Promoting the reform of college physics teaching through information-based means

Hao Lv, *Qiaojun* Liu and *Guanghai* Guo*

School of Mathematics and Physics, Qingdao University of Science and Technology, Qingdao, China

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Abstract. With the advent of the artificial intelligence era, advanced information technology has been widely applied in physics teaching. In the reform of college physics teaching, it is of great significance to determine the orientation of information-based teaching. By fully utilizing online resources, combining multimedia teaching with traditional teaching, and using the latest interactive media, college physics classroom teaching can be further optimized to improve the efficiency of classroom teaching.

1 Introduction

With the rapid development and widespread application of information technology, information-based means have permeated various fields and played significant roles in promoting educational modernization and improving teaching effectiveness. College physics teaching, as an important part of higher education, also faces the challenges and opportunities of the information age. The traditional college physics teaching model often focuses on the imparting of theoretical knowledge while neglecting the cultivation of practical skills and student initiative, leading to poor teaching effectiveness and students' difficulty in truly understanding and mastering physics knowledge. Therefore, exploring how to promote the reform of college physics teaching through information-based means has become an important topic in current educational research.

Information-based teaching methods have characteristics such as rich resources, strong interactivity, and personalized teaching, which can provide students with a more intuitive and vivid learning experience. By integrating information-based teaching resources and optimizing teaching content and methods, the interest and enthusiasm of students' learning can be effectively stimulated, and teaching effectiveness can be improved. At the same time, information-based means can provide students with more opportunities for practical exercises, helping them better understand and master physics knowledge, and cultivating their innovative and practical abilities.

* Corresponding author: ghguo@qust.edu.cn

We aim to explore how to optimize the reform of college physics teaching through information-based means, improve teaching effectiveness, and enhance students' interest in learning. By analyzing the current status of college physics teaching and combining the advantages of information-based teaching methods, specific reform strategies and suggestions are proposed. It is hoped that this research can provide valuable references and insights for the reform and practice of college physics teaching.

2 Status and challenges of college physics teaching

2.1 Current status of college physics teaching

At present, many college physics courses still use traditional lecture-based teaching methods, with the teacher at the center and students listening and taking notes in the classroom. Although this teaching method can systematically impart knowledge, it often overlooks the students' subjectivity and participation. Disconnection between theory and practice: college physics is a course that requires both theoretical knowledge and practical skills. However, in actual teaching, there is often a disconnection between theory and practice. Students may learn theoretical knowledge but lack opportunities for practical exercises and deep thinking, making it difficult for them to truly understand and master physics knowledge. Furthermore, there are still limited teaching resources, and some college physics laboratories have outdated equipment that cannot meet students' experimental needs. Challenges facing college physics teaching

Due to the abstract and challenging nature of college physics courses, coupled with the dullness of traditional teaching methods, many students have low interest in learning physics. How to stimulate students' interest in learning and improve their learning enthusiasm is an important challenge facing current college physics teaching. The teaching effectiveness of college physics is not satisfactory because of issues such as single teaching methods and limited teaching resources. Many students may study physics courses but fail to truly grasp physics knowledge and skills, making it difficult for them to meet the demands of subsequent learning and work. With the continuous development of technology, new physics theories and technologies continue to emerge. College physics teaching needs to constantly update and improve teaching content and methods to meet the demands of technological development. The problems of learning ability, learning motivation and learning habits of students are shown in Figure 1. However, for various reasons, some universities face difficulties in updating teaching content and methods, making it challenging to keep pace with technological advancements.

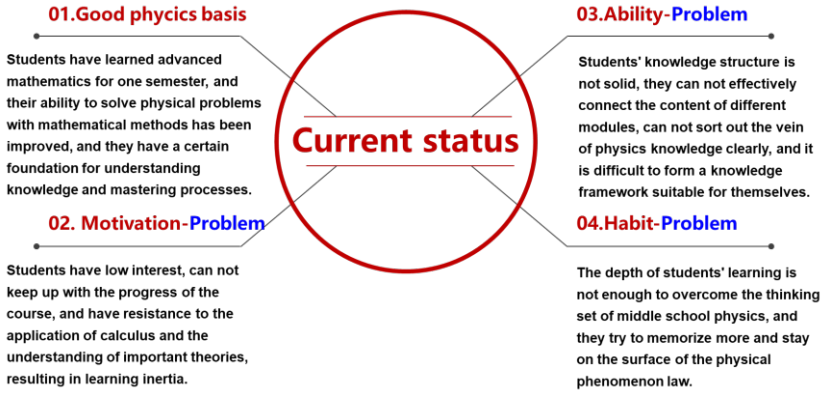

Fig. 1. The problems in college physics teaching.

