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Research on the Teaching and Reform of Electrodynamics Course Based on Multi Dimensions

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ABSTRACT

Electrodynamics, as one of the four major mechanics, is a required course for college students majoring in physics. It reveals the laws and essence of physical phenomena more profoundly, so it is more difficult and the current teaching situation is not optimistic. Based on the structure and characteristics of electrodynamics, this paper studies the teaching and reform of electrodynamics from multiple dimensions, in order to achieve teaching innovation according to the requirements of the new curriculum reform and the concept of modern talent training, and provide students with higher quality teaching services.

1. Introduction

Electrodynamics is one of the required subjects of physics. It includes the research of electronic engineering, radio, electromagnetic fields, and electromagnetic waves. It has a wide range of applications in China's electronic information, electromagnetic fields and other professional fields. However, with strong professionalism and high difficulty, the current teaching situation in colleges and universities and the learning effect of students is not satisfactory. Therefore, it is of great practical significance to deepen the teaching reform of electrodynamics from multiple dimensions based on the new curriculum reform and the concept of modern talent training.

2. Teaching and Reform of Electrodynamics Course

Electrodynamics is a systematic and well-organized disci-

pline with a rigorous knowledge system and structure. In terms of content, the abstract theoretical knowledge and professional practical content greatly increase students' learning difficulties. Attempts have also been made to carry out teaching reforms according to the characteristics of the subject, but the results have always been unsatisfactory. Specifically, the basic teaching situations in terms of teaching content, teaching methods, and student learning are as follows:

2.1 In Teaching Content

The teaching content of electrodynamics mainly consists of five parts: the general law of electromagnetic phenomena, special theory of relativity, static magnetic field, electrostatic field, and the propagation and radiation of electromagnetic waves. This knowledge has been widely applied in daily life, military fields, and physics research. However, current practical teaching tends to focus on the teaching of basic methods and theoretical knowledge, with

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less connection with actual life and even less connection with high-end research fields. As a result, students lack a deep understanding of theoretical knowledge, and their intrinsic learning motivation is not effectively stimulated. In the assessment of learning effect, students' mastery of basic knowledge is very unsatisfactory, and it is extremely difficult to achieve the expected teaching goals^[1].

2.2 In Teaching Methods

In the current electrodynamics teaching class, the negative impact of traditional teaching concept has not been fundamentally eliminated. Teachers still serve as the center for imparting knowledge in class and pass knowledge to students through explanations and multimedia courseware. In this teaching mode, students are completely passive. Although the purpose of "imparting knowledge" can be achieved, it cannot stimulate students' subjective initiative and enable them to actively explore and comprehend knowledge, thereby hampering the development of students' ability, especially in analyzing and solving problems.

2.3 In Student Learning

The principle of running vocational and technical schools and the students' schooling purpose is to master skills quickly and become practical talents. Therefore, in the process of studying electrodynamics, many students already have clear career goals, and will focus more on improving their skills. As a result, they will be eager for quick success and instant benefits in the study of electrodynamics; without real recognition of the important value of the subject, they ignore the application of disciplinary knowledge in social development and future employment and regard passing exams and assessments as the only goal. As a consequence, this leads to the derailment between the study of electrodynamics and the actual development of students, which seriously affects students' learning enthusiasm and subjective initiative^[2]. Over time, students will lose their passion and interest for learning because of the boring knowledge and the unintelligible content of electrodynamics, and take the study of electrodynamics as a burden.

3. Teaching and Reform Strategy of Electrodynamics Course

3.1 Reforming the Knowledge Structure

Under the limitation of class hours, the main goals of reforming the knowledge structure are to balance theoretical knowledge teaching and practical teaching, and to achieve the penetration of the practical application of electrody-

namics. It not only enables students to understand the practical application of electrodynamics knowledge in the frontier field, but also effectively stimulate students' enthusiasm and develop students' abilities from all aspects. Therefore, the reform of the knowledge structure should focus on specialties, based on modern pedagogical concepts and the development trend of the discipline, sort out the structure system and the knowledge relation of electrodynamics more systematically, reduce the theoretical knowledge appropriately, penetrate the theoretical knowledge into related information on modern development, and expand technical expertise. For example, the basic theoretical knowledge such as the electrostatic field, polarization and magnetization, and the experimental law of a stable current magnetic field should be simplified; relative contents with a modern atmosphere should be supplemented; and the knowledge with significant practical significance in recent development of electrodynamics should be added to the knowledge structure, such as the knowledge of optical fiber communication, so as to make students understand the practical application of electrodynamics in the development of modern science and technology, shorten the distance between knowledge and student life, and allow students to correctly comprehend the practical value of electrodynamics knowledge^[3].

