

# Exploration and Practice of Intercollegiate Credit Teaching Mode of Electromagnetic Fields and Waves

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**Abstract:** The overall allocation of higher education resources in China is relatively inadequate, and there is a lack of high-quality resources. In order to promote educational fairness and better promote the sharing of high-quality educational resources, colleges and universities are actively implementing the work of undergraduate intercollegiate credit, and the intercollegiate study credit has become one of the important directions of higher education reform. This paper takes the Electromagnetic Fields and Waves course as an example, starting from the intercollegiate credit teaching mode, the construction of the course team, the problems of the course intercollegiate credit teaching, the ways of reform and so on several aspects of the elaboration, through the construction of the student as the main body, the teacher as the leader of a new type of teaching mode, to enhance students' interest in learning, to better help students to complete the intercollegiate credit, but also to provide a reference for the subsequent teaching reform work. It also provides references for the subsequent teaching reform work.

**Keywords:** Electromagnetic Fields and Waves; Teaching Mode; Intercollegiate Credit; Teaching Reform; Flipped Classroom

## 1. Introduction

The arrival of the Internet+ era not only facilitates people's lives, but also provides a wealth of high-quality online learning resources. With the promotion of the Internet, open education resources have developed rapidly, the traditional teaching mode has been unable to meet the needs of the times, the reform of education and teaching mode has become an inevitable trend in the development of higher education at this stage<sup>[1]</sup>. Intercollegiate credit is the innovation of education and teaching mode in the context of the new era, in order to improve

the students' independent learning ability, professional ability, and to achieve the goal of collaborative sharing of educational resources, the intercollegiate study education and teaching mode has shown great advantages<sup>[2,3]</sup>.

Electromagnetic Fields and Waves course intercollegiate credit teaching online resources are carried out by the online open course platform "Cool learning Liaoning". The course is built by Liaoning University of Science and Technology, which is mainly responsible for the development and maintenance of online videos, online teacher-student interactive, chapter tests and uploading of online homework. Shenyang Jianzhu University, as the user of the course, is mainly responsible for students' offline classroom teaching, homework correction, and personalized counseling through understanding students' knowledge mastery, final exam arrangement, student scores and intercollegiate credit recognition. Students complete various tasks and assignments in a teaching mode that combines e-learning and regular offline classes.

## 2. Problems of Intercollegiate Credit

Compared with the traditional teaching mode, the teaching of intercollegiate credit not only provides students with more abundant course information and a good learning environment, but also cultivates students' independent learning ability. Students can acquire diversified knowledge and information, thereby achieving a comprehensive mastery of the curriculum content. However, in the practice of intercollegiate study, combined with the feedback from teachers and students, there are still some problems in teaching.

### 2.1 Students Lack Good Online Autonomous Learning Habits

Intercollegiate study course content requires students to independently learn relevant chapter videos, exercises and other content on the network resources in their spare time after

completing the school classroom learning. Due to the flexible and free learning mode, the learning time and place are not supervised by teachers, and some online teaching content videos are too long, leading some students to relax their requirements of their own, just simply brush the video to complete the learning task. Students gradually lose their interest and attention in online learning, and do not give full play to the superiority of online teaching.

## 2.2 Students Have Different Mathematical Foundations

The Electromagnetic Fields and Waves course has a lot of mathematical knowledge, and the theoretical derivation is dry and complex<sup>[4]</sup>. Some students hold the attitude of coping with the examination to study higher mathematics during the epidemic, and their weak mathematical foundation leads to difficulty in understanding and unsatisfactory mathematical effect when learning this course in the later stage. In addition, this course requires a certain foundation of physical knowledge<sup>[5]</sup>, and electromagnetism is theoretical and abstract, so many students are afraid to learn this course.

## 2.3 Single Teaching Assessment and Evaluation

The assessment mode of Electromagnetic Fields and Waves is based on the final closed-book examination results, and the online study results account for 10% of the total results, and only assess the degree of completion of the video viewing. This assessment method does not fully consider students' self-study effectiveness, does not test their autonomous learning ability, and overlooks the importance of independent learning. The assessment results do not clearly reflect whether have diligently studied the online course content, leading some students to merely watch videos without engaging in autonomous learning or active thinking.

## 3. Reform of Intercollegiate Credit Courses

The reform of the teaching mode of the Electromagnetic Fields and Waves course for intercollegiate study integrates educational theory and educational practice<sup>[6]</sup>, and follows the steps of "planning-implementation-feedback-revision-re-implementation" in the process of implementation, constantly optimizes the course content, improving teaching methods and assessment methods, and improving the teaching effect<sup>[7]</sup>. The course team combines offline teaching and assessment methods to

carry out reform work, so that there is both theoretical basis and applied exploration. The reform of the teaching mode of Electromagnetic Fields and Waves course for intercollegiate credit mainly includes the following aspects.

