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Reform and Practice of College Physics Teaching Based on the Concept of New Engineering Talent Cultivation

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Abstract: With the coordinated development of China's scientific and technological revolution and industrial transformation, the construction of new engineering disciplines has gradually become an important direction for the reform of higher engineering education in China. Its core goal is to cultivate more innovative and interdisciplinary talents who can adapt to the development needs of future industries. As a core basic course for all engineering majors, college physics undertakes the important task of imparting physical knowledge and connecting basic disciplines with engineering practice. In view of this, based on the core concept of new engineering talent cultivation, this paper systematically analyzes the epochal significance and existing problems of college physics teaching reform under the background of new engineering, and then puts forward practical reform strategies, so as to provide references for universities to promote the reform of college physics teaching.

Keywords: New engineering; Talent cultivation; College physics; Teaching reform; Practice

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1. Epochal significance of college physics teaching reform under the concept of new engineering talent cultivation

1.1. Matching the cultivation needs of core competencies for new engineering talents

The core competencies of new engineering talents mainly include solid basic ability, outstanding innovation ability, and good interdisciplinary literacy. College physics is an important carrier for cultivating these competencies. As a crucial natural science, physics contains thinking methods such as logical reasoning and abstract modeling, which provide important support for engineering students to solve complex engineering problems. Traditional college physics teaching focuses on the systematic imparting of knowledge but ignores the cultivation of students' thinking and practical abilities, making it difficult to meet the cultivation requirements of "emphasizing ability and pursuing innovation" for new engineering talents [1]. By carrying

out college physics teaching reform under the concept of new engineering talent cultivation, the concept can be better integrated into the whole process of college physics teaching, gradually breaking the traditional "knowledge instillation" mode. Teachers can better guide students to use physical knowledge to analyze specific engineering problems, which is conducive to the development of their abstract and innovative thinking.

1.2. Empowering technological innovation and industrial upgrading of emerging industries

New engineering should focus on emerging industries such as artificial intelligence and new energy, whose technologies are usually based on physical principles. For example, machine learning algorithms in artificial intelligence use probability theory of statistical physics, and technologies such as photovoltaic power generation in the new energy industry apply various knowledge of semiconductor physics. As an important bridge connecting basic science and engineering applications, the reform of college physics teaching content and mode will greatly affect students' understanding and application of emerging industrial technologies, and is also related to the technological innovation level and industrial competitiveness of China's emerging industries [2].

1.3. Promoting the iterative upgrading of college physics itself

With the continuous development of the concept of new engineering talent cultivation, it has gradually provided a new direction for college physics teaching reform in China. It can effectively promote college physics to break the traditional teaching framework and facilitate its own iterative upgrading. Through the reform, college physics courses can absorb cutting-edge achievements and engineering application cases of physics in a more timely manner, which is conducive to further optimizing the curriculum content system. It can also help teachers innovate their teaching methods and means, gradually breaking the barriers of traditional disciplines and promoting the in-depth integration of physics with various engineering majors [3]. In addition, teaching reform can promote the construction of college physics teaching staff, urging teachers to update their educational concepts in a timely manner and improve their professional literacy and comprehensive engineering practical ability.

2. Existing problems in college physics teaching under the concept of new engineering talent cultivation

2.1. Backward teaching concepts

At present, college physics teaching in many universities still adopts traditional educational concepts, with the core of imparting knowledge and coping with examinations. Teachers ignore the cultivation of students' innovation, practical ability, and interdisciplinary literacy in teaching, leading to a serious disconnection between actual teaching and the concept of new engineering talent cultivation. Teachers tend to emphasize theory over practice, focusing on the explanation of physical concepts and formulas, while neglecting to guide students to use physical knowledge to analyze and solve practical problems. As a result, it is difficult for students' engineering and innovative thinking to be further developed [4]. In addition, some teachers do not adopt a "student-centered" teaching concept, ignoring individual differences and the professional needs of students. They often adopt a "one-size-fits-all" teaching mode without analyzing students' majors and

basic levels, using the same teaching content and evaluation standards.

