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Discussion on Teaching Reform and Practice of College Physics under the Background of New Engineering

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Abstract: The proposal of new engineering aims to cultivate compound talents with interdisciplinary knowledge, innovation ability, and practical ability, which puts forward new requirements for the teaching of physics courses. However, there are many problems in the current physics course teaching in colleges and universities, which make it difficult to meet the diversified professional needs in the background of new engineering. Based on this, by analyzing the specific requirements of new engineering for physics course teaching, this paper discusses the existing problems in the current college physics course teaching and puts forward the corresponding reform strategies to provide reference for the college physics course teaching reform under the background of new engineering.

Keywords: New engineering; College physics course; Teaching reform and practice

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1. New engineering background overview

In 2016, the Ministry of Education issued the "Notice on the Development of New Engineering Research and Practice," marking the official prelude to the construction of new engineering in China [1]. The proposal for new engineering is not only to train engineering and technical talents with innovative spirit and practical ability, but also to promote China's transformation from a manufacturing power to a manufacturing power, and to provide strong talent support for realizing the Chinese dream of the great rejuvenation of the Chinese nation. The proposal for new engineering also reflects the profound insight into the development trend of international engineering education. In recent years, countries around the world have put forward their engineering education reform plans, such as the "Engineering Education 2020" in the United States, the "Engineering Education Innovation Plan" in the United Kingdom, etc. The core of these reform plans is to emphasize the cultivation of students' innovative ability and practical ability as well as the comprehensive quality of interdisciplinary [2]. In terms of the reform of physics course teaching in colleges and universities, under the background of new engineering, physics teaching should not only impart students solid basic knowledge of physics, but also pay attention to cultivating students'

innovation ability and practical ability. Therefore, the teaching reform of physics courses in colleges and universities should be closely combined with the goals and requirements of new engineering construction, and constantly explore new teaching concepts and methods to make contributions to the training of engineering and technical talents with international competitiveness.

2. The existing problems of physics course teaching in colleges and universities under the background of new engineering

2.1. The curriculum system is thin, and it is difficult to meet the needs of diversified majors

At present, the setting of physics curriculum often focuses on the teaching of basic theories, and pays insufficient attention to the frontier technology and practical application required by the new engineering major, which makes students lack the necessary knowledge reserve and technical support when facing practical engineering problems. At the same time, the teaching content of physics courses usually focuses on classical physics, while the knowledge of modern physics fields such as quantum mechanics, solid state physics and nanotechnology is less involved. This course setting not only fails to meet the diversified demands of new engineering majors for physics knowledge, but also limits the cultivation of students' innovative ability and practical ability in these fields [3]. Under the background of new engineering, students of different majors have significant differences in their demands for physics knowledge, which brings great challenges to the teaching content and methods of physics courses. On the one hand, physics courses need to cover a wide range of knowledge fields to meet the needs of students of different majors. On the other hand, the teaching content needs to have enough depth to help students apply physics knowledge to solve practical problems in their respective professional fields. However, the existing physics curriculum system is often difficult to accommodate these needs, resulting in a difficult balance between the breadth and depth of teaching content [4].

2.2. The teaching content is not forward-looking and contemporary

Most of the current physics course materials follow the traditional teaching content and fail to reflect the latest progress of physics in time. To be specific, some college physics courses still focus on the basic theories of classical physics, such as Newtonian mechanics, electromagnetism, thermodynamics, etc., and pay insufficient attention to the frontier fields of modern physics [5]. This limitation of teaching content makes it difficult for students to understand the importance of quantum mechanics in modern science and technology, let alone master related application technologies. On the other hand, the long update cycle of physics textbooks also leads to the disconnection between teaching content and practical application. Under the background of new engineering, the application range of physics knowledge is expanding constantly, from the traditional engineering field to the emerging information technology, biotechnology and other fields, all of which put forward new demands for physics knowledge. However, the existing physics textbooks focus on the traditional physics theory and lack a detailed introduction to the application of new engineering fields. It is difficult for students to flexibly apply what they have learned in the face of practical problems, which affects the cultivation of their innovation ability and practical ability.

