Online Teaching Course Design and Practice of College Physics

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Abstract—**Online teaching has demonstrated an essential role in ensuring normal teaching process and quality when the epidemic spread across the world in 2020. The pandemic didn't stop the teaching, however, it promoted the rapid development of online teaching course design and practice. How to develop effective online teaching and maximize the teaching effect has become one heated topic among college teachers of different subjects. This article takes the online teaching of College Physics as an example to explore the major problems and countermeasures in online teaching based on modern applications, websites and instant messaging tools. Through analyzing the characteristics of the teaching content and specific learning conditions of the students, this research formulated detailed teaching, adopted proper teaching methods and made effective assessment methods. The research concluded that teachers need to fully consider the students' psychological states, include ideological education in daily teaching practice, form emotional understanding, develop a complete online teaching concept, and create a harmonious interactive teaching atmosphere in order to further achieve excellent teaching results.**

Keywords—online teaching, interactive teaching, course design and practice

I. INTRODUCTION

Teaching methods and modes have been changing with the development of modern science and technology. Traditional teaching restricted within the classrooms has gradually included modern technologies and techniques. Various educational resources based on the Internet have been adopted to get rid of the restriction of space and distance, making the traditional school education an open place that has a wider influence outside of the campus. It can give full play to different subjects and educational resources and make the excellent teaching resources well circulated across the world. The unique information database management technology and interactive functions of computer networks can be effectively used in online teaching. On the one hand, online teaching system can achieve a complete tracking record of the individual learners' learning process and the institutions' personalized demand. On the other hand, the service system can provide personalized suggestions for different students based on the data recorded by the system. It can be said that online education provides a realistic and effective way to achieve personalized education [1-2].

Online teaching mainly relies on class-based teaching and real-time interaction. It takes the form of "recorded class and online Q&A" or "live broadcast + online Q&A", which adopts the way of remote teaching based on the Internet. Since the emergence of online teaching, it has received wide attention from the whole world due to its obvious advantages. For example, a course that lasts 60 to 70 minutes can be divided into several small sections. Learners can replay and study the materials at any time. It will also improve the learner autonomy. Those learners who are sitting in front of the computer will feel free to choose the subject, course and other options as they like. The Internet is powerful enough to contain numerous teaching resources, so learners can search for the information through the network and conduct deeper research to meet their need for specific academic purpose. Learning is a complex process and the Internet can provide more possibilities for learning in the modern age due to its inclusive and open features. The knowledge can be updated quickly, which is a great supplement to book knowledge [3-5]. Based on the research of previous experience on online teaching and learning, the application of this online course combines self-designed courses with existing courseware on the Internet and proves the effectiveness of online teaching of College Physics course by integrating online teaching with ideological and political education.

II. MAJOR ISSUES WITH CURRENT ONLINE TEACHING

Many problems arise with the wide application of online teaching. First of all, it lacks traditional face-to-face communication between teachers and students. Frequent emotional communication is very necessary in traditional teaching and learning process. In the first half of 2020 and during the spread of Covid-19, in order to help students adapt to online teaching, the Educational Department advocated online teaching among school teaching and learning of different levels. College students are a special group of adult learners and their learning can be guaranteed to great extent because of their self-discipline. Online teaching is accompanied by assignments, exercises and exams. Those students who lack self-consciousness and initiatives in learning can also be monitored. If effective management is not adopted, the teaching effect will be greatly reduced. Not all the teachers have had online teaching experience and it will take some time for them to get used to those teaching software and applications. If teachers keep dominating the class by covering too much time and allocate little time for students' discussion and reflection, there will be fewer interactions between teachers and students. What's more, students will feel tired after a long time of watching and listening. Online teaching lacking effective management and control of the class will lead to poor teaching and learning effects. If students lack self-discipline and proper motivation

for study, they will not concentrate on the teaching content and will turn to other entertainment things or even drop out of the class. Another problem with online teaching is that it is hard to guarantee a good learning atmosphere since teachers are unable to respond to all the students' problems and turn to appropriate teaching methods. The Q&A part and group discussions are also essential among students. Overall, the learning atmosphere in the classroom is much better than that of online teaching and learning[6-8]. Table I shows college teachers and students' views on major problems existing in online teaching.

