

# Experimental Teaching Reform of Building Materials Course Based on Innovation and Entrepreneurship and Subject Competition

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**Abstract**—It was studied and analyzed the common defects of experimental teaching of *Building Materials* by this paper. At the same time, it also discussed the measures of experimental teaching reform of building materials. This paper introduced the college students' innovation training project and college students' discipline competition project in the experimental teaching, integrates the experimental teaching system and reforms the experimental model. In these ways, students' learning enthusiasm is stimulated and their practical and innovative abilities are improved.

**Keywords**—experimental teaching reform; civil engineering; *Building Materials*; innovative undertaking

## I. INTRODUCTION

### A. The research background

Under the background of cultivating applied talents in local universities, experimental teaching is particularly important in the whole teaching process for civil engineering majors. It is an important link to improve students' innovation ability, practice ability and overall quality. In the knowledge system of theoretical courses such as Building Materials, Civil Engineering Materials, Concrete Engineering, Soil Mechanics and Material Mechanics, experimental teaching of building materials occupies a leading position. On the one hand, experimental teaching deepens students' understanding of theoretical knowledge; on the other hand, experimental teaching of building materials is directly related to students' work after graduation. Because civil engineering specialty is very engineering, technical and practical, we must pay attention to the experimental teaching of building materials[1].<sup>[1]</sup>But in reality, there are many problems in the experimental teaching system of building materials. Throughout the material experimental teaching of engineering majors, most of them are basic or confirmatory experiments, which are attached to theoretical teaching. Experimental projects are updated slowly and lack of autonomy and innovation. The experimental teaching mode remains unchanged for many years, and the teaching method is relatively undiversified, which lacks the cultivation of students' innovative spirit and research spirit, and students increasingly think that experimental courses are boring. On the other hand, with the rapid development of science and technology, traditional building materials have

been unable to meet people's requirements for higher performance building, and various new building materials have emerged. More and more construction projects are using new materials with special performance requirements, such as lightweight, high-strength, thermal insulation, thermal insulation, waterproof, energy saving, environmental protection and green, etc., and there are more and more researches on new materials at home and abroad[2]. Our experimental class has not kept pace with the development of science and technology, and the main experiments are still around the most common cement, sand, stone, steel, etc.

### B. Research significance

Based on the current situation, this study makes innovative reform of relevant experimental links of building materials, fully mobilizes students' subjective initiative, and introduces the admixture or admixture of new building materials such as research frontier hotspots into experimental teaching links, so as to connect with building materials research in new situations. At the same time, the experimental projects of students' independent innovation can be applied to the training projects of college students' innovation and entrepreneurship and related discipline competitions, such as the national concrete structure design competition, concrete mix design competition, and national college students' scientific and technological innovation competition[3-4].

Through the reform of this experimental teaching mode, it can not only cultivate students' comprehensive ability, but also understand the frontier development of the subject, and also drive students' enthusiasm for applying projects and participating in competitions, which has certain promotion value.

Combined with common materials such as concrete and mortar, the new construction materials selected by students may be studied together, and the experimental results may be of practical value. The research conclusion can provide certain data or conclusion support for relevant research, and has certain value.

## II. THE RESEARCH PROGRESS

### A. Present situation investigation

Experimental teaching is an important part to improve students' innovation ability, practice ability and overall quality. The training goal of civil engineering major is to cultivate senior application-oriented professional talents with certain knowledge, ability and comprehensive quality, oriented to production, construction, management, service front line or post group and adapted to its requirements, with sustainable development potential. Because this major has very strong engineering, technical, practical, therefore must pay attention to practical teaching. However, due to various reasons, there are still some problems in the current experimental teaching in Chinese universities. The content of practical teaching is slow to update and lacks of autonomy and innovation; experimental teaching form, teaching method, teaching means relatively unitary and backward; lack of students' innovative spirit and practical ability[5]. The original experimental teaching is only set for the content of the textbook. The general pattern is that the teacher prepares all kinds of materials and equipment before the beginning of the experimental class according to the content taught in class, and explains in detail the purpose, principle and steps of the experiment in class. The teacher even makes a demonstration experiment first, and then the students finish the experiment step by step, and finally hand in an experimental report that the whole class is similar. Such an experimental mode cannot meet the basic requirements of cultivating applied talents in our university at the present stage. Therefore, it is of great urgency to reform such courses as building material experiment.