2.3. The teaching method lacks creativity and vitality

At present, although advanced teaching technologies such as virtual reality, augmented reality, online education platforms and intelligent teaching assistants continue to emerge in the field of education, the application of these

technologies in the actual teaching process is still limited [6]. On the one hand, physics teachers in many colleges and universities have insufficient understanding and mastery of these new technologies and lack corresponding training and guidance, which makes it difficult to effectively apply them in teaching. On the other hand, the investment in hardware facilities in colleges and universities is also relatively insufficient, such as laboratory equipment, network environment, teaching software, etc., cannot meet the basic needs of the application of new teaching technology. In addition, some colleges and universities have rigid teaching management, and the incentive mechanism for teachers to use new technologies is not perfect, which leads to a lack of motivation for teachers to try and explore new teaching methods. Finally, there are differences in students' acceptance and adaptability to new technology. Some students feel unfamiliar and unadapted to the use of new technology, which affects the improvement of teaching effect [7].

3. The strategy of college physics course teaching reform under the background of new engineering

3.1. Establish multi-level curriculum system based on diversified professional needs

The rise of new engineering has a more specific and diversified demand for physics knowledge, emphasizing interdisciplinary, technological integration and innovative practice. As a basic discipline, physics plays an increasingly important role in the new engineering major. Under the background of new engineering, the demand for physics knowledge is not limited to the traditional mechanics, electromagnetism, heat and optics, and other basic content, but also emphasizes the application of this knowledge in practical engineering [8]. For example, emerging fields such as smart materials and devices, new energy technologies, and biomedical engineering all require a deep understanding of the physical properties of materials, energy conversion mechanisms, and biophysical processes [8]. Research and development in these fields cannot be achieved without a deep understanding and flexible application of physical laws. Therefore, college physics courses need to be adjusted in the teaching content, and increase the applied content closely related to the policy requirements of new engineering, such as physical phenomena in materials science, quantum effects in nanotechnology, optical imaging technology in biomedicine, etc. In addition, it is an effective way to improve the comprehensive quality of students, to strengthen the cross-integration of physics and other disciplines, and to build a multi-level curriculum system. Under the background of new engineering, the teaching of college physics emphasizes the comprehensive application of multidisciplinary knowledge, which needs to be deeply integrated with mathematics, chemistry, computer science, biology, and other disciplines. For example, the course of "Computational Physics" is set up, combining computer programming technology, so that students can master the numerical solving methods of physics problems. In addition, interdisciplinary comprehensive courses such as "Smart Materials and Device Design" can be set up to integrate knowledge from physics, materials science, electronic engineering and other fields to cultivate students' comprehensive innovation ability [9].

3.2. The teaching content is contemporary and forward-looking, and ADAPTS to the requirements of new engineering

With the rapid development of science and technology, physics, as a basic subject, its research results and technical applications are constantly updated. For example, breakthroughs in quantum computing, nanomaterials, biophysics and other fields have not only provided new perspectives for scientific research, but also brought revolutionary changes to engineering applications [10]. Therefore, the teaching content of college physics courses

should introduce this cutting-edge knowledge promptly so that students can master the latest physical theories and technologies, and lay a solid foundation for their future development in new engineering fields [10]. In order to achieve this goal, the teaching content of college physics courses needs to be systematically updated and optimized. First, the course content should cover the latest research results in physics, such as the latest progress in the fields of mechanics, quantum mechanics, relativity, condensed matter physics and so on. For example, quantum computing, as a hot field in recent years, its basic principles, experimental progress, and application prospects should be part of the teaching content. By introducing such cutting-edge knowledge, students' interest in learning can be stimulated and their innovative thinking and spirit of exploration cultivated. At the same time, teachers should encourage students to read the latest scientific research papers and participate in research projects to gain a deeper understanding of the latest developments in physics. In addition, physics teaching content should focus on practicality and application. More experiments and projects should be designed in the teaching content of college physics courses so that students can master physics knowledge and technology in practice. For example, some experimental projects related to industrial production, environmental protection, medical health and other practical issues can be set up, so that students can transform theoretical knowledge into practical skills through hands-on practice [11].

