

# Research on Teaching Reform of University Physics

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## Abstract

University physics is a compulsory basic course for science and technology students, and the proposed teaching reform is mainly combined with the new era and the new curriculum teaching reform background, it is found that the university physics course mainly has problems of high course difficulty, lack of innovation in teaching methods and means, and traditional teaching methods, so the university physics teaching reform in colleges and universities needs to seriously implement the teaching concept of student-oriented and teacher-led, adopt refining Teaching content and updating curriculum system, cultivating students' thinking ability and innovation ability, expanding teaching resources and enriching teaching methods, expanding teaching forms and innovative teaching modes, adjusting teaching contents, and bidding farewell to traditional teaching methods.

## Keywords

University physics; Problems; Teaching reform.

## 1. Preface

As we look at the entire history of scientific development, the three scientific and technological revolutions in history have been driven by major discoveries of physical laws. At the time when the fourth technological revolution is calling, we calmly consider that the fundamental role of physics cannot be ignored. For the professional development of science and technology students, elevating university physics knowledge to a professional level and combining physics knowledge with professional knowledge is the way to enhance students' professional foundation [1]. Physics is a natural science that studies the structure, fundamental motion, and interaction of matter, and is also the foundation of technical and engineering sciences. As a compulsory basic course in engineering colleges and universities, university physics plays an important role in cultivating students' ability to explore and innovate, and their ability to analyze and solve practical problems. In the context of the new era and new curriculum reform, strengthening students' political education has become one of the main goals in the teaching process, and the integration of the political science element in the course teaching can cultivate students' spirit of exploration and innovation, and help them establish a scientific world view, outlook on life and values. Recently, the Ministry of Education launched the construction of teaching in colleges and universities to optimize the educational and teaching conditions and promote the reform of teaching methods [2].

## 2. Research Status

Physics is an experimental science, and non-physics universities should actively innovate physics courses, actively cultivate students' scientific literacy of inquiry, enhance students' problem analysis and solving ability, strengthen hands-on experimental operations, and lay a good foundation for cultivating students' scientific thinking [3]. The teaching of university physics courses faces many problems in non-physics major institutions. Many electromechanical engineering students have low motivation to study physics courses and

think that physics courses are not specialized courses, so as long as they can pass the exams without failing, this is mainly because students do not recognize the importance of studying physics in college; then the course content is too difficult for electromechanical engineering students, the textbook content is The depth of cognition required by the content of the textbook is very difficult for students who do not have a good foundation in physics, especially for some of the content about the fixed-axis rotation of rigid bodies, mechanical vibration, electric field, magnetic field, optics, thermodynamics, etc. In particular, there are many formulas and concepts in the textbooks of university physics courses, and students generally lack interest in learning them. Some students who do not have a solid foundation in mathematics, are often deeply affected and can develop a fearful and intimidating mentality. Then the reform and innovative teaching research of university physics teaching professional teachers on physics teaching have become much less in recent years, and it is difficult to stimulate students' learning interest by using traditional teaching mode, which seriously affects the cultivation of core literacy of university physics courses for college students. Finally, the assessment form of physics courses is relatively single. The university physics course of electromechanical engineering is not a key major for students, because the traditional assessment form is still used in the assessment review. According to the traditional final examination, closed-book mode assessment as 60% of the total grade of students learning university physics course, the content of the examination is also purely conventional multiple-choice, fill-in-the-blank questions, judgment questions, calculation questions, 40% of the total grade from the usual attendance, homework classroom performance, there is no corresponding chapter of the experiment.

### 3. Problems in Teaching University Physics

(1) The difficulty of the course is high, and the students' fear of difficulty is obvious. The upper book includes kinematics of masses, dynamics of masses, fixed-axis rotation of rigid bodies, mechanical vibration, mechanical waves, and fluctuating optics; the lower book includes electrostatic field, steady magnetic field, electromagnetic induction and electromagnetic field, fundamentals of gas dynamics theory, fundamentals of thermodynamics, relativity and quantum physics, the teaching content is broad and difficult. Students tend to focus on memorizing formulas and do not pay attention to the inner connection between chapters and do not understand the way of thinking in studying physics problems.

(2) The teaching hours are generally insufficient, and the methods and means lack innovation. The shortage of teaching hours has led to the lack of a good connection between the teaching contents before and after the course; the teaching methods and means lack innovation. Most teachers still rely on PPT teaching, and the teaching process seems to be boring and monotonous, which completely emphasizes the teacher-led duck-fill teaching.

(3) The teaching methods are traditional and the number of hours is limited, and it is difficult to guarantee the number of hours of university physics classes for students according to the guidance of the Steering Committee of University Physics Courses in Higher Education Institutions. It can be adjusted according to the actual teaching situation. Due to the different needs of majors, our university physics courses are set up with 60 hours of upper university physics, 60 hours of lower university physics, and 30 hours of university physics laboratory, which are limited to the limited teaching hours. The common teaching mode of university physics courses is that teachers teach in a fixed classroom at a fixed time and students are "forced to learn". Once students are accustomed to the teaching mode of "teachers lecture and students listen", they will easily form a mindset, and the role of guiding students' innovative thinking, critical thinking training, and scientific spirit will be missing [4].