TABLE I. COLLEGE TEACHERS AND STUDENTS' VIEWS OF MAJOR PROBLEMS WITH ONLINE TEACHING

Major problems	Teachers (percentage)	Students (percentage)
Influencing eyesight	73.9	83.4
Strengthening work/study burden	66.1	88.1
Feeling distracted	58.5	90.3
Having difficulty in supervising the class	78.3	/
Bad network connection	90.5	89.6
Poor interaction and communication	50.6	59.3
Having difficulty in correcting exam papers	41.2	/
Unsatisfactory teaching/learning effects	49.6	51.9

Online teaching has gradually become an effective way to spread knowledge, while it depends much on students' learning efficiency without teachers' face-to-face supervision. Student's high learning efficiency will help them keep up with the teacher's tempo of teaching. For those students who have low learning efficiency, they are unable to achieve academic achievements as expected. Online teaching can provide these students with the recorded courses and they can review the key points at any time to keep up with the learning process. Therefore, it calls for teachers' attention on these problems arising from online teaching and a better learning effect can be achieved with the cooperation between teachers and students.

As a compulsory course for most college science and engineering students, College Physics has particular requirements for experiment time and frequency. When online teaching is completely carried out for the whole semester, teachers should gather their minds together to solve the problems caused by this. Several video conferences and group discussions are arranged to update the teaching plans, revise the teaching materials and make effective assessment methods to make them more applicable for online teaching. Besides, teachers can also carry out personalized teaching according to the actual situation of the class size, teaching schedule, students' acceptability and other specific cases.

III. INTEGRATING ONLINE TEACHING WITH IDEOLOGICAL AND POLITICAL EDUCATION

In online teaching, it is difficult for teachers to conduct face-to-face communication with students. However, regular emotional communication is really essential for all kinds of education forms. At the beginning of the semester, in order to help students adapt to online teaching as soon as possible, they were encouraged to improve their self-discipline and sense of responsibility when they began to switch to online learning completely. Students were encouraged to form a serious attitude towards study, study actively, complete their assignments on time, and study hard to realize their own

value. There were also some students who lacked the self-consciousness and initiative in learning. It can be seen from the students' homework performance. Some students could not hand in in time and the situation would become worse if they were not given proper and timely management. At this time, emotional communication was very important. Teachers need to issue questionnaires regularly to better know particular students' problems with the course and give corresponding feedback on their requirements. Students could also be forgiven with good reasons since their study at home might be influenced by many physical or emotional changes. Teachers and classmates' help and encouragement were really necessary for those students to change their attitude and improve their self-discipline in studying at home.

As an ancient fundamental subject, College Physics contains lots of ideological and political elements. For example, when talking about the momentum theorem of the system of mass points, the teacher can relate the epidemic to the content of the class. The system of mass points is just like our country and everyone is a mass point in the system. The unity of the country and the cooperation of all citizens can contribute to the success of the war against the virus. This kind of comparison can give the students a vivid ideological and political class at the right time.

At the beginning of online teaching, many students found it interesting and were willing to devote their energy and enthusiasm to this kind of teaching mode. However, they gradually lost their interests since the course of College Physics was really difficult for most of the students who did not major in physics. It was inevitable that some students felt tired of the online courses. At that time, timely detection and intervention would be of great necessity. Different assessment methods can be adopted and combined with incentive measures to encourage everyone to face their problems directly and share their experience with others. Students are divided into different study groups to fight for the honor of their team. Regular discussion and group performance account for a large percentage of the final mark. Students' enthusiasm is greatly motivated, which will further enhance the efficiency and overall performance of the whole class.

