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Teaching Reform and Practice of Mechanical Principles in Application-Oriented Universities under the Background of "New Engineering"

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Abstract: In the context of new engineering disciplines, the reform and practice of teaching Mechanical Principles courses in application-oriented universities are especially important. With the continuous update of technology and the rapid development of industry, traditional courses on mechanical principles can no longer meet the needs of modern engineering education. Therefore, application-oriented universities should start practicing the reform of Mechanical Principles courses to better cultivate students' practical abilities and innovative thinking. In this regard, this article first elaborates on the significance of the teaching reformation of the Mechanical Principles course in application-oriented universities under the background of "New Engineering", then analyzes the shortcomings in the teaching of the Mechanical Principles course in application-oriented universities, and proposes practical and feasible reformation strategies for reference.

Keywords: New Engineering; Application-oriented universities; Course on Mechanical Principles; Teaching reform

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1. Introduction

The significance of teaching reform in the course of Mechanical Principles in application-oriented universities under the background of "New Engineering" covers multiple different aspects.

1.1. Beneficial for meeting the development requirements of the new era

In this rapidly developing society, engineering education needs to make certain innovations and reformations, and the new concept of engineering education has been proposed accordingly. As a key focus of teaching reformation in engineering majors, it is necessary to study how to innovate and reform the teaching mode of Mechanical Principles courses [1]. Based on the "New Engineering" concept, reforming the teaching of the Mechanical Principles course can not only effectively meet various requirements proposed by the "New Engineering", but also adapt the teaching methods to the requirements of society, thereby promoting the improvement of the teaching quality of the Mechanical Principles course.

1.2. Beneficial for meeting the employment needs proposed by the industry

The ultimate goal of teaching the course of Mechanical Principles is to cultivate the talents that industries and enterprises truly need. In the context of the "New Engineering" discipline, the reformation of Mechanical Principles course teaching in application-oriented universities can activate students' interest in exploring and learning mechanical principle knowledge and skills through various teaching forms and content, enhance their understanding of various mechanical principles, master various mechanical production processes, usage methods and skills, etc. In this way, students can flexibly apply the knowledge and skills they have mastered in subsequent work to solve practical problems [2]. Therefore, the significance of reforming the teaching of Mechanical Principles courses is to enable students to better solve various problems encountered in the mechanical processing step, gain more practical experience, and ensure that application-oriented universities can provide high-quality talents for industries and enterprises.

1.3. Beneficial for improving the current teaching situation

During the teaching of Mechanical Principles courses, teachers often only explain course knowledge and skills to students, while students complete corresponding operational exercises based on the content explained by the teacher [3]. This traditional educational model limits the development of students' innovation ability and innovative thinking, and their learning effectiveness will also be negatively affected. The main problems are as follows: single theme, single teaching content, single teaching form, and single teaching evaluation. In response to these problems, there is an urgent need for teachers to reform the teaching of the Mechanical Principles course, combining the "New Engineering" education concept with the needs of industrial development. The current teaching environment of the Mechanical Principles course be effectively improved, and the teaching quality of the Mechanical Principles course be further enhanced through this approach.

2. Shortcomings in the teaching of Mechanical Principles in application-oriented universities under the background of "New Engineering"

2.1. Low classroom teaching efficiency

One of the shortcomings in the teaching of mechanical principles courses in application-oriented universities under the background of new engineering is the low efficiency of classroom teaching. This is mainly manifested in the single teaching method of teachers, lack of innovation, and inability to effectively stimulate students' learning interest and motivation [4]. At the same time, some teachers place too much emphasis on imparting theoretical knowledge and overlook the importance of practical operations, leading to difficulties for students in transforming theoretical knowledge into practical operational abilities. In addition, the teaching content of some Mechanical Principles courses in universities is too outdated, unable to keep up with the times, and lacks real-life cases and hands-on practices that are combined with practical applications, which also limits the learning effectiveness and practical application ability of students.

2.2. The comprehensive quality of students is not strong enough

At present, there are some problems in the course design and arrangement of mechanical principles, such as the separation of theory and practice. Students mainly focus on rote memorization of the basic knowledge explained by the teacher, and cannot effectively apply the knowledge learned to solve problems encountered in engineering practice [5]. In addition, some application-oriented universities neglect the cultivation of student creativity and only focus on assessing students' mastery level in exams, while neglecting the assessment of knowledge application ability. In addition, there are also problems such as insufficient refinement of assessment

scoring standards. This will lead to students focusing on theoretical knowledge in their daily teaching and learning, while neglecting to improve their practical abilities, thereby restricting the improvement of their comprehensive literacy.