In general, in the process of electrodynamics teaching, the teaching content of basic theoretical knowledge should be based on building a solid theoretical foundation for students; however, the penetration of theoretical knowledge into practical applications is more conducive to students' understanding and mastery, and to stimulating students' learning interest and subjective initiative. In addition, in the process of expanding students' horizons, carrying out teaching combined with cutting-edge research results can deepen students' understanding and cultivate students' abilities from multiple dimensions.

3.2 Reforming the Teaching Methods

Judging from the current teaching situations of electrodynamics courses, the teaching methods of college teachers are too traditional and backward, which will restrict the exertion of students' subjective initiative and severely squeeze their thinking space, which is very unfavorable to the development of their ability. Therefore, in the process of teaching reform, it is of great significance to carry out scientific reform of teaching methods.

Firstly, teaching should focus on cultivating students to master scientific learning methods. The purpose of course teaching is not simply to transfer knowledge to students, but to use knowledge as an opportunity to achieve the improvement and development of student abilities, so that students

can master correct learning methods and develop good learning habits. From the perspective of the disciplinary characteristics of electrodynamics, students should be consciously trained in theoretical analysis ability, material analysis and demonstration ability, and practical proof ability in teaching, so that they can develop the learning thoughts of raising problem-analyzing problem-solving problem, and take the initiative to think independently and make comprehensive use of knowledge in the learning process^[4].

Secondly, teaching should focus on training students' ability to apply knowledge. The study of theoretical knowledge is to better serve the practice, so teaching needs to make students correctly understand the interpretation of basic knowledge, and be able to analyze natural phenomena and engineering technology from a professional perspective using professional knowledge. For example, after studying related knowledge of electromagnetic wave, teachers can also link this part with daily life phenomena, and guide students to adopt professional explanations to reasonably explain physical phenomena in life, so as to cultivate students' thinking of linking theory with practice in teaching.

Finally, the traditional teaching methods should be transitioned to penetrating teaching. Traditional teaching methods rely too much on teaching materials. Although they can systematically explain knowledge to students, they are too stable and rigorous to facilitate students' understanding. Through penetrating teaching, students are allowed to start learning with infinite unknowns and accumulate knowledge little by little in solving, exploring and thinking about problems. For example, in the teaching process of basic knowledge such as basic laws, a penetrating teaching method can be adopted to infiltrate knowledge by analyzing the latest research results and cases at the current stage, thus students can effectively grasp the knowledge in the process of analyzing and thinking.

3.3 Reforming the Teaching Model

At the present stage, relevant conditions and teaching modes of the theoretical teaching of electrodynamics in colleges and universities have been perfected and matured, but the practical teaching is still lagging. This is mainly because the theoretical knowledge is too complicated, and teachers often want to realize students' quick understanding through simple experiments; and advanced research requires expensive equipment or materials, but vocational technical colleges are not capable of developing experimental platforms of corresponding levels with limited funding. Facing such a situation, we still need to strive more actively for the support of the state, schools and the society, solicit funds, equip electrodynamics with experiments, and allow students'

subjective initiative to be more fully exerted through the Theory + Experiment model. However, this work cannot be accomplished overnight. Experimental projects, such as microwave spectroscopy experiments, radio wave emission characteristic measurement experiments and optical device spectral sensitivity experiments should be introduced step by step, allowing students to experience the fun of electrodynamics courses in hands-on experiments, guiding them to think and produce innovative thinking, and exercising their abilities from all aspects.

4. Conclusion

In summary, under the guidance of the new curriculum reform, the teaching reform of colleges and universities continues to deepen, and the teaching reform of electrodynamics course has become the focus of college teaching reform. However, due to the content and characteristics of the course, the current reform effect is not significant, especially in the course quality and the classroom efficiency without great positive effects of reform. Therefore, colleges and universities should recognize that the teaching reform of electrodynamics course is a long-term task, which requires teachers to continuously explore and try in practical teaching, to innovate from multiple dimensions, and to link the discipline with the frontiers of physics and the development of science and technology. They should always adhere to the concept of advancing with the times, reform the knowledge structure, teaching methods and teaching models, start from the actual development needs of students and provide students with personalized teaching services, in order to realize the improvement of teaching quality and teaching level.

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