At present, many universities in China have been aware of this problem and are trying to carry out the reform and innovation of experimental teaching, which has received good results. However, most of the reform mainly starts from experimental methods and experimental means, and ignores the connection between experimental teaching and professional disciplines. With the development of science and technology, the development of experimental teaching should take into account the development of frontier knowledge[6]. Although a large number of researchers have conducted a lot of research and achieved a lot of results on new building materials, there are few reforms on the experimental teaching of building materials at present.

Traditional building materials are mostly cement, concrete, mortar, steel bar, lime and stone commonly used in construction projects, while new building materials have been developed into special materials with energy saving, green, light and high strength properties. Experimental teaching of traditional materials is mostly simple basic and verifiable experiments, and materials are also common sand, concrete, etc., but now scientific research experiments involving building materials are developing towards adding additives or admixtures to improve the performance of original materials[7]. For example, adding additives such as water reducing agent, air entrainer and early strength agent to concrete or adding some admixture such as ghananian rice powder, rubber powder, limestone powder, polymer dry powder and polymer SBS can improve concrete performance in different mixing schemes.

For example, adding phosphogypsum, fly ash, lime and steel fiber to cement slurry or mortar can also improve some properties of the mixture to some extent. Therefore, we can introduce these frontier knowledge points in the experimental teaching, choose the hot additives or admixtures, and also select some new admixtures innovatively, so that the reformed experimental teaching can not only conform to the pattern of application-oriented personnel training, but also be closely connected with the development of the subject.

At present, Chinese college students' participation in innovation and entrepreneurship projects or discipline competitions mostly relies on the guidance of teachers to select topics, and students rarely consult literature. Under the new social situation, college students should be able to study and study independently. Teachers should pay attention to students' independent learning, fully mobilize students' innovation ability, and play a supplementary role in the project application or competition participation after the completion of experimental research, so that students can fully feel the realization of their own ability.

### B. The research target

- Cultivate students' creative thinking, team spirit, academic research ability and paper writing ability.
- In-depth understanding of the frontier development trend of new building materials, understanding the properties of various new building materials, and close contact with cutting-edge technology.
- Improve students' interest in the experimental course and their cognition of the experimental course.
- Students are willing to participate in the innovation and entrepreneurship training program and discipline competition, increase the number of subjects, improve students' self-recognition and confidence, and at the same time increase the opportunity to bring honor to themselves, the class and the school.

### C. Key problems to be solved

- Establish students' recognition of college students' identity and feel the college life of academic research. Teachers should cultivate students' ability to consult academic literature, train students' basic skills in scientific research, and cultivate students' ability to analyze and solve problems independently with the comprehensive application of knowledge.
- Close contact with new building materials, so that students can truly feel the use of learning. The teacher should combine the theoretical knowledge taught in class with practice, guide the practical operation with theoretical knowledge, and strengthen the understanding of theoretical knowledge with practical operation.
- Cultivate students' cooperative ability and feel the team atmosphere, which can make students truly feel the joy of cooperation and strengthen the ability of cooperation, communication and communication.
- Don't talk about the hero in terms of ordinary grades.

#### D. Implementation plan

1) *Add open experimental projects:* For the experimental projects of building materials, we retain some original basic or verifiable experiments. In this part of the experiment, students will be involved in the material inspection on the project site after graduation, such as the tensile strength of steel bars, material density, water absorption rate, cement fineness, standard water consumption and so on. Another part of the experiment added ductility and openness experiment items on the basis of the original experiment, such as concrete, mortar, cement slurry mix proportion, strength or consistency. The guidance teacher should give a broad range of subjects. Students should consult literatures independently in groups, choose one or more new building materials to be added into different experimental projects, and each group should independently determine the experimental scheme. Finally, the instructor gives the revision suggestion, forms the research topic. Teachers should grasp the principle of "intra-group heterogeneity and inter-group homogeneity" to group students, so that there is comparability between groups and motivate students. Teachers should also induce students to take the initiative according to their own strengths to cooperate. In this way, the advantages of each student can be brought into play, which is beneficial for the members of the group to learn from each other and improve together. Meanwhile, it is also convenient to carry out inter-group competition and give play to the wisdom of the group.

