



Design and Practice of College Physics Online Teaching

You Yu^(✉), Dan Zhou, Yan Mei, Xuelian Niu, and Lina Wang

Dalian Ocean University, Dalian 116023, Liaoning, China
yuyou221213@126.com, {zhoudan,meiyan1971,niuxuelian,
wanglina}@dlou.edu.cn

Abstract. According to the characteristics of college physics courses, this paper has carried out teaching design and practice for online courses of college physics. In the teaching process, it has realized the integration of online teaching and modern technology based on multi platform collaboration, relying on Chaoxing Fanya platform, intelligent online homework system, digital courses of higher education society, Tencent conference and QQ. Taking students as the center, we designed a three-stage teaching mode of “preview before class, study in class, and consolidate after class” to achieve “learning before teaching” and cultivate students’ self-study ability and independent thinking ability. After a semester of teaching practice, students’ participation is high and the teaching effect is good.

Keywords: college physics · Online teaching mode · Self-study ability

1 Introduction

Due to the impact of the COVID-19 epidemic, teaching in colleges and universities has shifted from offline to online, which puts forward new requirements for education and teaching. Under the command of “suspension of classes without suspension of learning, suspension of classes without suspension of teaching”, we will continue to deepen the integration and innovation of Internet and teaching, and at the same time, we will continue to promote the construction of curriculum resources under the requirements of Golden Course [1]. College physics is a compulsory basic course for engineering, agriculture, medicine and other majors. Learning college physics not only helps to cultivate students’ science thinking and scientific literacy, but also lays an important physical foundation for learning other professional courses. In this paper, according to the characteristics of college physics course, student-centered, in order to improve the quality of teaching as the goal, relying on Superstar Fanya platform, intelligent online homework system, Tencent conference, higher education press digital courses and other platforms to reshape the whole process of online teaching, put forward a three-stage teaching mode of preview before class, learning in class and review after class. On the basis of cultivating students’ self-learning ability, we should achieve knowledge goals, ability goals and emotional goals.

2 Course Description

The course construction of university physics in our university formally began in 1978, and was determined as the key construction course of the basic department in 1997. In 1998, it was appraised as the excellent course of Dalian Fisheries College. In 2001, the course of university physics in our university was appraised as the first batch of excellent courses of colleges and universities in Liaoning Province. In 2003, the course of physics was awarded as the first batch of excellent courses of colleges and universities in Liaoning Province. In 2008, the teaching team of basic physics was awarded the provincial teaching team. In 2020, University Physics (Agriculture) was recognized as the first batch of first-class online and offline mixed undergraduate courses at the national level. College Physics (A Engineering), College Physics (B Agriculture) and Physics Experiment (including College Physics Experiment A, B and Basic Physics Experiment) are all recognized as provincial first-class undergraduate courses. Over the years, we have been focusing on improving the quality of education and teaching to carry out curriculum teaching research and reform and innovation. A total of five achievements have been awarded the undergraduate teaching achievement award of Liaoning Province, including the first prize in 2020, 2018 and 2013, and the second prize in 2009 and 2005, which has effectively promoted the level of curriculum construction.

In June 2018, Minister Chen Baosheng of the Ministry of Education first put forward the concept of “Golden Course” at the National Conference on Undergraduate Education in Colleges and Universities in the New Era. In November of the same year, Wu Yan, Director of the Higher Education Department of the Ministry of Education, made the theme report of “Building China’s Golden Course”, and put forward the criteria of “Gender One” of “Golden Course”, namely high-level, innovative and challenging [2, 3]. In recent years, the University Physics Teaching and Research Group of our university has carried out group teaching and research on the course content, formed an efficient course construction team, comprehensively promoted the construction of online course teaching resources, and built a wealth of online digital resources by recording micro-courses, building digital courses, developing and applying intelligent online homework system [4]. This paper explores the integration of double-creation education into physics teaching. In 2017, the first “College Physics Course Intelligent Online Homework System” developed by the course group in China, which can automatically read multiple choice questions, judgment questions, fill in the blanks, calculation questions and other types of questions, passed the expert appraisal, and the results reached the leading level in China. In 2020, one new agricultural project and one new engineering project were approved by the Ministry of Education. In 2021, it took the lead in formulating and publishing two national curriculum standards.

