

Research on the Reform Path of Student-Centered University Physics Classroom Teaching

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Abstract: University Physics is one of the important courses for science and engineering majors, and teachers should continuously explore the application of new teaching strategies in university physics teaching. Under the “student-centered” educational philosophy, more attention is paid to students’ learning experience and the satisfaction of their learning needs than to their academic performance, thereby improving students’ physics literacy and ability to solve practical problems. Based on this, this paper briefly analyzes the importance and current status of university physics classroom teaching reform, and discusses the reform path of student-centered university physics classroom teaching.

Keywords: Student-centered; University physics; Teaching reform

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1. Introduction

University Physics is a course that helps students master the basic concepts and methods of physics, as well as how to use them to solve practical problems. It is an important carrier for cultivating students’ ability to solve complex problems, scientific research and inquiry capabilities, and innovative awareness. However, in current university physics teaching, the traditional model of “teachers lecture and students listen” is still the mainstream teaching model. In the new era, teachers should update their teaching concepts, implement the “student-centered” approach throughout the teaching process, and further improve the educational effectiveness of the university physics course.

2. Importance of university physics classroom teaching reform

2.1. An inevitable choice to adapt to the construction of new engineering

Cultivating students’ interdisciplinary thinking, engineering capabilities, and innovative thinking is an important educational goal of the new engineering education philosophy. With the in-depth advancement of the construction of new engineering in universities, the university physics course also needs to innovate and reform its curriculum content system and teaching model in combination with the development of the discipline field, so as to improve

students' physics knowledge literacy and ability to solve complex engineering problems^[1]. Student-centered university physics teaching emphasizes that teaching activities should start from students' cognitive laws and learning abilities. By introducing physics cases closely related to engineering practice, abstract physical concepts become clear and understandable, helping students establish the connection between physical knowledge and practical application, which can also effectively enhance students' initiative in physics learning^[2]. At the same time, teachers' application of teaching methods such as project-based learning and problem-oriented learning in classroom teaching also helps students deepen their understanding and application of physical knowledge in solving real engineering problems.

2.2. An effective way to improve teaching quality

In the new era, as one of the important basic courses for science and engineering majors in universities, the reform of university physics teaching is imperative. Implementing a student-centered education model requires teachers to fully consider students' learning needs and interests, and stimulate students' internal motivation through diversified forms and means^[3]. For example, teachers assign preview tasks to students on online teaching platforms, allowing students to naturally complete the learning and mastery of basic theoretical knowledge of corresponding chapters while watching micro-lecture videos. During formal classes, teachers then answer questions and impart knowledge to students through teacher-student interaction, group inquiry and other methods^[4]. In addition, to carry out university physics teaching reform centered on students, teachers also need to teach students in accordance with their aptitude based on their individual differences, and provide personalized learning support for students with different physics knowledge levels and learning progress by setting hierarchical teaching tasks, so as to achieve the goal of improving the quality of university physics teaching.

3. Current status of university physics classroom teaching

3.1. Relatively monotonous classroom teaching model

At present, although many teachers have recognized the importance of university physics teaching reform, they still use traditional lecture methods to carry out classroom teaching activities in order to complete the teaching tasks specified in the syllabus within the limited class hours, and have not innovatively applied diversified teaching strategies. For example, when teaching some boring physical principles and formulas, they only let students rote-learn these contents in combination with PPT courseware and textbooks, instead of introducing micro-lectures and MOOC videos to allow students to conduct meaningful learning through intuitive images^[5]. In addition, the rapidly developing information-based teaching technology has provided more diverse teaching resources and tools for university physics teaching, but some students lack the awareness of independent learning because they are used to following the teacher's rhythm in course learning, making teaching auxiliary tools such as virtual laboratories and online teaching platforms fail to play their due roles.