3 Application and advantages of information technology

3.1 The application cases of information technology

Several methods were employed to improve the information technology-based teaching. Multimedia teaching combines text, images, audio, and video elements to make abstract physics knowledge more intuitive and easy to understand. For example, when teaching electromagnetic fields and waves, animations can demonstrate the propagation process of electromagnetic waves, helping students better visualize physics concepts. Online teaching platforms such as MOOCs (Massive Open Online Courses) and Learning Management Systems provide students with opportunities for self-directed and collaborative learning. Students can access teaching resources on these platforms anytime, anywhere for previewing, reviewing, or in-depth study. Additionally, online testing and interactive discussion features on these platforms help students reinforce knowledge and improve learning outcomes. Virtual laboratory technology offers students a safe, cost-effective, and efficient experimental environment. Through virtual experiments, students can conduct experiments, observe phenomena, and collect data without being constrained by time and location. For instance, in the optical part of teaching, we have established the basic optical principle and application expansion simulation virtual experiment project to help students understand the polarization and transmission characteristics of light in 3D. Then we introduce the academic frontier of laser holographic lithography into the experiment, which not only strengthens the optical knowledge foundation of students but also enhances the interest in learning and exploring physics, shown in Figure 2. Virtual laboratories enable students to deepen their understanding of quantum phenomena through simulated experiments. Data analysis and simulation software like MATLAB and Python provide students with powerful tools for data processing and visualization. In physics education, these software tools can be used for analyzing experimental data, simulating physical processes, or conducting numerical calculations. By utilizing these software tools, students can gain a deeper understanding of physics principles and methods.

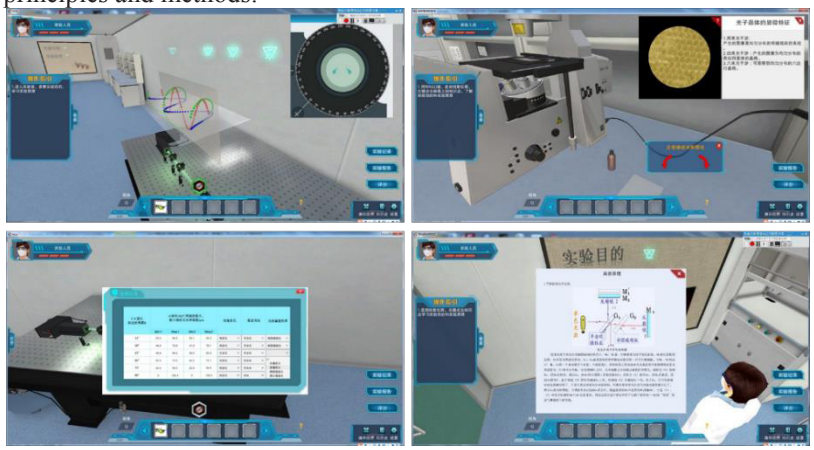

Fig. 2. The basic optical principle and application expansion simulation virtual experiment project.

3.2 The advantages of information technology

Information technology can present abstract physics knowledge to students more intuitively and vividly, thereby improving students' understanding and memory efficiency of the knowledge. Additionally, multimedia teaching and online teaching platforms can save

teachers time and energy, enhancing teaching efficiency. Information technology stimulates students' learning interest and motivation by providing diverse teaching resources and interactive features. For example, interactive discussions on multimedia teaching and online platforms encourage students to actively engage in the learning process, boosting their motivation and learning outcomes. It can also provide more opportunities for practical exercises, such as virtual laboratories and data analysis and simulation software offer students more opportunities for practical exercises, helping them better understand and master physics knowledge. Through virtual experiments and simulation calculations, students can enhance their practical and innovative skills without being limited by time and location.

4 Implement and suggestions

With the rapid development of information technology, information technology provides new opportunities for the reform of college physics teaching. To fully leverage the advantages of information technology in college physics teaching, improve teaching effectiveness, and enhance students' interest in learning, we propose the following specific implements and suggestions.