3 Exploration and Implementation of the Online Teaching Mode of University Physics

College physics is usually taught in large classes. On the premise of ensuring the quality of teaching, the key to online teaching is to let more students participate in the classroom and catch their attention. By designing the teaching mode and enriching the teaching

content, we can reshape the efficient teaching process. Teachers and students are the two main bodies in the whole teaching process. Starting from teachers and students, a three-stage teaching mode is designed, namely, preview before class, learning in class and consolidation after class (Fig. 1), to cultivate students' self-learning ability and independent thinking ability.

The whole teaching process is that the teacher issues a learning task list (Fig. 2) one week before class, requiring students to complete the preview task according to the learning task book. Learning task books are designed for students, that is, from the perspective of students, through learning task books, students need to know what to say, what to learn, how to learn, what knowledge must be mastered and what content must be completed. The task book includes chapters, materials (including the page number of the textbook and the name of the video resources in the Superstar Fanya platform), homework questions in the homework system, learning requirements and thinking questions. Students can see what they are going to learn at a glance by looking at the learning task list. The video resources in the learning task list are the videos recorded and built by the teachers of our school. The duration of the videos has been marked. Most of them are a few minutes, and a few are more than ten minutes, so as to avoid students losing interest in learning because of the lengthy videos. Teachers can emphasize and supplement the content of the micro-lesson video during the live broadcast in class, so students need to watch and preview the video in advance. The content of thinking

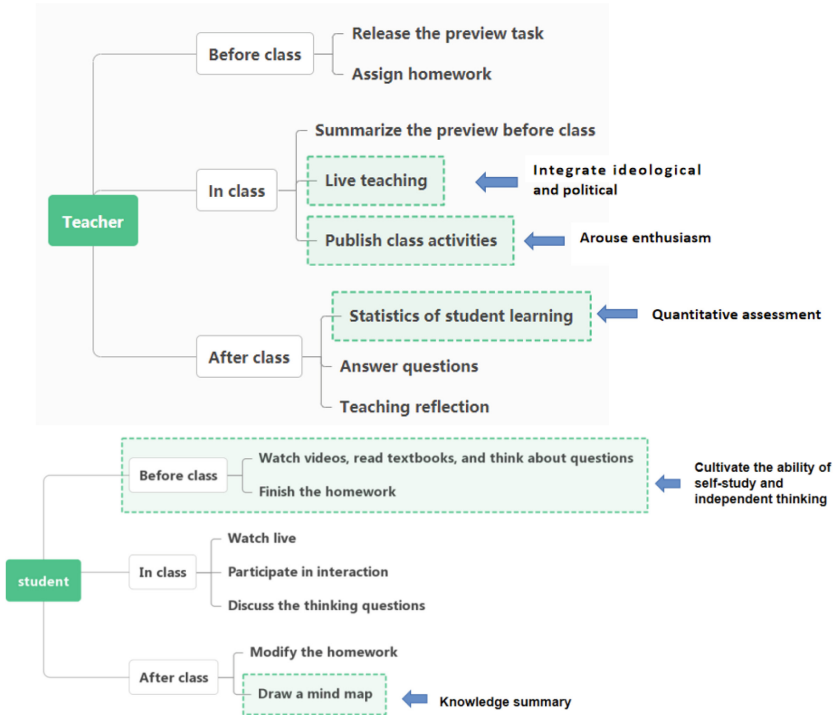


Fig. 1. Design of online teaching mode of college physics

questions is the content that students need to master to complete this section. Students can learn with questions. For example, in the section of wave interference, on the basis of mechanical vibration synthesis, we can understand the relationship between mechanical wave superposition and mechanical vibration synthesis, and then we can grasp the root cause and law of mechanical wave superposition. In the process of completing learning tasks, we should cultivate students' self-learning ability and independent thinking ability. Students have questions in the process of learning, hoping to find the answers live in class, which improves the learning efficiency in class.