3.2. Weak information-based teaching capabilities of teachers

Many teachers' understanding and application of information-based teaching tools only stay at the basic operation level, and they have not effectively applied them to university physics course teaching. For example, when explaining the content of electromagnetism experiments, teachers only use traditional experimental instruments for demonstration, without using simulation software to create corresponding electromagnetic field scenarios. This makes it difficult for students to intuitively understand abstract physical processes^[6]. In addition,

to improve the quality of university physics teaching, teachers also need to design and produce micro-lectures, animations or interactive courseware that meet the actual learning situation according to students' professional characteristics and cognitive levels. However, due to teachers' weak information-based teaching capabilities, students' information-based learning experience is not ideal.

3.3. Teaching assessment and evaluation system needs to be improved

The assessment method of university physics courses in many universities evaluates students' learning achievements of the semester through final exams, focusing on examining students' mastery of physical principles and formulas as well as problem-solving skills, which cannot reflect students' practical abilities, innovative thinking, and performance in the learning process. Students' active participation in experimental operations and group projects, as well as their innovative performance, are important process-oriented evaluation indicators. The lack of these contents makes the evaluation one-sided. This single evaluation system easily makes students rote-learn knowledge points and example questions two days before the final exam to pass the exam, which is not conducive to students' in-depth understanding and practical application of physical knowledge^[7].

4. Analysis of the reform path of student-centered university physics classroom teaching

4.1. Explore ideological and political elements to stimulate students' interest in physics learning

Most university physics knowledge is a continuation of high school physics, which is more obvious in the first few chapters. However, the teaching content also focuses on the derivation of basic physical theorems, laws, and formulas. Students need to focus on using mathematical methods such as calculus to complete the derivation process, making many students feel that university physics learning is boring. Some students even have a sense of frustration in university physics learning due to their weak physics foundation^[8]. Therefore, teachers should deeply explore the ideological and political elements in physical concepts and formula derivations, guide students to understand the profound connotations behind the physics discipline, make physics learning vivid and close to students' lives, which can effectively stimulate students' interest in physics learning.

For example, when learning the content of "nonlinear optical principles", create a "master spirit" teaching module, introduce vivid cases of multiple breakthroughs and challenges in the history of nonlinear optics, and introduce scientists' academic pursuits, scientific literacy, and humanistic feelings to students, subtly cultivating students' scientific spirit. At the same time, build a curriculum ideological and political education pattern, integrate ideological and political education into the entire process of university physics course teaching, strengthen the organic integration of discipline teaching and ideological guidance, stimulate students' family and country feelings and awareness of serving the country through science and technology, and guide them to establish correct values^[9]. For example, in the teaching of "Chinese-brand crystals", focus on explaining the innovative exploration process of Academician Chen Chuangtian's team in the research of nonlinear optical materials BBO, LBO, and KBBF. Use China's first product that imposes technical embargoes on Western developed countries to stimulate students' national pride and encourage students to establish the lofty ideal of serving the country through scientific research.

4.2. Use information technology to innovate the blended classroom teaching model

Blended teaching combines traditional face-to-face offline teaching with online teaching based on digital technology, aiming to provide students with a more personalized and interactive learning experience. First,

teachers should make good use of online platforms and digital teaching tools to integrate rich teaching resources such as textbooks and lecture notes, MOOCs and micro-lectures, and experimental simulations, allowing students to choose suitable learning resources according to their learning progress and interests. For example, using virtual laboratories to carry out experimental operation training can not only ensure that students can safely conduct physics experiment exercises but also help improve students' experimental literacy and abilities^[10]. Secondly, there should be differences in teaching content for different students. Teachers can use online teaching platforms to collect students' learning data and formulate personalized learning methods for them to improve students' learning efficiency.

Finally, students should be encouraged to actively participate in online discussions and group projects. Build a platform for teacher-student interaction based on social media, online Q&A, etc., to deepen students' understanding and application of physical knowledge. In addition, in the process of university physics teaching, teachers can also introduce interdisciplinary cases and project tasks, such as interdisciplinary content of physics and engineering, physics and environmental science, to guide students to understand the practical application of the physics discipline in various fields from multiple perspectives and dimensions, and improve their core physics literacy^[11]. At the same time, teachers should establish a relatively sound teaching feedback mechanism. Through functions such as online quizzes, homework exercises, and project evaluations in online teaching platforms, real-time understanding of students' learning progress and confusion can be achieved, so as to make corresponding adjustments and optimizations to the content and model of university physics teaching.

