

# Exploration on Teaching Reform of Basic Mechanics Course for Engineering Majors in Universities

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**Abstract:** Basic Mechanics is an important professional basic course in engineering majors in colleges and universities. With the continuous development of social science and technology, the application range of Basic Mechanics is becoming wider. In order to give full play to the role of Basic Mechanics courses in engineering majors, this paper starts with the characteristics of Basic Mechanics courses, analyzes the current teaching status and problems of Basic Mechanics courses in engineering majors. This paper puts forward some measures for teaching reform from the aspects of teaching objectives, teaching methods, teaching level and assessment system, in order to improve teaching quality and enhance students' practical ability, so as to cultivate high-quality and highly skilled comprehensive talents for the society.

**Keywords:** Engineering majors; Basic Mechanics; Teaching reform

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## 1. Introduction

It is the main content of Basic Mechanics to study the force, movement, deformation and types of various structures of components in engineering, and it involves a very wide range, including material mechanics, theoretical mechanics, engineering mechanics and so on. This course can further improve students' logical thinking ability and practical operation ability. However, due to the influence of the abstract content of the textbook, backward teaching methods of teachers, incomplete evaluation systems and other factors, students' interest in learning is not high, the classroom effect is not obvious. Students' comprehensive quality cannot be effectively cultivated. Therefore, colleges and universities should carry out targeted teaching reforms according to specific learning conditions and combined with their teaching experience to ensure the quality of Basic Mechanics courses for engineering majors to continuously improve students' comprehensive ability <sup>[1]</sup>.

## **2. The characteristics of the Basic Mechanics course**

### **2.1. The combination of theory and practice**

The teaching of Basic Mechanics is not only taught through the knowledge content in the textbook but also requires social practice skills, including case analysis, problem guidance and experimental operation, etc. Students can improve their practical ability through various teaching means to combine the abstract theoretical knowledge of mechanics with practical ability <sup>[2]</sup>. Through such teaching methods, students can realize the practical application value of textbook theoretical knowledge in the process of solving practical engineering problems. At the same time, it can also stimulate their interest in exploring and solving practical problems, and help them deeply internalize the understanding of mechanics principles.

### **2.2. A wide range of professional applications**

The core principles of Basic Mechanics play a key role in many disciplines and engineering fields, and their application range is very wide. In mechanical engineering, for example, efficient energy conversion and demanding motion control are achieved by applying the principles of mechanics to mechanical components. In nanotechnology and materials science, fundamental mechanics can help design the properties of novel nanomaterials. In civil engineering, it is very important to ensure the safety of bearing loads. Basic Mechanics can be used to analyze the structural stability of buildings, to achieve the purpose of ensuring safety. In addition, Basic Mechanics in biomechanics can also help to study the mechanical properties of organisms, provide a theoretical basis for it and promote the research and development of medical devices <sup>[3]</sup>. Therefore, it can be seen that in many scientific research and practice, the theory of Basic Mechanics is universally applicable and it is an indispensable basic theoretical knowledge in modern engineering technology.

## **3. Present situation and existing problems of Basic Mechanics course teaching**

### **3.1. Vague teaching objective and boring teaching content**

The teaching content of Basic Mechanics is abstract, but some colleges and universities allocate fewer class hours, so teachers often only give a systematic explanation of knowledge, rather than deeply help students solve problems. It can be seen that colleges and universities do not provide teachers with a clear teaching goal, resulting in teachers' classroom teaching without focus and students' learning being difficult. Moreover, under the influence of the traditional teaching mode, most teachers still adopt the teaching mode of reading from textbooks, and the teaching content is only carried out according to textbook knowledge. Although it seems that the whole course can be completed smoothly on the surface, students are not given certain thinking time during the class. This will lead to students in the learning process if the problem cannot be solved in time, and ultimately reduce the efficiency of the class <sup>[4]</sup>.

