

Teaching Status and Improvement of Basic Mechanics Course in University

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Abstract: *The basic mechanics course in higher education is a basic course that must be taken by engineering students such as water conservancy and hydropower engineering majors. The mechanics courses of engineering majors in colleges and universities generally have problems such as few class hours and single assessment method, students have shallow knowledge, insufficient awareness of the importance of mechanics knowledge and low interest, which leads to poor practical application ability. This paper takes the three basic mechanics courses of engineering majors as examples, and makes a preliminary discussion on the future reform of mechanics courses from the aspects of teaching problems, students' characteristics and teaching reform methods, in order to provide reference for the teaching reform of similar courses in the new historical period.*

Keywords: *water conservancy and hydropower; basic mechanics; teaching reform*

1. Introduction

Mechanics of materials, together with theoretical mechanics and structural mechanics, are called the three basic mechanics, which is a mandatory basic course for engineering students in water resources, civil engineering and mechanics. What is the foundation is what must be mastered. The main content of theoretical mechanics is three blocks, the first block is statics, then the second block is dynamics, and finally kinematics. Mechanics of materials is mainly about bar materials. Structural mechanics mainly deals with the force and deformation problems of some specific practical structures, such as frames, rows, arches, trusses, etc.^[1]

Students need to master the knowledge of basic mechanics in their freshman and sophomore years to establish the concept and system of "mechanics" in engineering, so as to lay the foundation for their future work or research in related fields. Therefore, the study of basic mechanics is very important for engineering students in colleges and universities. However, from the current teaching effect of basic mechanics for engineering students, the result is not optimistic. It is mainly manifested as the following three points: first, the lack of knowledge of mechanics, many basic concepts are blurred, even some students are not even clear about the most basic concept of elastic modulus after getting into graduate school; second, the mechanics system of engineering as a whole is not established, and the relationship between stress, strain, displacement, load, constraint, etc. is not clear; third, the combination of mechanics knowledge and engineering practice is less, for example, in the mechanics of For example, "hinge support" is taught in mechanics, but almost no students know how to realize the actual engineering, and even if they see the actual engineering "hinge support", they do not recognize it. This situation reflects that the students' knowledge of mechanics is not solid, and they are "struggling" in the subsequent study, work or research tasks, and the results are not obvious. As engineering is inseparable from mechanics, the teaching level of basic mechanics courses and the learning effect of students are crucial, and it is important to promote its teaching reform.

2. Problems in the teaching process

2.1 Problem 1: Insufficient class time

According to the training program, theoretical mechanics, mechanics of materials, and structural mechanics (for example, theoretical mechanics) are currently taught at North China University of Water Resources and Hydropower, with 48, 64, and 80 credit hours. This amount of lecture hours is not enough in relation to the needs of water and hydropower engineering and the content of the course. The

three basic mechanics have many contents that must be mastered by undergraduate students in water and hydropower engineering, but due to the lack of class time, teachers can only choose the most important knowledge points to teach. Some students said that in the course of theoretical mechanics lectures, the three major aspects of statics, dynamics and kinematics are still difficult for students who first encounter mechanics, but due to the tight class time, teachers do not have time to explain the post-class homework problems. As for mechanics of materials, students only studied the first six chapters because there were only 48 hours. For students, the content of the first six chapters is small and the knowledge students can learn is limited, making the final exam assessment dilute the difference in students' learning ability and level. In conclusion, due to the lack of class time, on the one hand, teachers have to discard many important knowledge points when teaching, and some knowledge points, even if they are explained, are shallow and cannot be deepened; on the other hand, during the lecture, teachers may need to deliberately speed up the lecture, which will cause students to receive knowledge faster than the teacher's teaching speed, and gradually they may lose their interest in learning^[2].