Before attending class formally, remind a student to attend class in QQ group, send Tencent conference date to QQ group. Double attendance of Xuetong and Tencent conference, there are individual students who only sign in at Xuetong, but do not enter the conference room in time, late and absenteeism in the two platforms are included in the attendance, which can urge students to enter the classroom as soon as possible. The live broadcast platform of the class is Tencent Conference, which is a software with high usage rate for students. Before explaining the teaching content, the teacher releases the test questions to test the students' preview results, summarizes the students' preview situation through the answers to the test questions, finds out the weak points of knowledge, and adjusts the key points of the class content in time according to the students' preview situation. Live teaching can break through the time and space constraints of teachers and students, but students are easily affected by the surrounding environment in the learning process, so how to improve the enthusiasm of students to learn has become the key point of online teaching, I will implement from the following points:

a. While teaching the content, classroom activities are set up through learning, such as multiple choice questions, short answer questions, discussion questions, etc. According to the curve of students' attention change, the activity interval is generally set at 15–20 min. The setting of multiple choice questions is generally aimed at some conceptual, basic and judgmental questions, with strong operability and high participation of students. For the questions that can be directly selected after learning the course content, the answers are included in the usual performance assessment. For example, when the light source moves faster towards the observer, the observer measures the speed of light faster. Is this statement correct? Questions that need to be considered and calculated are not included in the usual assessment. For example, if an object is subjected to two forces and the resultant force is zero, can it rotate? Short answer questions are generally set as questions and answers to important formulas. Through students' answers, they can strengthen their understanding and memory of formulas.

b. Because there are many important formulas in the college physics course, in order to enable students to better understand the formulas, the live broadcast mode of double accounts and double cameras is used to deduce the formulas in the teaching process. One account camera is used to show the teacher's face live broadcast, and the other account camera is used to demonstrate the specific derivation process, simulating the manual derivation of the blackboard in offline class, so as to enhance students' understanding.

c. Innovation of teaching content. Physics is a natural subject with a long history. With the development of science and technology and the progress of society, physics has penetrated into all areas of human life. While teaching theoretical knowledge, it is particularly important to strengthen the application of knowledge, and to increase the

College Physics AI Online Learning Task List
I. Learning content
6.4 Diffraction, reflection and refraction of Huygens principle waves
6.5 Interference of waves (emphasis)
II. Learning Process
(1) Learning before class
a. Look at the textbook:
University Fundamental Physics (Second Edition), pp. 148-158
b. Superstar Learning Link (watch the course video):
College Physics AI-2022 Spring Semester
Diffraction and Interference of Waves in Section 7.9 (14 minutes and 49 seconds)
"Huygens' Principle, Wave Diffraction" in Section 7.8 (12 minutes and 15 seconds)
C.PDF file "Chp06 Mechanical Wave 2" uploaded in QQ group
(2) Explanation in class. Live broadcast of Tencent conference
(3) Homework after class
Log in to the online homework system, click "Homework", select the course "College Physics AI", and enter the chapter "Mechanical Wave"
(4)Q & A:
1. What is the Huygens principle?
2. What are the conditions for intervention?
3. In wave interference, who decides whether the interference of a particle is strengthened or weakened?
4. When two waves that satisfy the coherence condition interfere, what are the conditions under which the interference is strengthened and weakened?
What is the relationship between the superposition of mechanical waves and the composition of mechanical vibrations?

Fig. 2. Learning task list

cases combined with concrete practice in the teaching content, so as to improve students' interest in learning. For example, the relativity section, which is somewhat boring and abstract and difficult to understand. When explaining that the movement of light does not obey the change of Galileo's speed, the example of supernova explosion recorded in the historical materials of the Northern Song Dynasty is introduced. If calculated according to the change of Galileo's speed, the strong light of supernova explosion lasts for 25 years, but actually lasts for 22 months, which provides strong evidence for the unchanged speed of light, and can also arouse students' interest in learning and increase persuasion.