### **3.2. Single teaching method and low interest in learning**

At present, the teaching mode of Basic Mechanics of engineering majors in colleges and universities is relatively backward. In the form of teaching, teachers play a dominant role and students passively accept knowledge. Homework is assigned by teachers and handed over to teachers for review after students finish it <sup>[5]</sup>. This kind of teaching method is too simple, not only has many shortcomings, but also reduces students' interest in learning, cannot meet the new requirements of the new era in the in-depth development of education, and cannot help students truly master the knowledge, cannot cultivate students' flexible use of knowledge and

hands-on ability.

### **3.3. Less communication between teachers and students, and limited teachers' professional level**

First of all, due to the influence of a single teaching method, the communication between teachers and students in the Basic Mechanics courses of engineering majors in colleges and universities is also insufficient. Teachers are unable to answer some difficult questions raised by students due to the limitation of the professional level, thus limiting the interaction opportunities with students <sup>[6]</sup>.

Secondly, college teachers will face the limitation of teaching resources and teaching time, and some teachers will take on a lot of teaching tasks. As a result, they may not have time to provide personalized guidance for each student, which will further weaken the quality of classroom interaction.

Finally, some professional teachers in colleges and universities have not participated in actual engineering practice, leading to teachers' teaching content being limited to theoretical knowledge, which will cause teachers to fail to complete the teaching objectives, and also cause the teaching form of Basic Mechanics courses to be superficial. Colleges and universities should pay attention to the situation that teachers' professional knowledge cannot be effectively supplemented to ensure the quality of teaching.

### **3.4. No comprehensive evaluation system and the assessment method is divorced from reality**

In the process of efficient teaching, the assessment of curriculum design generally includes classroom tests, homework, mid-term and final exams, etc. These assessment links can help teachers effectively grasp the learning situation of students and play an important auxiliary role in teaching activities. However, in the actual application process, teachers usually only pay attention to the final exam, through which they can judge the specific learning situation of students, and students who get the corresponding score can pass. This examination method is more about checking students' grasp of theoretical knowledge, and it is relatively simple in form, only through a centralized invigilator. The disadvantage of this examination method lies in that students will focus on the surprise review before the exam to pass the examination, and will not pay attention to the usual classroom learning, ignore the original intention of the university to arrange classroom teaching, and cannot truly master the knowledge.

## **4. The teaching reform of engineering mechanics courses in colleges and universities**

### **4.1. Focus on teaching objectives and enrich teaching content**

First of all, in the course design of Basic Mechanics engineering majors in colleges and universities, the teaching objectives should be clearly defined, ranging from the teaching objectives of each unit to the teaching objectives of the whole semester, and the fundamental task of what kind of people will be cultivated should be effectively implemented. Teachers should be clear about the key objectives of each course, do a good job in teaching design, and make class arrangements based on the semester objectives. At the same time, it is necessary to enhance the cultivation of students' practical ability and strive to cultivate comprehensive talents in line with social development <sup>[7]</sup>.

Secondly, teachers should enrich the connotation of abstract basic theories. In the course of Basic Mechanics, the main content taught is basic knowledge. Teachers can apply practical application cases to

the class, guide students to explore relevant basic theoretical knowledge by themselves and make abstract knowledge more concrete, which can improve students' understanding ability and enhance their learning enthusiasm.

Finally, when constructing the teaching content, it is necessary to break the limitations of traditional textbook knowledge, pay attention to the practical application of theoretical knowledge, highlight the ideas and solutions of Basic Mechanics research problems, combine practical engineering problems with relevant problems in life, guide students to focus on the course on phenomenon analysis and law discussion, to stimulate students' enthusiasm for learning.