2.2 Problem 2: Defective assessment methods

In most engineering colleges and universities, the assessment of basic mechanics courses is generally based on the traditional final examination. The content of the final exam is usually some test questions, such as multiple choice, judgment questions, calculation questions and other fixed forms. This way of assessment is effective to a certain extent. However, most students have actually mastered the method of passing this kind of assessment at present, for example, some students choose to go for some test questions from previous years as a way to master the routine of problem solving. This leads to some students not even having to understand the meaning of the formulas in the test questions when they take the test, just by memorizing the formulas and remembering which formulas are used for which test questions to get the correct answers. Research has found that these methods are easier to pass the exam and get high marks, and also save revision time. Although this method can effectively cope with the assessment, but these students actually did not really master the knowledge, not to mention the integration of the knowledge learned, after the application of the actual project. For students who are able to do serious derivation of formulas and understanding of principles, although they will also achieve high scores, but their time and effort are much more than those students mentioned earlier, but the difference in test scores is not large. It can be seen that the reform of the assessment method is necessary for the water conservancy and hydropower engineering students who need to master the mechanics knowledge deeply.

3. Teaching reform proposals

3.1 Increase class hours and optimize the overall setting of basic mechanics education

According to the characteristics of the course studied, we can add a lesson on "Let students express their knowledge and mastery of the course", so that we can grasp students' knowledge of the course and let teachers better teach them; we can know students' mastery of the course, so that we can teach them according to their abilities, treat different students in different ways, and solve different problems of students (such as differences in existing foundation, understanding ability and learning methods). We can also help teachers to better understand students' knowledge of the course, to know their mastery of the course, to teach them in different ways according to their abilities, and to solve the problems of different students' differences (such as differences in their existing foundation, understanding ability and learning methods).

This will allow the instructor to develop a program that is tailored to each student's unique characteristics. This will make the course more accessible to students and increase their attention span during class.

3.2 Mixed online and offline classes

3.2.1 Implementation significance

In recent years, more and more open online course platforms have come to our attention. In China, many teachers have set up courses on these open online course platforms, and some of these high-quality online courses have been recognized and praised by students, and some of them have even been recognized as national "golden courses". There is no doubt that these high-quality online courses

are the result of the hard work of experienced core teachers, who use flexible teaching methods to present rich course content and reflect the wonderful art of teaching. At present, most colleges and universities have the problem of low credit hours and tight curriculum, so the hybrid online and offline courses can make full use of time and enable students to learn better.

3.2.2 Implementation Method

To make online and offline hybrid teaching effective, instructors need to deploy from 4 stages: pre-class pre-reading, classroom teaching, post-class review, and practical application, which is in line with the nature of basic mechanics courses^[3]. ① For classroom pre-study, students must have their own pre-study tasks before the lecture. These pre-study tasks include letting students watch some quality teaching videos online, pre-study the content of the textbook corresponding to the next class, and let students go alone to complete some practice problems of appropriate difficulty after completing the pre-study tasks. In addition, teachers can give students a video of the next lesson before class to get them interested in the lesson and to help them focus in the next lesson. If you have already studied the class content and have a general understanding of the content, it will be easier for you to grasp the content after the teacher's lecture. The teacher should allocate more time to the core content and focus on it. At the same time, the teacher should make sure that the content is consistent with the previous chapters and that the classroom lectures are logically connected to the pre-reading, and the classroom prepares for the class. At the same time, when designing the questions in class, teachers need to focus on students, choose the appropriate question types and contents from the students' perspective, and combine the lecture contents. ③ For post-class review, teachers should suggest the key problematic content that students need to review after class and assign relevant post-class test questions. ④ Practical application is the most important point. All purpose is practice. Teachers can ask students to do some practical applications in class or after class. For example, teachers can give students a practical engineering mechanics case and ask them to upload it on the Internet after class, so that students can communicate and discuss. It is also very important for teachers to select online classes for online teaching. With the rapid development of Internet technology today, there are many online classes available, and the quality of online classes varies. To prevent students from being influenced and misled by those poor quality online classes. For example, for the students of North China University of Water Conservancy and Hydropower, it is more suitable for them to learn theoretical mechanics, mechanics of materials and structural mechanics by using our mechanics courses on China University MOOC, which may be more suitable for the needs of our students. Of course, the content of other schools' online courses can also be borrowed, such as Hehai University and other universities, so that students can learn diversity, understand the similarities and differences of different universities' lectures, and integrate them.