The ideological and political course in college physics aims at promoting students' correct world outlook, values and outlook on life, promoting scientific and rigorous scientific spirit, and enhancing students' sense of national pride and honor [5]. Ideological and political education in college physics course requires teachers to excavate ideological and political elements and compile ideological and political teaching plans before class. Because everything is inseparable from physics, and physics is a mature science with a

rich history of development, in addition, our country has done a lot of outstanding work in scientific research, some of which have reached the world's leading level. Therefore, there are many ideological and political contents that can be interspersed in teaching. For example, in the explanation of angular momentum and angular momentum conservation, the demonstration experiment of angular momentum conservation in Tiangong classroom of China Space Station is introduced, and the formation process of pulsars and the conservation of angular momentum in the formation process are introduced, as well as the outstanding achievements in pulsar navigation in China. When teaching the Hall effect, the history of the development of the Hall effect is introduced, and the work of Academician Xue Qikun's team in quantum anomalous Hall effect is popularized, so as to enhance national self-confidence and promote the cultivation of students' persistent and diligent research spirit. The combination of ideological and political cases in teaching makes the knowledge content more convincing and realizes the mutual promotion of teaching and educating people.

d. Optimize teaching ideas. The course of College Physics has the characteristics of covering a wide range of particles and abstract concepts. Learning College Physics well requires students to have certain science thinking. Although students have a certain knowledge base in high school, they will inevitably feel bored in the face of complex formulas in the deeper study of the university stage. This requires teachers to optimize teaching ideas, formulate the main line of knowledge in each lesson, so that students can form a knowledge framework in their minds after learning, and draw their own mind maps.

After-class consolidation learning is also very important, QQ group to strengthen communication and counseling with students, according to students' feedback, questions and supplements, improve the teaching content, forming a virtuous circle. QQ group answering questions should solve students' problems in real time and in time, otherwise it will easily affect students' enthusiasm for learning. After class, students are required to modify the homework in the intelligent online homework system. At the same time, teachers should check the students' answers in the homework system in time, sort out the error-prone questions, find out the error-prone knowledge points, and give targeted explanations and guidance in the exercise class. The attendance list of students can be derived from the Tencent conference, the students who are late and absent can be sorted out in time, and the participation of students in class can be evaluated.

4 Teaching Evaluation

Teaching evaluation is a key link to improve the quality of teaching. The most direct way to improve the quality of teaching is to communicate with students and adjust the teaching plan according to the teaching evaluation. After class, I conducted an anonymous questionnaire to the students on the situation of online learning. The situation is as follows (Fig. 3): In the survey on whether online learning can promote learning initiative, a total of 80 students participated in the questionnaire, and 56% of the students chose linear teaching to promote students' learning initiative. In the comparison of online teaching and offline teaching, a total of 94 students participated in the questionnaire, 39% of the students preferred online teaching, 45% of the students thought

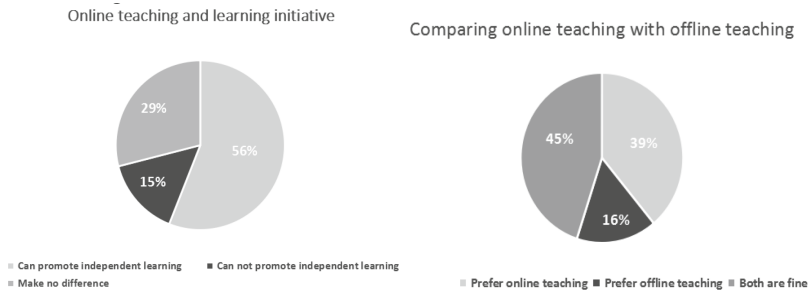


Fig. 3. Questionnaire

that both forms of teaching were acceptable. According to the communication, these students thought that online learning was not limited by time and space, and they could communicate better with teachers and answer questions more enthusiastically. Another 16% of the students like offline teaching. They think that offline learning experience is strong and their attention is easier to concentrate, while online learning feels more relaxed. In view of this, we need to strengthen the supervision of students in the future online teaching.

5 Experience and Conclusion

The outbreak of the epidemic has made online teaching teachers and students face many difficulties. Teachers should take students as the center and improve the efficiency of classroom teaching as the goal. They need to make full preparations before class, such as compiling learning task books, compiling ideological and political teaching plans, compiling test questions before class, debugging hardware, organizing and preparing classroom teaching content, and sorting out students' attendance and classroom participation after class. However, what teaching has done can also lay the foundation for offline blended teaching in the future, and improve their professional accomplishment in the process of preparing lessons. Hope that we can continue to explore and improve in the specific teaching process.

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