4.3. Strengthen teacher training to improve teachers' information-based teaching capabilities

At present, the application of information technology in the field of education is becoming increasingly in-depth and extensive, and the ways and means of carrying out teaching activities have also undergone new changes. In this context, the level of teachers' information-based teaching capabilities has a direct impact on the effectiveness of university physics teaching reform. First, universities should regularly carry out special training on information technology for teachers, providing them with systematic information-based teaching concepts and theoretical teaching content, as well as rich ideas and tools for integrating online teaching resources, so that teachers have basic information-based teaching literacy and abilities^[12]. On this basis, universities can also improve teachers' mastery of information-based teaching technology through distance education, online teaching and research, etc.

Second, universities should continuously improve the mechanism for improving teachers' information-based teaching capabilities, such as establishing special teaching and research groups to regularly exchange the application of information technology in university physics teaching, and promoting communication and learning among teachers. At the same time, build a teaching resource sharing platform based on teaching and research groups, which not only collects and integrates high-quality digital teaching resources such as university physics teaching videos, online experiments, and interactive exercises to provide teachers with sufficient teaching materials but also encourages teachers to upload self-made micro-lecture videos, teaching courseware, and project cases to the resource library, so as to enhance the interest and interactivity of university physics classroom teaching with rich online teaching resources^[13]. In addition, teachers should also actively participate in teaching and research academic activities, and establish an incentive mechanism for teachers' information-based teaching achievements. Teachers who perform well in information-based teaching reform should be commended and rewarded, which not only helps teachers more accurately find the goals and directions for improving their information-based teaching capabilities but also stimulates teachers' motivation for continuous learning and self-

improvement.

4.4. Focus on students to improve the teaching assessment and evaluation system

Students' university physics course scores usually consist of two parts: usual grades and final exam scores, among which classroom performance and homework are the usual grades. To further improve the quality of university physics teaching and students' learning effects, teachers should focus on students and improve the teaching assessment and evaluation system^[14]. For example, design some open-ended questions for students after teaching each chapter. Through scientific research training, broaden students' academic horizons, cultivate their core literacy such as literature analysis ability, induction and summary ability, academic expression ability, and critical thinking, and test students' learning achievements in the form of small papers or reports.

For example, when learning about conductors in electrostatic fields, teachers require students to choose their own topics from the basics and cutting-edge research directions of superconductors. In groups, through independent retrieval, establish a small-scale "paper pool" containing 6-10 relevant academic papers from top and mainstream journals in the past five years, and carry out intensive reading and comparative reading throughout the course as one of the assessment methods for midterm and final exams of university physics^[15]. Among them, students are required to give an in-depth lecture on 1-2 papers in the midterm, as well as ask questions, evaluate, and conduct extended reading on the papers presented by other groups, and form reading reports. At the end of the term, an overall presentation of the "paper pool" is carried out, that is, students are required to refine the similarities and differences of each paper, sort out mind maps, summarize the research logic and trends of related directions in recent years, and submit reading notes and reading reports of the "paper pool". Through the above measures, students' academic inquiry ability is strengthened, and teaching evaluation is transformed from a single knowledge assessment to an evaluation of students' comprehensive abilities.

5. Conclusion

In summary, as an advanced teaching philosophy, the application of "student-centered" in university physics teaching has important practical significance for improving the quality of course teaching. By exploring ideological and political elements, using information technology, improving the evaluation system, and continuously enhancing their own information-based teaching capabilities, teachers enable students to gain real knowledge, literacy and application abilities in university physics learning.

Disclosure statement

The author declares no conflict of interest.

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