IV. CONSTRUCTION AND APPLICATION OF TEACHING RESOURCES

A. Construction of Teaching Resources

The course of College Physics in our university adopts the high-quality curriculum resources based on Chaoxing Fanya platform and develops a teaching mode combining self-designed teaching materials and database of the platform. Self-designed teaching materials are recorded and uploaded to the chosen materials in the database. What's more, assignments, tests, weekly teaching tasks, supporting materials, syllabus, teaching plans and other relevant resources are also added to Chaoxing Fanya platform to facilitate students' self-study. Meanwhile, QQ groups and Tencent meetings are also adopted to conduct live broadcast and make real-time communication with students.

B. Application of Teaching Resources

This online course makes full use of the Chaoxing Fanyaplatform. In addition to online learning, it also conducted 13 online assignments, 14 online exams, 17 online discussions, 2 online questionnaires, 47 online

announcements and 10 check-ins. All the homework and exam papers were given timely feedback. QQ groups were used to answer questions 40 times and 16 videos were made for exams.

College Physics is an experiment-based subject. It is rather difficult for students to understand the abstract contents by simple explanations. However, high-quality online course resources can help the teachers to solve this problem. At first, students learn the major contents of the course through videos by themselves. Then, the teacher summarizes the key points through self-designed courseware, explains the key and difficult points, and answers frequently asked questions through QQ live broadcast. The combination of existing courses with self-designed materials takes the students' individual capability into consideration and can help achieve better teaching and learning effects.

V. Teaching Organization and Practice

A. Teaching Organization

The basic principle of online teaching of College Physics just includes the following procedure: issuing teaching plans, students preparation, online learning, note sharing, exams, summary of exams, Q&A and online discussion. These steps form a complete teaching and learning process and can help to achieve a better teaching effect.

B. Teaching Practice

The major procedures of one particular class include the following details. First, homework is given every Friday and students can make good preparations for the coming week according to the preview list. Next, students can study online and conduct online discussions. There are many compulsory courses for freshman students, so it is necessary to remind them and organize online teaching before each class. After the online learning, students can share their notes, which will have the teacher better know the study effects and enhance the students' initiatives as well. In addition, quizzes will be conducted the next day. The quiz is an important indicator to evaluate students' understanding of the content of the course. Through these quizzes, students will conduct a review to better solve the problems they encounter. After the quiz, pre-recorded exercise explanations will be posted in the QQ group and students' questions will also be answered. In the questionnaire, students' answers show that this mode of examination and explanation is very beneficial to them because the recorded explanation of typical questions is helpful since they can watch it repeatedly until they fully understand the points. Finally, assignments are also a critical assessment criterion in both formative and summative assessments. Students usually have a strong sense of urgency to hand in after-class assignments, but online assignment usually depends on students' self-discipline. Teachers need to control the number of online assignments, and the amount of questions and the difficulty of questions. In this way, students will not easily feel tired of repeated and numerous assignments. Also, they can find corresponding videos for these assignments. This kind of teaching and learning mode receives great response from the students. The boundary caused by physical distance is shortened by this invisible bond of interaction between teachers and students.

VI. Teaching Method Reform and Innovation

The most difficult part of online teaching is to guarantee the excellent learning effects. Exams are an effective way for teachers to know to what extent their students can benefit from the live courses or recorded courses. Teachers will provide specific advice on frequently asked questions and common mistakes in exercises and exams. Therefore, timely interactive communication and explanation can greatly improve students' learning efficiency. The teaching mode of "teaching and learning on the same day" proves to be quite useful for achieving expected results. To be specific, Q&A, exams, explanations, correcting exam papers and summary of the key points are completed within the same day.

Firstly, the teacher answers questions before the exercises or exams. According to the survey result, students raise more questions during this period. Thenexercises or examswill take place on the second day after class. The students will still have a fresh memory of the knowledge and the exercises or exams can help them to better understand the key points of the course.