## 4. Teaching Reform

The teaching process of student-oriented undergraduate university physics courses is to cultivate students' knowledge, ability, and quality to develop in a coordinated way. The teaching concept of student-centered and teacher-led is implemented seriously. In the work of teaching reform, we should change the traditional teaching philosophy, pay attention to the cognitive rules of students when teaching, make the theoretical connection with practical, stimulate students' learning enthusiasm, cultivate students' independent learning, and pay attention to students' personality development.

What is student-centered? According to the requirements of contemporary higher education and engineering courses for university physics teaching, we adopt refining teaching contents and updating curriculum system, cultivating students' thinking ability and innovation ability, expanding teaching resources and enriching teaching methods, expanding teaching forms, and innovating teaching modes, adjusting teaching contents and bidding farewell to traditional teaching methods, by building a "classroom and extra-curricular" "theory and practice" teaching system. "By combining "theory and practice", "teaching and education", we can achieve the training goals of knowledge and skills, process and method and emotional value of university physics courses. The specific practices are as follows:

(1) Refine the teaching content, update the curriculum system, center on students, determine the teaching content system according to the demand of different majors for physics knowledge, refine the topics closely related to professional knowledge for different majors, make students realize the practical value of college physics courses, to stimulate students to pay attention to college physics courses.

(2) Cultivate students' thinking ability and innovation ability. The teaching reform must focus on cultivating students' proficiency in using the basic theories of physics to correctly analyze and study physics problems of general difficulty through observation, analysis, analogy, association, and experiment. For some less complex, practical problems can grasp the main factors, reasonable simplification, the establishment of a suitable physical model, using physics thinking to think about the problem, the use of mathematical and physical methods to solve the problem, open up students' ideas, stimulate students to explore and innovation, enhance the practicality of university physics.

(3) Expand teaching resources, enrich teaching methods, record special micro-lessons: according to the logic of "teaching objectives → core knowledge → typical example problems", record micro-lessons on key contents to deepen students' understanding of core knowledge, interesting physics discussions, and stimulate students' interest. Create a homework library: Set up post-class homework for the content of the class, which is reviewed online immediately after submission by students and gives detailed solutions to the problems. Encourage students to use what they have learned to develop small experiments or create visual animations.

(4) Expand the teaching form and innovate the teaching mode, and design the course with the idea of "introduction of problems → knowledge explanation → example problem analysis → expansion of space → course thinking", and adopt three combinations of innovative teaching modes: "inside and outside the classroom" combined in the mobile network environment, the classroom and extra-curricular are both important. The teacher builds a teaching design that combines systematization and fragmentation, and students learn the micro-lectures videos and PPTs provided by the teacher through smartphones and other mobile terminals before class to complete the acceptance of knowledge, ask questions, discuss problems and solve problems during class to complete the absorption of knowledge, and use a variety of online and offline learning and communication tools after class to complete the consolidation of knowledge, thus realizing the internalization of knowledge, enhancing students' enthusiasm for learning and improving their learning ability. Combining theory and practice, through "teacher-led, student-

led, and teamwork", students are encouraged to participate in various innovative and entrepreneurial competitions, scientific and technological activities, and practical activities to cultivate students' independent learning ability and innovation. Teaching and education are combined, and a brief history of the development of physics and typical cases reflecting the laws of cognition are organically integrated into the teaching process to impart correct values to students and achieve value guidance for them.

(5) Adjust the teaching content, according to the curriculum of the School of Mechanical and Electrical Engineering of our university, find out the knowledge points related to university physics from the specific contents of subjects such as advanced mathematics, electrical and electronic, digital electronics, analog electronics and engineering mechanics offered by students, and adjust the teaching content of university physics in a targeted way. In the course of lectures, students should be more interested in the practical examples of life, so that students can use the theoretical knowledge to solve practical problems and apply what they have learned.

(6) Say goodbye to traditional teaching methods. Case teaching, in the teaching process, according to the specific course content appropriate introduction of real-life and engineering practical cases to explain. For example, when teaching the law of conservation of angular momentum of rigid bodies, you can give students the example of why figure skaters bring their arms together when they do a high-speed rotation on the ice. In some chapters, students are allowed to work in small groups and spend their time outside of class to select any problem from the problem bank, consult the data, discuss it within the group, and make a PPT to explain it to the class in class. The problem teaching method is used in appropriate chapters. A video is shown for students to watch, and the teacher raises a question based on the content of the video, and the lesson is kicked off with the question, and through the teacher's explanation, students discuss in small groups to liven up the classroom atmosphere and leave the traditional teaching mode [5].

## 5. Conclusion

University physics courses in colleges and universities are in the call of the new engineering era, and the university physics teaching should cover both basic knowledge and frontier science, and at the same time be integrated with the professional technology students learn, so the reform of university physics teaching is urgent. This paper combines the current situation and problems in university physics teaching, seriously implements the teaching concept of student-oriented and teacher-led, adopts the teaching methods suitable for contemporary college students, bids farewell to the traditional teaching methods, solves the problems in teaching, and allows college students to truly experience the use of university physics and to apply what they have learned.

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