

*Original Research Article*

# Exploration on Innovation and Reform of Experimental Teaching of Materials Science and Engineering in Colleges and Universities

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**Abstract:** Materials science is one of the majors in many undergraduate colleges. With the continuous development of education, experimental teaching, as an important part of college education, plays an important role in the major of materials science and engineering. This article focuses on the experimental courses of materials science and engineering and explores the shortcomings in experimental teaching, and innovates the teaching mode with the goal of cultivating students with both innovation and application in the new era.

**Keywords:** Colleges and Universities; Major in Materials Science and Engineering; Experimental Teaching; Innovative Reform

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## 1. Introduction

As a typical representative of engineering specialty, experimental teaching lays a solid foundation for cultivating talents of new materials specialty. The main goal of experimental teaching is to cultivate all-round applied talents in material design, research and development and testing, and to combine experimental teaching with theoretical teaching, so as to cultivate students' practical ability and ability to explore and solve problems. Because of the outstanding characteristics of experimental teaching, students can directly participate in the experiment process, which strengthens students' interest in learning, exercises their hands-on operation ability and strengthens their mastery of professional knowledge. Experimental teaching has become an important teaching method for materials science and engineering majors. The experimental teaching in materials science and engineering majors makes the theoretical knowledge of materials science verified, which is an important way to

realize educational reform and cultivate students' innovative ideas and comprehensive practical analysis ability. In the traditional teaching process, teachers generally attach importance to the teaching of theoretical knowledge, while ignoring the teaching of practice. Students' passive learning mode results in slow improvement in their operation ability and weak ability to analyze and solve problems, which cannot fully meet the development requirements of cultivating innovative and practical college students. Therefore, in today's era, optimizing the teaching mode and reform the teaching system plays a vital role in personnel training. This article explores the existing problems in the experimental courses of materials science and engineering by taking the core professional courses of materials science as an example.

## 2. Status quo of experimental teaching of material science and engineering

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With the gradual deepening of the educational concept of personnel training at present, the experimental course of materials science and engineering has made great breakthroughs and changes compared with the previous teaching mode. However, in the actual teaching process, there is still a phenomenon that theory is valued but practice is ignored. In the experiments offered under the theoretical course, the relationship between theory and experiment is not close, and there is little correlation between practical teaching and theoretical teaching. In the courses of materials science and engineering, modern analysis and testing technology experiment is one of the important courses, which mainly introduces the general analysis and testing methods of material analysis and characterization. Its main teaching goal is to train practical and applied talents engaged in material analysis and testing, and strengthen students' innovative ability and practical ability. In the experimental teaching, the instruments involved are more precise. Instruments, like X-ray diffractometer, atomic force microscope, scanning electron microscope, transmission electron microscope, scanning probe microscope, have common characteristics, that is, high price and precision. In practice, most teachers perform demonstration operation, while students are only responsible for watching and learning. In the teaching process, students are not in the process of designing experiments, which leads to weak experimental operation ability of students, and bad quality and effect of experimental teaching. Therefore, it is of positive significance to reform and innovate the experimental teaching of materials science and engineering.

## **2. Exploration on the reform of materials science and engineering experimental teaching**

### **2.1 Closely combining experimental and theoretical knowledge to optimize teaching quality**

Material analysis and testing technology in materials science and engineering specialty is to analyze and explore materials with the help of professional materials analysis and testing instruments, characterize the basic properties of materials, analyze the properties of materials, explore the morphology of materials, and solve problems such as material failure. It is the learning goal

of students majoring in materials science and engineering. In the process of material testing, there are many kinds of testing instruments involved because of the difference between the tested materials and performance. How to choose the appropriate testing instruments and match the professional testing knowledge to accurately test the performance of materials is the key to study the course of material analysis and testing. Therefore, in the experimental teaching of material analysis and testing, theoretical knowledge and courses should be closely combined. It is necessary to avoid the phenomenon of emphasizing theory over experiment, but to take theory as the basis of teaching, refer to the guidance of theory, choose the appropriate instruments and professional knowledge to test material properties. This is the key to the study of material analysis and testing course. It must combine theoretical knowledge with practice closely. Only by carrying out teaching activities under the guidance of theoretical course can we better choose testing means to analyze material properties, optimize teaching quality and innovate teaching mode for cultivating innovative and applied talents.