2.3. Failure to closely integrate with ideological and political education

For a long time, teachers have neglected to enhance and cultivate students' professional qualities due to the influence of heavy knowledge explanation and transmission [6]. In the teaching of Mechanical Principles course, students not only need to master and understand mechanical principles and design methods, and apply them to practice but also need to integrate ideological and political education into the course teaching, leading students to establish correct professional views. However, in actual teaching, teachers tend to overlook the integration of ideological and political education, resulting in the lack of integration between Mechanical Principles course teaching and political education.

3. Teaching strategies for Mechanical Principles courses in application-oriented universities under the background of "New Engineering"

3.1. Utilizing the advantages of multimedia technology to reform the teaching mode of courses

In the teaching of Mechanical Principles course, teachers can use multimedia teaching to vividly and intuitively present the originally dull and abstract teaching content through animation, images, and other dynamic ways. It can also simplify the teaching process, improve the efficiency of teaching mechanical principles, and expand the breadth of mechanical principles teaching, helping to comprehensively improve the quality of mechanical principles teaching [7]. For example, in the teaching of exercise classes, due to the significant differences among students, students who perform well may feel that the course content is repetitive, while weaker students may find it difficult to understand these questions for a long time. As time passes, they may feel bored. At this point, teachers can use multimedia to provide examples of similar problems, effectively extending the teaching content of mechanical principles course exercises. And it also maximizes the role of teaching Mechanical Principles courses, while allowing students to deeply expand their knowledge and maximize their self-learning ability [8]. In addition, during the teaching process, teachers can use multimedia technology to make the obscure content of the Mechanical Principles course more intuitive and vivid. Compared with traditional teaching methods, the use of multimedia technology can impart more knowledge to students in a shorter time, achieving the goal of saving teaching time. By using the saved time, teachers can also add some internship activities, such as organizing students to conduct on-site inspections in enterprises, starting from the actual production, to have a deeper understanding of the Mechanical Principles course, and effectively improve the professional level of students.

3.2. Enhance students' innovation awareness around innovative projects and competitions

In the context of new engineering disciplines, application-oriented universities can introduce national and provincial-level engineering skills competitions, mechanical innovation competitions, and "Challenge Cup" competitions into mechanical principles courses, making the courses more practical. For example, a carbon-free car is a device that uses gravitational potential energy as a driving force to bypass obstacles during driving. It requires designers to effectively utilize gravitational potential energy to ensure the uniform speed and stability of the transmission and steering mechanisms, as well as the reliable operation of the entire system, which involves many basic theories of mechanical principles. On this basis, teachers can divide the entire system of the carbon-free car into the power transmission mechanism (chapter on Gear Mechanism and Universal

Mechanism), steering mechanism (chapter on Planar Linkage Mechanism and Cam Mechanism), high-efficiency energy-saving part (chapter on Mechanical Efficiency, Planar Mechanism Motion and Friction), and complete the design and assembly of the entire structure. Then, they can conduct dynamic and kinematic analysis on it, and finally obtain the optimal design scheme [9]. In subsequent teaching activities, teachers can ask students to independently design and process in groups, and use the works jointly completed by the groups to register for competition. In this process, students' innovation awareness, creativity, communication and collaboration abilities can be effectively improved. At the same time, through innovative projects and competitions, their ability to design and solve engineering problems can be improved, promoting their comprehensive development.

3.3. Strengthening practical teaching and improving practical application abilities

The course of Mechanical Principles should strengthen practical teaching and focus on cultivating students' ability to connect theory with practice. In this regard, application-oriented universities can offer open experiments to combine theoretical knowledge related to mechanical principles with 3D virtual prototyping technology, 3D printing technology, etc., enabling students to independently complete practical training operations on mechanical principles, thereby improving their practical application abilities.

Firstly, 3D virtual prototyping technology enables students to simulate mechanical motion and behavior in a virtual environment and to observe and analyze mechanical motion and behavior in real time [10]. For example, teachers can design the following experiments:

(1) Mechanical virtual experiments. Students can build mechanical systems in a virtual environment, such as levers, sliders, gears, etc., and apply force and adjust parameters to achieve a more intuitive understanding of the mechanical system, promoting students to have a more intuitive understanding of mechanical principles course knowledge and effectively internalizing the knowledge they have mastered.

