

Research on the Classroom Teaching of Engineering Mechanics in Vocational Colleges

Meiqin Liang^{1*}, Junliang Jia¹, Jinru Ma²

¹College of Automation Engineering, Beijing Polytechnic, Beijing 100176, China

²School of Automotive Engineering, Beijing Polytechnic, Beijing 100176, China

*Corresponding author: Meiqin Liang, liangmeiqin@bpi.edu.cn

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Abstract: The Engineering Mechanics course has great significance in vocational education as it affects the quality of subsequent specialized courses, such as mechanical design, control technology, and automation. However, the teaching quality of Engineering Mechanics in vocational colleges has been subpar due to the extensive knowledge points, abstract concepts, complex formulas, and other factors. This paper aims to elucidate the early-stage research conducted by scholars and analyze the primary issues in the teaching of Engineering Mechanics. Furthermore, we provide five concrete suggestions to improve the teaching quality of this course. The findings of this study may serve as a reference for innovating the teaching model of Engineering Mechanics in vocational colleges.

Keywords: Teaching; Engineering mechanics; Vocational colleges; Vocational education

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1. Introduction

Engineering Mechanics is a compulsory basic course for mechanical, electrical, and rail transportation majors. Its knowledge system is relatively comprehensive, involving many branches such as statics, dynamics, and mechanics of materials ^[1]. This course contains a wide range of content and many abstract concepts and complex formulas. Students in vocational colleges generally find Engineering Mechanics difficult to learn. On one hand, it is because the solution of practice problems requires many calculations, which is their weakness ^[2]. On the other hand, students lack practical experience and do not understand the dynamics of mechanical equipment, which makes them unaware of the importance of Engineering Mechanics, so quality of Engineering Mechanics teaching in vocational colleges remains poor ^[3,4]. In this paper, we studied the innovation of Engineering Mechanics teaching with the aim of improving its teaching quality. We provided some targeted suggestions based on an in-depth analysis of the problems in teaching. The findings of this paper can provide reference for the classroom teaching reform of front-line teachers.

2. Research status

Many scholars have conducted early-stage research on the teaching of Engineering Mechanics. Yue ^[5] integrated professional knowledge into classroom teaching and observed that this approach sparked curiosity among students. Jiao ^[6] incorporated cutting-edge testing techniques into classroom teaching and discovered that this enhanced students' comprehensive skills and innovation abilities. Zhao ^[7] conducted a teaching experiment in which Engineering Mechanics was oriented towards professional certification. The results showed that this model clarified the learning objectives and improved classroom teaching efficiency.

Chen ^[8] proposed a hybrid teaching mode that is combining online and offline teaching, in which he believed provided more convenience for students and met their diverse needs. Zhu ^[9] analyzed the problems in classroom teaching and recommended an engineering capability-oriented teaching method that achieved positive results in practice. Su ^[10] discussed the need for teaching reform in Engineering Mechanics from a talent training perspective and proposed effective measures to cultivate students' problem-solving abilities.

3. Challenges faced

Engineering Mechanics is a professional technical foundation course that focuses on both theory and practice. The traditional teaching mode has certain drawbacks that does not allow students to fully master this course. Therefore, teachers must pay attention to these drawbacks and actively carry out teaching innovation, strive to improve teaching quality, and lay a good foundation for their students' future learning.

3.1. Disconnection between theory and practice

The traditional method of teaching Engineering Mechanics focuses on theoretical knowledge, but ignores the cultivation of practical ability. It is difficult for students to combine theoretical knowledge with practical engineering applications, which leads to weak practical ability of students. The teaching of Engineering Mechanics courses in some vocational colleges lacks opportunities for students to improve their practical skills, and students just listen to lectures and watch videos in the classroom. This means that students' theoretical knowledge is disconnected from practical operations, which in turn lead to their weak practical and hands-on ability, and it will be a hidden danger when students look for jobs in the future.

3.2. Outdated teaching materials

The teaching materials used in some vocational colleges are outdated. The content of these teaching materials is mostly theoretical, and the content lacks variety and is disconnected from practical engineering applications. Many graduates stated that, "after I started working and saw the mechanical components on the production line, I realized that this is what we learned in our books." This shows that too much emphasis is placed on theoretical knowledge and the content is not well-connected to what is practiced in the industry. With the development of science and technology, the field of Engineering Mechanics is also progressing and developing, so it is necessary to update the teaching materials to reflect the latest research and technological development in order to strengthen the training of students' comprehensive quality.

3.3. Single teaching method

The traditional teaching method of Engineering Mechanics course is mainly theoretical, focusing on explaining the formula and derivation process. This teaching mode easily leads to students' lack of practical ability and difficulty in mastering the practical application of Engineering Mechanics knowledge. Modern teaching methods focus more on practical skills and experiments and encourage student participation. To improve the teaching quality, teachers should teach theoretical knowledge and allow their students to operate different equipment at the same time and combine the two organically.

3.4. Insufficient cultivation of innovation ability

Some vocational institutions only focus on the theoretical knowledge in the teaching of Engineering Mechanics but neglect the cultivation of students' innovation ability and comprehensive quality. As a result, students will only focus on using formulas to perform different calculations, but lack understanding of the actual production process, which in turn is not conducive to the students' ability to innovate in practical operations. The cultivation of innovative ability is not important enterprise jobs, but also an important ability that vocational college students should master.