### **2.2 Paying attention to inquiry-based experiments and innovating teaching methods**

In the process of teaching in some colleges and universities, due to the limited hardware conditions and facilities, students can't participate in experiments when colleges and universities carry out the analysis and test experiment course. Teachers' single explanation makes the teaching of this course lack the corresponding interest, students' interest in learning is not high, and the expected teaching effect is not achieved. In the process of teaching, the experimental method with strong operability is adopted to enhance students' sense of participation and optimize students' learning effect. Activate students' innovative ability and corresponding practical ability, adopt the teaching mode of comprehensive practice in classroom teaching, change the traditional teaching mode, and break through the step-by-step teaching mode. The traditional teaching mode will affect students' creative ability and initiative. With the help of comprehensive inquiry experiment teaching mode, students are guided to practice, study problems and find solutions, which can not only solve problems, but also trains students' ability to deal with problems and cultivate students' ability to

retrieve information. Students have a clearer understanding and mastery of material analysis and testing. In actual teaching, with the help of practical teaching mode, students have a deeper understanding of problems and their learning awareness of experiments can be strengthened.

### **2.3 Paying attention to problem solving and cultivating practical talents**

In the specialty of materials science and engineering, material analysis and testing technology is an important way for students to analyze and solve problems with existing knowledge by analyzing materials and characterizing their performance. In order to achieve the teaching goal of experimental courses, cultivate students' innovative ability and application ability, and achieve the purpose of developing talents, teachers should strengthen the combination of theory and practice when designing experiments, and replace demonstration projects with comprehensive inquiry projects, so as to promote the construction and development of students' ability to explore and solve problems. For example, in the experimental teaching of friction and wear properties of materials, based on the failure samples of wear-resistant devices, students should analyze the composition of the failure samples, the surface wear morphology, the wear amount, and the main reasons of failure of wear-resistant devices with the help of diversified analysis and detection methods, making students have a deeper understanding of the testing methods of friction and wear properties of materials and the analysis and detection process of failure samples. The performance test of actual materials instead of the explanation method of instrument performance can promote students' mastery of material analysis and testing technology, and cultivate students' ability to analyze and solve problems, which plays a positive role in cultivating innovative technical talents and applied talents. In such a learning environment, it can help students develop good learning character, train students to do what they say, think carefully and think clearly, and contribute to their study and future development.

### **2.4 Improving teaching quality and extending teaching hours**

Nowadays, in some colleges and universities, theoretical courses are highly valued, which leads to the re-

duction of experimental courses. Because of the reduction of experimental course hours, students' learning quality cannot be effectively improved, and the original efficient experimental course cannot be effectively implemented. In order to cope with the experimental teaching tasks, in the actual teaching process, it evolved into a demonstration experiment, which weakened the students' practical ability and failed to achieve the original teaching objectives. The original teaching purpose could not be well reflected, and the students' knowledge could not be verified by experiments, resulting in the students' lack of enthusiasm for experimental teaching. In order to ensure the effect of experimental teaching of materials science and engineering specialty, it is necessary to extend the hours of experimental teaching, turn the usual teaching demonstration into a comprehensive teaching experiment, guarantee the time of experimental course, ensure students have plenty of experimental time to complete the analysis and testing of materials, and ensure the quality of experimental course of material analysis and testing. To meet the requirements of educational development of the times, it is necessary to cultivate all-round talents, pay attention to students' practical ability and problem-solving ability, optimize students' learning thinking and innovation ability, and realize teaching reform.

### **2.5 Innovating the evaluation method of experimental results**

In actual teaching, performance evaluation plays an important role, and its evaluation has special functions. First, it has the function of diagnosis and feedback, giving feedback to students' knowledge mastery and practical ability. Second, it has the function of evaluation, evaluating students' academic achievements. Third, it has the guiding function, evaluating students' advantages and disadvantages, so that students have a clear understanding of their own situation and promote their autonomous learning and optimize their shortcomings. Fourth, good incentive function. It can better spur and encourage students to complete the experiment. Finally, the function of identification and selection. It can clearly grasp students' professional learning, optimize students' practical ability, and actively introduce teaching evaluation in actual teaching, which is an important factor to ensure the high-quality completion of the course, and can also stim-

ulate students' learning motivation. To ensure the scientific evaluation of experimental results, and truly reflect the students' mastery of basic knowledge and skills, the evaluation of experimental results can be divided into four aspects, namely, the proficiency in the use of analytical instruments under the guidance of theoretical knowledge, followed by students' key practical ability, analytical ability and problem-solving ability, students' ability to consult relevant data, and students' ability to summarize experiments and realize the transfer of experimental knowledge. In the evaluation of experimental results, these four aspects are mainly examined to cultivate and enhance students' experimental literacy and achieve scientific evaluation.

### 3. Conclusion

In the development of education in the new period,

aiming at cultivating talents who adapt to and meet the social development, realizing innovative and applied talents training, the reform of teaching mode of materials science and engineering major plays a positive role. It is necessary to continue to optimize students' basic abilities, thus effectively achieving the goal of training talents for engineering majors and realizing the training of innovative and applied talents in a true sense.

### References

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