(2) Sports simulation experiments. Using 3D virtual prototyping technology, simulate mechanical motion systems such as pendulum swing and car steering, and observe the dynamic behavior of the system by adjusting initial conditions and parameters.

Secondly, utilizing 3D printing technology to encourage students to engage in more realistic mechanical system manufacturing and observation experiences [11]. Experiment examples are as follows:

(1) Component manufacturing and assembly testing. Students attempt to use 3D printing technology to create various mechanical parts such as gears, connecting rods, and connecting rods. On this basis, assemble and simulate the construction and motion of each component. In this way, by participating in production and assembly firsthand, students will understand the connections between various parts and understand how force, torque, and motion affect the behavior of the system.

(2) Power transmission experiment. Students can use 3D printing technology to design and print simple mechanical transmission devices, such as devices with gears. Verify dynamic concepts such as speed ratio, torque transmission, and gear interaction by observing the actual motion of the system.

3.4. Emphasis on implementing interdisciplinary education and cultivating interdisciplinary thinking

In the context of "New Engineering" disciplines, application-oriented universities should focus on implementing interdisciplinary education and cultivating students' interdisciplinary thinking. The course of mechanical principles not only involves knowledge in the field of mechanical engineering but also has close connections with other disciplines such as computer science, electronic engineering, materials science, etc. Therefore, in the

teaching of Mechanical Principles courses, teachers should actively introduce knowledge and methods from other related disciplines, help students establish interdisciplinary knowledge systems, and cultivate their ability to comprehensively consider multiple disciplinary fields when solving complex engineering problems. When designing intelligent robots, knowledge of the kinematics and dynamics of mechanical principles is crucial [12]. For example, when designing a drone that can autonomously navigate in different environments, a strong knowledge of mechanical principles can help engineers analyze the dynamic characteristics of the aircraft, such as attitude stability and control performance, to ensure safe and stable flight control [13]. Alternatively, in Artificial Intelligence assisted design. Teachers can integrate machine learning with Mechanical Principles courses, and introduce automated design tools into course teaching, guiding students to use these tools to optimize various components and thereby improve the efficiency of Artificial Intelligence assisted design.

3.5. Combining ideological and political education to deepen the effect of moral education and talent cultivation

Based on the "New Engineering" discipline, application-oriented universities should combine the teaching of Mechanical Principles courses with ideological and political education, and guide students to consciously internalize the requirements put forward by the country and society into value orientation and behavioral awareness through subtle influence [14]. In this regard, we should make good use of typical examples in the ideological and political education resource library, expand the content of ideological and political education in the course of mechanical principles, implement the fundamental task of cultivating morality and talents, improve students' comprehensive quality, and encourage them to actively participate in the mechanical industry while contributing to the development of the industry.

Firstly, ideological and political education on planar linkage mechanisms. By selecting different points on the connecting rod of the planar linkage mechanism, different linkage curves can be obtained. Therefore, teachers can introduce the concept of "Peaks on the Ridge Side, and Differences in Height and Distance" to inspire students to think about complex mechanical systems from multiple perspectives. It is clear that there is an unchanging core, and the connecting rod will still be that connecting rod, but the selected location and angle are different. So, students should see multiple aspects of things without changing the core. When encountering difficulties, they should consider the problem from different perspectives and use the most effective way to solve the problem [15].

Secondly, ideological and political education for gear mechanisms. China is one of the countries with the earliest mechanical development in the world. For example, the ancient people invented the "Guide Car", which relied on gear control for direction, while the "Jili Drum Cart" was mobile under the principle of gear transmission. Under the influence of this ideological and political case, students can fully activate their national pride, actively follow the knowledge from the past, and contribute to the development of the country.

4. Conclusion

In summary, under the background of new engineering, application-oriented universities can effectively improve the teaching quality of mechanical principles courses, cultivate students' innovative abilities and comprehensive qualities, and cultivate more outstanding talents for the development of the national mechanical industry by reforming the curriculum teaching mode, strengthening practical teaching, carrying out innovative projects and competitions, implementing interdisciplinary education, and integrating ideological and political education. At the same time, application-oriented universities should continuously compile their experiences in practice, promote innovation and development of new engineering education, and make greater contributions to

cultivating more outstanding engineers and technical talents.

Disclosure statement

The authors declare no conflict of interest.

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