

Challenges in and Suggestions for the Teaching of Basics of Mechanical Engineering in Vocational Colleges

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Abstract: Basics of Mechanical Engineering is a very important professional course. Its teaching quality directly affects the learning of subsequent courses, such as Mechanical Design Manufacturing and Automation. At present, the teaching quality of Basics of Mechanical Engineering in vocational colleges has been poor for a long time. In order to improve the teaching quality and students' learning enthusiasm, this paper puts forward targeted suggestions based on the analysis of the problems in teaching. The views of scholars were first analyzed, we then analyzed the challenges faced by classroom teaching. Lastly, six targeted suggestions are given. The suggestions put forward in this study can act as teaching innovations in vocational colleges.

Keywords: Basics of Mechanical Engineering; Challenges in teaching; Vocational colleges

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1. Introduction

Vocational education is an important part of China's education system. Since the reform and opening up, vocational education has provided many talents, which drove the development of economy. In the context of industrial transformation and upgrading, the demand for professional and skilled talents in various industries is increasing, and the role vocational education has become increasingly important ^[1]. In order to cultivate high-quality talents, vocational colleges have been carrying out teaching innovation in recent decades.

Basics of Mechanical Engineering is an important course for mechanical engineering majors in vocational colleges. Its teaching quality directly affects the teaching of follow-up courses, such as Mechanical Design, Mechanical Manufacturing, and Hydraulic and Transmission. Due to its strong theoretical nature, scattered content, and abstract concepts, the quality of classroom teaching of Mechanical Foundation courses has been poor for a long time. The traditional and monotonous teaching method leads to low learning enthusiasm and learning effect, which makes it difficult for students to adapt to the requirements of their future jobs ^[2,3]. This paper studies the challenges faced by vocational colleges and puts forward targeted suggestions to improve the teaching quality of the Basics of Mechanical Engineering course.

2. Research status

Scholars have studied the teaching of Basics of Mechanical Engineering from different aspects. Liu ^[4]

studied how to realize mixed-mode teaching from the aspects of structured micro-lesson production, online platform construction, and offline environment support. The results show that this new teaching mode both the advantages of traditional and online teaching. In addition, it can stimulate the students' learning interest and initiative. Zhu ^[5] studied the teaching mode of Basics of Mechanical Engineering with the purpose of improving the students' interest towards the course. He found that the integration of practical lessons into theoretical teaching can improve the interest towards of the course and thus motivate the students. Zhang ^[6] analyzed the impact of the COVID-19 pandemic on classroom teaching. He argued that the hybrid (online and offline) teaching mode has a catalytic effect on the effectiveness of classroom teaching. Liu ^[7] analyzed the problems in the teaching process and put forward some targeted teaching reform strategies. Wu ^[8] analyzed the impact of innovative education on the teaching of Basics of Mechanical Engineering. He believed that integrating the concept of innovative education and creating a diversified curriculum system and experimental methods can effectively improve the problem of traditional teaching system. Fan ^[9] studied the application of flipped classroom in the reform of the Basics of Mechanical Engineering course. He believed that the teaching mode can give full play to students' subjective initiative and improve their learning interest. Yan ^[10] studied the role of 3D printing technology in promoting the teaching of Basics of Mechanical Engineering. He suggested that using the 3D printing models helps students understand abstract concepts and enhances their interest in learning. Shi ^[11] analyzed the problems in the teaching Basics of Mechanical Engineering from the characteristics of students' learning in middle-level colleges and universities. He believed that the teaching should be integrated with various modes such as software simulation, task leading, and task evaluation in order to effectively improve the quality of the course. Lv ^[12] studied the teaching reform of Basics of Mechanical Engineering based on the educational concept of OBE (Outcome Based Education) in terms of course objectives, design, and evaluation system.

3. Challenges faced

3.1. Students' lack of interest

Basics of Mechanical Engineering is usually taught in the first year of university. When studying this course, students have no experience in industrial field visits and practice, and they know very little about mechanical engineering equipment and their working principles. Therefore, the knowledge learned will be abstract to them, making them lose interest in the course. However, teachers usually ignore their students' learning ability in order to complete the syllabus in time.

3.2. Monotonous teaching mode

There are two teaching modes in this course. One is "board teaching," where teachers write and explain the course contents on the blackboard; the other is PowerPoint presentation. Many teachers only choose one of them, but do not combine the two reasonably. PowerPoint slides can show the structure of complex parts well, but not the steps, such as the details of 3D drawing. Most teachers do not combine these two teaching modes, which affects the quality of teaching. In addition, new technology should be applied to the reform of teaching mode to improve the quality of teaching and motivate the students.