3.3. Diversified teaching methods should be adopted to activate the teaching atmosphere and rejuvenate the teaching vitality

On the one hand, adopting the case teaching method and the interactive teaching method is an important means to strengthen the interdisciplinary integration of physics teaching content. In case teaching, teachers can choose practical cases that are closely related to new engineering majors. For example, when explaining electromagnetism, the battery management system of electric vehicles can be selected as a case to let students understand the application of electromagnetism in modern industry. Through case analysis, students can not only master physical knowledge but also cultivate the ability to solve practical problems. Interactive teaching principles encourage students to actively participate in class discussions and improve students' teamwork and communication skills through group cooperation and role playing [12]. For example, when explaining quantum mechanics, students can be organized to discuss the basic principles of quantum computing in groups. Each group is responsible for one aspect and reports at the end. Other groups can raise questions or add opinions to form interactive communication. On the other hand, the use of modern teaching methods is also an effective way to strengthen the interdisciplinary integration of physics teaching content. The development of modern information technology provides abundant resources and tools for teaching, such as virtual laboratories, online course platforms, multimedia courseware, and so on. Among them, the virtual laboratory can allow students to conduct physical experiments in a virtual environment, such as simulating atomic structure, molecular movement, etc., to help students understand physical concepts more intuitively. The online course platform can provide rich learning resources, such as video lectures, interactive exercises, online tests, etc., so that students can learn independently and improve learning efficiency. Multimedia courseware can display complex physical phenomena in the form of animation, images, etc., to enhance the vividness and interest of teaching. For example, when explaining optics, multimedia courseware can be used to show light interference, diffraction, and other phenomena to help students understand abstract concepts [13].

3.4. Construct a goal-oriented, comprehensive evaluation mechanism for new engineering

The multi-dimensional design of the evaluation content aims to comprehensively evaluate students' knowledge

mastery, practical ability, innovative thinking and teamwork ability. The traditional single examination method can no longer meet this demand, therefore, it is necessary to build a comprehensive evaluation system, covering theoretical knowledge, experimental skills, innovative ability and other aspects. First, the assessment of theoretical knowledge. Through closed-book examinations, open-book examinations, online tests and other forms, these assessments can not only test students' understanding of basic physics concepts and principles, but also assess their ability to apply physical knowledge. For example, closed-book tests can test students' mastery of basic theories, while open-book tests and online tests can assess students' comprehensive ability in accessing materials and solving problems [14].

The second is the test of experimental skills. The writing of the experimental report not only requires students to have a solid theoretical foundation, but also requires them to accurately record the experimental data, analyze the experimental results, and write a standard experimental report. The assessment of experimental operation focuses on students' hands-on ability and experimental skills, and examines students' use of experimental instruments and mastery of experimental procedures through practical operation. The assessment of experimental design pays more attention to students' innovation ability and experimental design ability, requiring students to design reasonable experimental schemes according to given problems and carry out experimental verification. The third is the assessment of innovation ability. Through innovative projects, innovative competitions, and innovative papers, the assessment of innovative projects requires students to put forward innovative project plans and carry them out in practice to test their innovative thinking and practical ability. Innovation competition tests students' innovation ability and teamwork ability in a competitive environment by participating in various innovation competitions. The assessment of innovative papers requires students to write high-quality innovative papers that demonstrate their research results and innovative ideas in a certain field. In this way, students' abilities can be evaluated more comprehensively and accurately through the combination of multiple evaluation methods [15].

4. Conclusion

In short, this paper first summarizes the concept of new engineering and its requirements for physics teaching in colleges and universities, and points out that the teaching of physics under the background of new engineering needs to be contemporary, forward-looking, and applicable. By analyzing the problems existing in the current physics teaching in colleges and universities, such as the weak curriculum system, the lack of modern teaching content, and the lack of creative teaching methods, it emphasizes the negative impact of these problems on the training of new engineering talents. Given these problems, this paper puts forward some reform strategies, such as establishing a multi-level curriculum system, updating teaching content, adopting diversified teaching methods and constructing a comprehensive evaluation mechanism, to provide strong support for talents training in the background of new engineering.

Disclosure statement

The author declares no conflict of interest.

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