the key and difficult points, and improve student participation in the classroom through group discussion and case analysis.

After class: We focus on teaching reflection, which includes promoting the professional growth of teachers, and homework tasks are focus on promoting student expansion thinking. Students are guided by posting questions to stimulate their interest in learning.

We adopt online and offline mixed teaching modes to solve the contradiction of excessive teaching content and insufficient teaching hours for the Civil Engineering Materials course, at the same time, students-centered methods are implemented. According to the teaching logic of learning online → teaching → analysis → group discussion → interaction → evaluation and assessment, and the ideological and political elements can be incorporated timely so that the students can set up correct values and form good professional ethics.

## 5. Conclusion

Integrating the concept of engineering education accreditation into the teaching of civil engineering materials. which is beneficial to transfer the education idea of “student-centered”, change the learning state to active learning instead of passive learning, strengthen the integration of theory and practice courses, cultivate students’ engineering consciousness, engineering design ability, teamwork, and problem solving abilities.

It can stimulate students to have a strong interest in learning, cultivate the ability of students to learn independently, improve students' ability to analyze and solve problems, and better adapt to the requirements of professional certification in engineering education through the introduction of online and offline hybrid teaching modes.

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