## **4.2. Reform the teaching method, improve the interest in learning**

### **(1) Use multimedia technology flexibly**

At present, multimedia technology has been widely used in the course of teaching in colleges and universities. The popularity of electronic courseware has set aside a lot of teaching time for teachers so that teachers can carry out more classroom activities, such as group cooperation, problem exploration, etc., which helps to change the traditional teaching mode, change the subject of class from teachers to students, realize heuristic teaching and ensure the teaching quality of class<sup>[8]</sup>. In addition, teachers of Basic Mechanics courses for engineering majors in colleges and universities should pay attention to the correlation between the front and back pages when using electronic courseware, to facilitate students' understanding. When explaining key knowledge points, teachers can also use blackboard writing to assist in teaching. At the same time, to obtain good teaching results, teachers should constantly practice their teaching skills and improve their grasp of class rhythm. To ensure the participation of students in the class<sup>[9]</sup>. Finally, the design of electronic courseware can scientifically and reasonably cite some animation displays, which can not only enrich the teaching content but also improve the teaching effect. For content related to specialized fields, multimedia technology can also be used to add some related background stories to improve students' interest in learning.

### **(2) Use computer technology to increase experimental teaching**

In the actual engineering system, in the modern engineering design, computer-aided analysis has become one of the most commonly used means of work, and in the past Basic Mechanics courses of computer-aided analysis of the course content is relatively small, teachers in the teaching process is generally a little, this teaching mode is no longer suitable for the current education environment<sup>[10]</sup>. In practical engineering work, part of the large-scale engineering application software developed based on the basic principles of mechanics has also been popular<sup>[11]</sup>. Therefore, to improve students' practical ability and professional accomplishment, the Basic Mechanics courses of engineering majors in colleges and universities should also add relevant computer-aided analysis content. After the completion of theoretical courses, students should be arranged to practice on the computer, and computer technology should be used to guide students to carry out relevant curriculum experiment activities, and the application of relevant professional software should be added to this process. Besides, computer technology can also deepen their understanding of key knowledge through hands-on operation. On the one hand, students can first understand the calculation method of large-scale engineering software and realize the importance of mastering theoretical knowledge. On the other hand, it can also lay the foundation for students' future engineering services.

### **4.3. Improve the teaching level based on the quality of teachers**

A contingent of teachers with high quality, high level and high teaching ability is the prerequisite for carrying out the task of teaching reform<sup>[12]</sup>. Therefore, colleges and universities should pay attention to improving the overall teaching level of teachers, invite outstanding teachers and experts from outside the school, organize school seminars, discuss the teaching reform direction of Basic Mechanics for engineering majors, and carry out teaching experience sharing activities, constantly absorb excellent teaching methods from outside and improve the teaching level of teachers in the school<sup>[13]</sup>. In addition, teachers should also pay attention to professional development in time, pay regular attention to teaching forums, take improving their professional level as the main goal, and constantly develop their abilities. They can also participate in relevant practical engineering work, experience teaching methods in practice, and constantly improve their teaching level.

### **4.4. Improve the assessment system to ensure the quality of teaching**

At present, the assessment of Basic Mechanics of engineering majors mainly depends on the final examination to determine the final score, which is already regressed for the present teaching mode. After the completion of the teaching process, teachers should pay attention to the combination of assessment methods such as homework, mid-term and final exams, experiment reports, papers, etc. and can increase the assessment of practical activities, such as independent design of experiments, analysis of engineering examples and other assessment methods, scientific and reasonable allocation of assessment forms, the assessment results integrated as the final score of students<sup>[14]</sup>. For example, in the assessment of papers, teachers can give a variety of different topics, such as in-depth discussion of a knowledge point, chapter summary, etc. The scope of topics can be extended to life, including the cracks of asphalt pavement, traffic lights and other common arguments in daily life that do not cause students to think seriously, to seize students' curiosity and stimulate their exploration of psychology. At the same time, teachers can also include students' daily performance in the final assessment, and standardize students' learning attitude through different forms of assessment, to ensure the final teaching quality<sup>[15]</sup>.

## **5. Conclusion**

In a word, the Basic Mechanics course is the foundation for the development of engineering majors, and it is also an important part of engineering majors. The theoretical knowledge of Basic Mechanics can also be of great help to students in their future studies and work. Therefore, colleges and universities should make clear the main direction of the current course development, carry out teaching reform according to the problems in teaching, constantly improve their teaching level and teaching quality, and escort students' professional learning.

## **Disclosure statement**

The authors declare no conflict of interest.

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