3.5. Poor course evaluation mechanism

The evaluation mechanism of Engineering Mechanics course is relatively simple, which is mostly based on examination results. This assessment mode lacks a comprehensive evaluation of students' comprehensive ability, and it is difficult to effectively evaluate students' learning effect and practical ability. Since the usual classroom performance has nothing to do with the final grade, students will not pay attention to classroom lectures and ignore the learning process. In order to cope with exams, some students study in a blitz a few days before the exam. In this case, even if they manage to get good grades, the knowledge will be easily forgotten and their foundation will be weak, which will affect their future development.

4. Targeted suggestions

In view of the problems faced in teaching Engineering Mechanics, we have put forward several suggestions to improve the effectiveness of classroom teaching.

4.1. Strengthening the basic knowledge

Engineering Mechanics is a basic course in engineering disciplines, which requires students to have solid knowledge of mathematics and physics. Therefore, teachers need to emphasize the importance of basic knowledge in their lessons to help students establish a solid theoretical foundation. Many of the concepts in Engineering Mechanics are abstract, and students face difficulties in understanding and integrating the theoretical knowledge in the textbook. Therefore, teachers should make models with real objects and explain the concepts through concrete examples. Besides, teachers can help students understand the practical application of Engineering Mechanics through case studies. These cases can be actual engineering problems or derived from major engineering projects to help students better understand the principles of Engineering Mechanics and motivate them to learn.

4.2. Emphasizing practical applications

Practicality has been increasingly emphasized in Engineering Mechanics, which is the connection between theoretical knowledge and practical application. In teaching, teachers can prompt students to think and explore through case studies, experiments and simulations to help students understand the connection between theoretical knowledge and practical engineering applications and enhance their application ability and innovation abilities. When teachers teach Engineering Mechanics, the focus should be on practical applications. Teachers can provide many examples of practical problems for students to learn how to apply the principles to actual engineering problems and perform simulation experiments to make students understand the principles and laws more thoroughly and improve the effect of classroom teaching.

4.3. Strengthening the calculation ability

Engineering Mechanics is a course that requires a lot of calculations, and students often cannot obtain the correct results due to careless mistakes, so teachers need to strengthen students' calculation ability. Teachers can guide students to master the calculation methods and techniques, while focusing on the rationality and accuracy of the calculation results. When explaining the Engineering Mechanics course, students should be provided with some targeted exercises to help them master various calculation skills and methods of analyzing problems.

4.4. Diversified teaching methods

The methods of teaching Engineering Mechanics should be diversified, including lectures, discussions, case studies, experiments, and other ways. Through different teaching methods, teachers can meet the learning needs of different students and improve the teaching effect. Engineering Mechanics is a difficult course.

Therefore, teachers need to pay attention to students' learning progress and identify and solve the problems they face in time. Teachers should always consider their students' feelings, set up targeted questions for important and difficult points in the textbook, answer their students' questions, and encourage them to think and draw conclusions, thus mobilizing their learning enthusiasm. Teachers should also teach some new technologies related to mechanics, such as computer modeling and digital analysis, to help students understand the principles of Engineering Mechanics more deeply. With the continuous development of digital technology, the teaching of Engineering Mechanics courses in vocational colleges and universities has also been gradually digitalized. Teachers can use multimedia courseware, network resources, and videos to teach and improve the effect of classroom teaching.

4.5. Focusing on the cultivation of innovation ability

Modern Engineering Mechanics course teaching has begun to emphasize more on the cultivation of students' practical ability and innovation ability. The talent cultivation methods of Engineering Mechanics course should be diversified. For example, teachers can let students master the related knowledge and skills by carrying out innovative projects and participating in competitions. Moreover, teachers should also cultivate students' innovation consciousness and entrepreneurial ability through project-based teaching and practical courses to lay a solid foundation for their future career development. With the development of economy, the teaching of Engineering Mechanics in vocational colleges and universities has been increasingly emphasizing on the cooperation with enterprises. Higher vocational colleges and universities should establish an industry-university-research collaborative platform to cultivate students' practical and application skills through projects and training bases to improve their employment competitiveness and innovation skills.

5. Results

In this article, we analyzed the problems existing in the teaching of Engineering Mechanics in vocational colleges based on previous studies. Furthermore, we have put forward some targeted suggestions, such as focusing on the cultivation of innovative ability, diversifying teaching methods, enhancing computing ability, emphasizing practical applications, and strengthening basic knowledge. It is crucial for vocational colleges to continue to explore and adopt innovative teaching methods that align with the needs and characteristics of their students to improve the quality of Engineering Mechanics teaching. With these innovative methods, students can better understand the complex concepts of Engineering Mechanics, enhance their problem-solving skills, and ultimately become more competitive in the job market. The findings of this paper can serve as a valuable reference for vocational colleges seeking to enhance their Engineering Mechanics teaching quality through innovative approaches.

6. Conclusion

The trends of teaching reform of Engineering Mechanics courses in vocational colleges and universities are diversification, practicability and innovation. These trends will help improve students' learning effectiveness and practical ability, and better meet the needs and development requirements of society. The problems in the teaching of Engineering Mechanics courses in vocational colleges are multifaceted. Therefore, teachers should make efforts to improve and innovate teaching methods, especially on the combination of theory and practice. Engineering Mechanics is a very practical subject, and its content is closely related to engineering. Hence, students' practical and innovative abilities should be emphasized to better adapt to the needs of enterprise positions and personal career development.

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Author contributions

M.L conceived the idea of the study and wrote the first draft. J.M revised the format of the article.

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