Secondly, the teacherexplains the questions shortly after the exercises or exams. According to the psychological characteristics, most students are eager to know the results of the exams. Shortly after the exercises or exams, the pre-recorded videos will be sent to all students via the QQ group. Then students can compare their answers with the correct answers and find the problems in time. The teacher will also provide online support for those who still have problems with the exam questions. This kind of explanation can improve students' ability to solve problems by themselves and help them have a deeper understanding of knowledge.

Thirdly, the teacher correct the exam papers on the same day. Timely correction of the exam papers can make the teacher have a thorough understanding of students' acceptance of the knowledge points, find common problems among students, and adjust the teaching progress in time. For example, when students are dealing with the wave equation, the common problem is that most of the students have difficulty in solving the initial phase and judging the direction of transmission. A further specific class for this point will be carried out and another similar exam will take place to test whether all the students have truly understood it.

Finally, the teacher makes a summary of the students' overall performance. After the exercises or exams, the teacher will summarize the results, point out common problems, help the students to analyze the reasons for their mistakes, and encourage them to make more progress.

VII. Teaching Effects

A. Questionnaire

At the end of the online teaching of this course, a questionnaire survey was conducted among the students, and the participation rate reached 69%. They were asked to talk about their feelings about online teaching this semester. Everyone agreed with the overall online teaching concept of this course, especially the teaching mode of "teaching and learning on the same day". This teaching mode has received high praise among the students. Timely explanations and feedback will enable them to understand their shortcomings and correct them in time, deepen their understanding of knowledge content, and achieve good teaching results. Table II shows the students' level of satisfaction towards online learning of College Physics of this semester.

TABLE II. STUDENTS' LEVEL OF SATISFACTION TOWARDS ONLINE LEARNING OF THIS COURSE

	Very unsatisfied (%)	Somewhat dissatisfied (%)	Neither satisfied nor unsatisfied (%)	Satisfied (%)	Very satisfied (%)
Teaching attitude	0	6	32	59	3
Use of technology	2	8	55	30	5
Teaching materials	6	15	16	61	2
Interaction	5	10	66	10	9
Q&A	0	2	12	66	20
Correcting exercise and exam papers	0	8	8	68	16

B. Students' Academic Performance

College Physics adopts a formative assessment method, which includes regular grades and two sampling exams for the whole university. The students in this class have achieved satisfactory results, with an excellent rate of 56.85% and an average score of 79.46, which also fully proves the efficiency of online teaching of this course. Figure 1 shows the proportion of students' scores in the summative assessment.
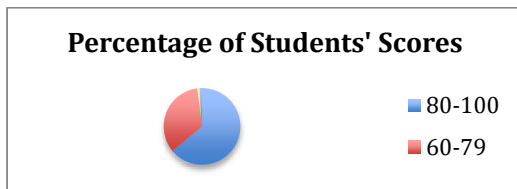

Percentage of Students' Scores
- 80-100
- 60-79

Fig. 1. Students academic performance in summative assessment (Total score: 100)

VIII. CONCLUSION

In order to improve the effectiveness of online teaching, in the future teaching, students' ideological and psychological education can be closely incorporated within the courses. When studying at home, students can't receive normal ideological and psychological education as they do in colleges and universities. The supervision of students usually relies on their parents' irregular monitoring. Teachers should rationally choose teaching materials and resources and focus on personalized course design. Teachers need to make good preparations for the class and upload pre-recorded relevant videos for students to review them when they are in trouble with their study. At the same time, students follow strictly teachers' instructions, actively participate in group discussions, finish assignments, raise questions and seek help from the teachers and classmates. The questionnaire and students' performance show that online teaching can be a great supplement to traditional in-class teaching mode when it is well employed [9-10].A harmonious relationship between teachers and students will help to create a great learning environment for students, improve the students' motivation, enthusiasm and initiatives to achieve better effects.

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