2.2. Outdated curriculum content

Curriculum content is the core of college physics teaching reform under the concept of new engineering talent cultivation, and the key to improving the quality of new engineering talent cultivation. At present, the content of college physics courses in Chinese universities is outdated and overly theoretical, with many knowledge points seriously disconnected from engineering practice and cutting-edge physical technologies. The current college physics curriculum system in many schools is still dominated by classical physics, with teachers focusing on traditional content such as mechanics and thermology, and introducing little knowledge about modern physics, nano-physics, and new energy physics, making it difficult to meet the knowledge structure needs of talents for emerging industries [5]. The content of college physics lacks connection with engineering practice, mainly consisting of abstract concepts and formulas without specific engineering application cases and practical scenarios. This easily leads to students' difficulty in understanding the practical application value of physical knowledge, resulting in the phenomenon of "disconnection between learning and application." Moreover, the content of college physics teaching for different majors in many universities is basically the same, without targeted adjustment according to the characteristics of different majors, making it difficult to meet the learning needs of students in different majors [6].

2.3. Single teaching methods

Teaching methods are an important means to achieve the reform goals of college physics teaching under the concept of new engineering talent cultivation. However, college physics teaching in many universities in China still mainly adopts "lecture-based" teaching, with relatively simple and boring teaching methods. There is a lack of interaction and innovation between teachers and students, and between students and knowledge, making it difficult to stimulate students' learning interest and initiative, which is not conducive to achieving the goal of cultivating students' innovative ability under new engineering [7]. In classroom teaching, teachers usually dominate the class, and students mostly receive knowledge passively with little classroom interaction. This makes it difficult for students to participate deeply in the teaching process, which is not conducive to cultivating their independent learning ability and innovative thinking [8]. In addition, many teachers use traditional teaching methods. Although some universities have introduced multimedia teaching, teachers usually convert blackboard writing content into PPTs, lacking the application of new teaching means such as virtual simulation and online-offline blended teaching. For example, for some abstract physical concepts (such as quantum superposition, electric and magnetic fields) and complex physical experiments (such as high-energy physics experiments, precision optical experiments), traditional teaching means are difficult to display intuitively, which easily leads to students' difficulty in understanding and mastering relevant knowledge and skills.

3. Practical strategies for college physics teaching reform under the concept of new engineering talent cultivation

3.1. Renew teaching concepts and anchor the cultivation goals of new engineering

To improve the effect of college physics teaching reform under the concept of new engineering talent cultivation, attention must be paid to the renewal of teaching concepts. Establishing a teaching concept

compatible with new engineering talent cultivation can more effectively promote teaching reform. Therefore, educators can establish a "student-centered" teaching concept, respect individual differences and professional needs of each student, and dare to break the traditional "one-size-fits-all" teaching mode. Teachers should pay more attention to students' learning process and ability improvement in teaching, gradually guiding them to shift from "passive acceptance" to "active learning and independent inquiry" [9]. Teachers should gradually change their role positioning from knowledge imparters to learning guides, focusing on guiding students to use the physical knowledge they have learned to analyze and solve practical problems in class, so as to gradually cultivate students' engineering and innovative thinking. In addition, educators also need to establish a teaching concept of "emphasizing practice and pursuing innovation", so as to better integrate practical teaching and innovative ability cultivation into the whole process of teaching, gradually breaking the "disconnection between theory and practice." Teachers should try to guide students to combine physical knowledge with engineering practice [10]. Teachers should fully recognize the core role of practical teaching in new engineering talent cultivation, so as to better integrate innovative thinking and practical ability cultivation into every teaching link and better stimulate students' innovative awareness. Moreover, educators also need to establish a teaching concept of "interdisciplinary integration", which can better break the barriers between physics and various engineering majors, promote the in-depth integration of physical knowledge and professional knowledge, and gradually achieve the goal of basic courses serving professional learning.