4.1 Integrate information technology teaching resources and optimize teaching content

It is very useful to develop and collect high-quality multimedia teaching materials, such as animations, videos, and interactive simulations, to enrich teaching content. Build an online question bank to facilitate students' self-testing and knowledge consolidation. Provide relevant study materials and references for students to delve deeper into learning and research. The teaching methods need to be updated with different teaching contents. Adopt the flipped classroom teaching model, where students preview materials before class and deepen their understanding through discussions and practical activities in class. Introduce inquiry-based learning to stimulate students' interest and initiative through problem-oriented and task-driven approaches

4.2 Utilize online teaching platforms to implement a blended teaching model

Select powerful online teaching platforms such as MOOCs platforms, and online course management systems, to provide a convenient learning environment and interactive tools. Regularly update and maintain platform content to ensure the timeliness and accuracy of teaching resources. In the process of teaching, real-time interaction is carried out on platforms such as Rainclassroom and Chaoxing to fully understand students' learning status and effectively enhance their enthusiasm to participate in learning. Content and background review are carried out before class, while in-class exercises, barrage feedback and in-class tests are carried out during class, then knowledge summary, mind mapping, topic training and paper writing are carried out after class. We employ a blended teaching model of online and offline integration, where the online resources provide students with flexible learning time and space and face-to-face lectures, discussions, and practical activities in offline classrooms can enhance interaction and communication between teachers and students.

4.3 Promote virtual laboratories to provide more practical opportunities

It is very useful to establish a virtual laboratory system to enhance the teaching results. In college physics, many knowledge points are not easy to understand, such as optics, quantum

physics, momentum and so on. Using a virtual simulation experiment project, we can model this difficult knowledge and realize the purpose of understanding and mastering it through virtual operation. Also, we provide virtual experimental equipment and tools for students to conduct experimental operations and data analysis in a virtual environment. During the use of virtual experiments that align with course content, students deepen their understanding of physics principles and methods through virtual experiments. Combine online and offline teaching modes, allowing students to preview and explore through virtual experiments before class, and present and discuss experimental results in class.

4.4 Strengthen teacher training to enhance information technology teaching abilities

Teachers are the key to teaching in college physics reform. We organize teachers to participate in training courses and seminars related to information technology teaching to enhance their information technology teaching skills and capabilities. By inviting experts to give lectures and share experiences, application cases of information technology teaching in college physics education are introduced. The teacher's teaching process is also to keep pace with the times, actively contact and embrace new information technology, such as the current hot ChatGPT. By using these information technologies, we can enhance teaching interest and academics, so that students can listen to, understand, and learn thoroughly.

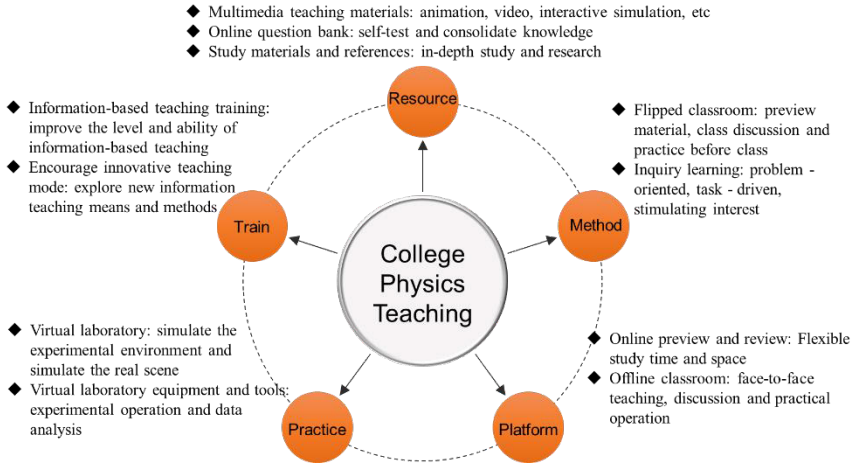

Fig. 3. The implements of college physics teaching reform based on information technology.

5 Conclusion

We explored the importance and specific implementation strategies for promoting college physics teaching reform using information technology. By conducting a thorough examination of the current state of college physics teaching and the benefits of information technology, we proposed a set of precise implements and recommendations designed to enhance teaching efficacy and student engagement. These strategies encompass integrating teaching resources, blending online and offline teaching approaches, advocating for virtual laboratories, and bolstering educators' proficiency in information technology teaching. By amalgamating information technology teaching resources, refining teaching methodologies and approaches, using virtual laboratories, and other initiatives, we can effectively improve the college physics teaching effect and talent training quality of students.

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