2) *Participate in college students' innovation and entrepreneurship training program and discipline competition:* In the research process of open experimental project, we also participate in the application of college students' innovation and entrepreneurship training project and discipline competition based on the original topic or similar topic.

3) *Look up the problems:* All groups of students look up the problems in the research process, think about the solutions, summarize the experience in the process, and provide help for the future experimental research. Students are required to present the experimental research results in the form of experimental reports and write papers, laying a foundation for the writing of graduation thesis and further study.

4) *Participate competitions:* According to the experimental project in the research, students in each group apply for the undergraduate innovation and entrepreneurship training project (university-level and national-level) and participate in various material discipline competitions.

5) *Specific implementation plan:* During the first half of the school year, the content of experimental teaching was arranged: teachers should arrange students to operate basic experiments with normal teaching, get familiar with the experimental process and ideas, and master basic experimental skills; teachers should arrange a comprehensive experiment to preliminarily exercise students' experimental design ability; at the end of the semester, an experimental teaching reform plan and an experimental instruction should

be prepared for the problems found in this semester; students are divided into groups, and they start to consult literatures according to the instruction, and keep an eye on the development trend of building materials; students are required to learn data analysis software, such as EXCEL and SPSS.

The laboratory will be open to all students during the second half of the school year: First of all, each group proposed the experimental design preliminary scheme, after the instructor modified the experimental scheme, each group purchased the selected new admixture or admixture. Second, the laboratory experiment equipment, materials, objects and time are fully open. Students will gradually carry out experimental research after class. Due to the high comprehensiveness and difficulty of the experiment, it is required that each student must cooperate with each other and complete the experiment together. Thirdly, all data of the experimental process should be kept in a timely manner, and the experimental results should be analyzed at the same time, so as to adjust the experimental scheme in a timely manner, which is obviously inconsistent with the research value.

### III. FEATURES AND INNOVATIONS

The features and innovations of this course reform are mainly reflected in: The experiment related to the course textbook is extended to the experimental teaching mode related to the subject; Relying on the normal experimental teaching, and not limited to the teaching scope of the content of the textbook, the frontier hotspots related to the subject are introduced into the experimental teaching; Change the basic, closed and validated experimental teaching mode and explore the open and research-based experimental teaching mode; The discipline competition should be closely combined with the research content, and combine the theory with practice and teamwork, so as to find and solve problems in the experiment, exercise the will, enhance confidence and cultivate the ability of innovation in the experiment.

### IV. CONCLUSION

The innovative teaching method of building materials experiment is to select one or more new ecological, environmental and green additives or admixtures independently after students are familiar with the frontier knowledge of the subject development. On this basis, it is added to the ordinary experimental link, and the research scheme is determined by independent analysis. Guidance and Suggestions are given by teachers, and the students independently complete the relevant research and complete the record of all experimental procedures, analyze the experimental results and form reports. It can not only exercise students' ability of literature review and report writing, enable students to get familiar with the language of the thesis as soon as possible, lay a solid foundation for the writing of graduation thesis, but also exercise students' ability of doing, analyzing, cooperating, innovation and research. College students' innovation and entrepreneurship training programs and various discipline competitions mainly focus on students, which is an organic combination of the establishment and improvement of students' knowledge system, theory and practice. It has obvious promoting effect on the cultivation of students' innovative thinking and research ability, as well as comprehensively cultivating their engineering consciousness,

team spirit, innovation ability, organizational ability and other comprehensive qualities. In this way, the reform based on experimental teaching provides research direction for innovation and entrepreneurship projects and discipline competitions, while innovation and entrepreneurship and discipline competitions provide a platform for the demonstration of achievements in experimental teaching reform.

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