3.2. Optimize curriculum content and realize connection with engineering practice and cutting-edge technologies

The optimization of curriculum content is the core of college physics teaching reform under the concept of new engineering talent cultivation. Therefore, educators should build a curriculum content system of "basic core + professional adaptation + cutting-edge intersection" combined with the needs of new engineering talent cultivation, so as to better realize the in-depth connection between curriculum content and engineering practice and cutting-edge technologies. In teaching, teachers should further consolidate the basic core content, retain the core contents of mechanics, thermology, electromagnetism, and other aspects in classical physics, and be good at explaining the essence and application methods of physical concepts and formulas, so as to help students consolidate their physical foundation. At the same time, educators should simplify some overly complex theoretical derivations, continuously improve the practicality and transferability of physical knowledge, so that students can flexibly use the physical knowledge they have learned to solve some practical problems [11]. In addition, educators can add some professional adaptation content and adjust the content of college physics courses in a targeted manner according to the characteristics and needs of different majors, so as to better highlight the professional focus. For example, for mechanical majors, educators can add contents of mechanics and thermodynamics; for electronic information majors, educators can add contents of electromagnetism and optics in circuit design, so as to better realize the adaptation of knowledge and majors [12].

Furthermore, educators also need to integrate some cutting-edge interdisciplinary content, and timely absorb some cutting-edge achievements and emerging knowledge of physics, such as quantum information, nano-physics, and new energy physics, which can effectively broaden students' knowledge and horizons. In classroom teaching, teachers can introduce some engineering application cases, so as to better transform abstract physical knowledge into specific engineering scenarios, let students have a deeper understanding of

the application value of physical knowledge in emerging industries, and help cultivate their interdisciplinary literacy and innovation ability [13].

3.3. Innovate teaching methods and improve classroom interaction and innovation

The innovation of teaching methods is the key to improving the quality of college physics teaching reform under the concept of new engineering talent cultivation. Therefore, educators should dare to break the traditional "lecture-based" teaching mode, build a new "interactive and inquiry-based" teaching mode, and combine online-offline blended teaching means to further improve classroom interaction and innovation, so as to effectively stimulate students' learning interest and initiative. In the practice of college physics teaching, educators can actively implement inquiry-based teaching to guide students to explore physical laws and phenomena more independently, so as to cultivate their innovative thinking and independent learning ability [14]. In addition, educators can also carry out project-based teaching. Combined with some practical engineering design project tasks, students can complete the whole process of project design, implementation, and summary in groups, which can more efficiently cultivate students' practical ability and teamwork ability. For example, educators can design a project of "Design of New Energy Power Generation Device Based on Electromagnetic Induction", and then let students use the physical knowledge they have learned to solve some practical engineering problems, which can greatly improve students' engineering application ability.

Online-offline blended teaching is an important path for college physics teaching reform under the concept of new engineering talent cultivation. Teachers can combine online teaching platforms such as MOOCs and Xuexitong to further break the time and space constraints of traditional classrooms and achieve a higher level of online preview and offline teaching. For example, teachers can release some preview materials and teaching videos online, so that students can preview relevant knowledge in advance; in offline classes, teachers can focus on explaining the difficult and key points of college physics knowledge, organize students to carry out interactive discussions, experimental operations, and other activities. Through online preview and offline practice, students' comprehensive ability and literacy will be further developed [15]. Moreover, to ensure the effect of college physics teaching reform under the concept of new engineering talent cultivation, teachers should further expand classroom interaction forms and further stimulate students' learning interest through a variety of interactive methods, such as group discussions, classroom quizzes, and bullet-screen interactions, which can greatly improve students' classroom participation. For example, when explaining optical knowledge, educators can carry out case analysis combined with some optical phenomena in life (such as rainbows, mirages), and then guide students to discuss the physical principles, which can help students understand the knowledge they have learned more deeply and intuitively and improve their comprehensive literacy.

Disclosure statement

The author declares no conflict of interest.

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