In addition, it is important to make sure that the content of the online and offline classes is the same. For students, when they receive the learning content for the first time, they tend to be more impressed, and if the content of the first learning is contrary to the subsequent ones, then it will have a negative impact on students. At the same time, students will compare, digest, and integrate with their previous knowledge system when learning online. Nowadays, the network is developed, online courses are diversified, and the content of textbooks in different universities is generally different. During the teacher's offline lecture, for the same content, the teacher may recommend students to study some more excellent online courses, but different students will choose different courses among them, and there are differences between courses and courses. So this time it is necessary for the lecturer to compare these different online resources from the basic definition, the way of presenting the teaching content, and the conclusion of the offline textbook before recommending them to the students, so that the students will not learn those courses that are contrary to the content of the textbook and then have a sense of disorder about the knowledge they have learned, and at the same time avoid adding some unnecessary troubles to the students. For example, for water and hydropower engineering students, offline course instructors may consider the relationship between stress and strain in material mechanics more important than kinematics in theoretical mechanics, while some majors focus more on the latter, so it is important to ensure the consistency of online and offline lecture standards.

3.3 Teaching methods and assessment methods need to keep up with the times

In the case of mechanics of materials, the traditional course on mechanics of materials focuses on one-dimensional rods, studying stress-strain, which are the most basic intrinsic structure relations. Since then, we have started to talk about combined deformers first, introducing the concept of stress state to introduce the problem of strength and stiffness in combined deformation mode. At the end of

the course, the students are taught the problem of compression bar stability. These traditional lectures on the mechanics of materials were basically formed around 1975, however, to this day, we still use them as the main content of the mechanics of materials. The above-mentioned traditional teaching contents focus on making students master theorems, theories and research methods in mechanics of materials, which can only develop students' ability of deduction, but the effect of practical application is not obvious^[4]. Such an old way of teaching does not actually develop students' innovative thinking, but even solidifies students' thinking, which is contrary to the current situation of rapid development in China. Therefore, it is urgent to adapt the content of teaching materials to the current form of development. For the basic mechanics course carried out in science and technology colleges and universities, as a teacher, first of all, we should clarify what to talk about, to what depth, in what way, how to build the knowledge system and other issues. According to the traditional teaching method, teachers can build a more complete knowledge framework with rigor and systematization, however, if three basic mechanics class time is tight (for example, 48 hours of teaching), it is difficult for those students with poor foundation and weak understanding ability to generate sustained interest in learning. Therefore, in order to ensure that the lectures are effective, we must first change the teacher orientation to student orientation, theory orientation to reality orientation, and subject orientation to competence orientation. This will enable students with different backgrounds to maintain their motivation and good learning behavior in the same classroom. For the assessment method, we should change the way we used to do, not to be limited to the assessment of test questions only, which will only make more and more engineering students give up the formula derivation, principle understanding, etc., and start to apply the formula all the time, instead of fully understanding the substance of the three basic mechanics. Undoubtedly, this is not conducive to students' ability to expand and apply what they have learned, and the practicality is not good. Therefore, in order to ensure the teaching effect of three basic mechanics (theoretical mechanics, mechanics of materials, structural mechanics), in addition to the traditional assessment methods, we should add more open-ended test questions, such as formula derivation, practical scenario application test questions, and also conduct multiple assessments to test students' mastery comprehensively. The assessment of experimental courses can also be adjusted, for example, the experimental items can be more abundant, and it is better to combine with the actual scenario design.

4. Conclusion

Under the constraints of short class time nowadays, how to achieve a more thorough understanding of the basic concepts in the limited class time, and how to apply them in real life on the basis of understanding and mastery, has become the theme of teaching and teaching reform of these basic courses at present^[5]. This paper addresses the problems of the current teaching mode, i.e., the lack of class time and the lack of assessment methods, and gives teaching reform suggestions suitable for the current characteristics of students, i.e., on the one hand, to increase the number of interactive communication courses with students to a certain extent, through which the teacher's teaching methods can be adjusted to improve teaching efficiency; on the other hand, to adopt a mixed online and offline teaching mode and optimize the assessment methods to make up for the lack of class time and assessment in this course. The course is not sufficient now. Through the communication with the students of water conservancy and hydropower, most of them agree with the ideas given in this paper and approve the suggestions of this paper, and think that this method can alleviate the problems in the teaching process of the three basic mechanics to a certain extent.

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