3.3. Students' thinking ability is weak

There are many contents in Basics of Mechanical Engineering that challenge the students' abilities. For example, drawing geometry, which is an important part of this course, requires students to have a good sense of space and three dimensions. However, students in vocational schools have weak spatial thinking skills, which makes it difficult for them to understand the structure of parts based on three-dimensional drawings and to draw three-dimensional drawings of the parts. However, very often, classroom teachers do not leave enough time for students to think in order to complete the syllabus. It leads to many students with

poor spatial thinking ability not being able to follow the teacher's ideas, resulting in poor learning effect.

4. Suggestions

4.1. Optimizing teaching contents

Vocational colleges and universities are the main source of skilled talents. With the continuous advancement of technology, the requirements of enterprises towards the employees are changing. The course content should be optimized according to the requirements of the enterprises. Therefore, it is very necessary to modify the teaching materials accordingly. In addition, the connectivity of the teaching contents should also be taken into account. In teaching, teachers should help students establish a systematic framework so that students can better understand the principles, structure, and performance of equipment, and also lay a good foundation for the upcoming courses.

4.2. Improving teaching methods

Since the content of Basics of Mechanical Engineering is considered dull and complicated by many, it is then crucial to improve the teaching method of this course. Teachers should focus on the introduction of the course and take initiative in the class. For example, teachers can prepare some 3D printed parts when explaining 3D drawings. In this way, the students can observe the parts from different angles to get an intuitive understanding of concepts like the front view and the top view. With the help of these physical models, teachers should also encourage students to speak and discuss more. Setting up controversial topics around the content is a good way to increase the students' interest in the course. In short, teachers can use various teaching methods to improve students' attention and participation in order to improve the quality of teaching.

4.3. Focusing on innovative thinking

In the teaching of Basics of Mechanical Engineering, teachers should encourage students to speak and exercise their creative thinking. For example, teachers can introduce a specific mechanical failure in the classroom and make students think about the causes and propose solutions, which will help improve their thinking skills. Cultivating students' creativity and ability is very important for their future job and career development. With the continuous development of technology, the mechanical industry is also innovating and developing. Teachers should introduce new technologies and concepts in the mechanical industry to help students understand the latest mechanical technology and future development trends in order to improve their employment competitiveness.

4.4. Focusing on developing practical skills

Most of the students who study mechanical engineering will end up working in the production line, thus the development of their practical skills should be prioritized. In addition to theoretical teaching, experiments and case studies should be given more attention, so that students can understand mechanical knowledge from multiple perspectives and also increase their interest and motivation in learning. Besides, it is necessary to give students hands-on experience. For example, students should be allowed to operate, repair, or maintain some equipment. In this way, they will better understand the mechanical principles and workings and be prepared for their future jobs and careers.

4.5. Emphasizing on teamwork skills

Nowadays, industrial production lines are highly centralized. Most mechanical failures are not the result of a single fault. This means that the collaboration between professionals from multiple fields will be required to solve the issue. Therefore, teachers need to focus on developing students' teamwork skills. In the

classroom, teachers can develop students' teamwork skills through group projects and other means. Besides, teachers should also encourage discussion among group members, which can not only help them improve their writing ability, but also help them exercise their expression ability.

4.6. Focusing on on-site learning

Mechanical courses are closely integrated with the industry, which means that it is necessary to strengthen the learning in industrial sites. Schools should provide opportunities for students to visit enterprises, internships, and many more, so that students can go to the actual production site to learn about the operation and working principles of the equipment. On-site learning in enterprises can not only enable students to have a deeper understanding of the knowledge they have learned, but also improve their learning interest and enthusiasm.

5. Conclusion

Basics of Mechanical Engineering is an important basic course in higher education institutions and its teaching quality must be emphasized. Higher education institutions should consider the learning characteristics of students and emphasize on the applicability of the course. This paper points out the challenges faced in the teaching of the basics of mechanical engineering in vocational colleges and puts forward six targeted suggestions, such as focusing on the cultivation of practical skills and strengthening teamwork ability. The findings of this paper act as a reference for the innovation of teaching mode in higher vocational institutions.

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Author contributions

S.W. and F.P. conceived the idea of the study and wrote the first draft of the article. B.C. revised the format of the paper.

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