### 3.1 Reasonable Planning of Online and Offline Mixed Teaching

The intercollegiate credit course of Electromagnetic Fields and Waves mainly adopts the teaching method of combining online network resource theory course independent learning and offline classroom face-to-face teaching plus flipped classroom<sup>[8]</sup>. According to the requirements of the course syllabus and teaching schedule, make detailed online cross-school study plan and offline face-to-face classroom teaching plan. Each chapter of online learning content is assigned by the instructor in advance, and students are required to complete independent study within a specified period of time. It mainly includes video, lecture notes and PPT viewing, task point exercises, online quizzes and online unit tests. Students can use their own fragmented time to study online videos, chapter quizzes and other task points, and there is no limit to the number of times and duration of task point content study. When students have questions during the learning process, they can solve them by discussing with the online lecturer or other students through the online forum, so that students can solidly grasp the basic knowledge of electromagnetic fields. In offline teaching, flipped classroom mode is adopted for some difficult contents. Students report to each other in groups, teacher and students discuss and interact in class to solve these problems, and groups are encouraged to participate actively in solving them through competitions and other ways. In the student report and discussion, the teacher found the knowledge that the students did not master, and explained and sorted out.

### 3.2 Focus on Cultivating Students' Ability

Teacher is "light on formulas and heavy on essentials" in the offline classroom. Teacher introduces the frontier progress of electromagnetic field in conjunction with knowledge points, so that students can understand the progress of this subject and deepen their understanding of knowledge points, stimulate the interest in exploring the nature of science, cultivate scientific thinking. The key

knowledge that is difficult to understand and master in the course content is explained with examples and engineering examples, the ideological and political elements such as Beidou satellite and FAST are integrated into the course, which improves students' learning interest, cultivates students' scientific literacy, scientific spirit and socialist core values, and achieves the same direction and long-term ideological and political cooperation. The teaching is student-oriented, encouraging students to participate in scientific research projects of professional teachers, such as electromagnetic parameter measurement combined with terahertz communication, guiding students to participate in various innovation and entrepreneurship competitions, etc., which improves students' hands-on practice and innovation ability in various aspects.

### 3.3 Attaching Importance to the Correlation between Courses

According to the characteristics of the Electromagnetic Fields and Waves course, the teaching team modifies and formulates a more scientific syllabus and cultivation plan, and builds a solid mathematical and physical foundation before learning this course. "If you want to do a good job, you must first sharpen your tools". When explaining the content of the first chapter of vector analysis of this course, the teacher uses a certain teaching time to review the relevant content of higher mathematics required by the course, and does more exercises and quizzes to help students establish a good mathematical foundation, establish the concept of vector field analysis, remove the obstacles in mathematics, and lay a foundation for subsequent systematic learning.

### 3.4 Diversified Assessment and Evaluation Mechanism

The assessment indicators of online learning process are no longer simple, mainly including: the integrity of online teaching video viewing (students need to complete the task of watching course videos within the time specified by the teacher), the completion quality of chapter tests, and the degree of participation in online discussion. The assessment indicators of offline learning process mainly include: class listening status, class group presentation, discussion participation, homework completion quality, etc. Through the establishment of a multi-

dimensional assessment and evaluation mechanism<sup>[9]</sup>, we can not only fairly and comprehensively assess students' performance, but also deepen students' mastery of basic knowledge and improve students' ability of independent learning<sup>[10]</sup>, unity and cooperation, independent problem-solving and innovative practice.

The regular process evaluation is mainly conducted online, including teacher evaluation, peer evaluation, and automatic evaluation by the Learning platform. The evaluation content mainly focuses on the basic knowledge and theory of Electromagnetic Fields and Waves. The final closed-book examination content mainly focuses on the mastery of the basic knowledge of Electromagnetic Fields and Waves, as well as the practical application of basic theory in the field of electromagnetic waves.

### 4. Implementation Effect of Intercollegiate Credit

The implementation of the intercollegiate credit teaching mode broadens the horizon of teachers and students, further promotes the reform and construction of classroom teaching, and cultivates students' ability of independent learning, communication and expression, and ability to analyze and solve engineering problems, and has achieved remarkable results.

The number of students in the two semesters of Electromagnetic field and electromagnetic wave course is 61, here, the examination results of the students of the grades of 2021 and 2022 in the course Electromagnetic Fields and Waves are compared. The data show that the highest score rate of students watching videos is 95.2%, the discussion score is 90.1%, and the test score is 84.3%. Comparing the examination results of students in grades 2021 and 2022, 16.7% of students in grade 2022 scored more than 90 points, which is higher than that of students in grade 2021. The average score of students in grade 2022 is 74.5, which is higher than that of students in grade 2021, which is 72.3. It can be seen from the examination results that with the continuous adjustment of the teaching method of inter-school credit, the teaching effect is constantly improved.

### 5. Conclusion

Intercollegiate credit is a new type of teaching mode, with the help of the Internet platform, it breaks through the traditional teaching mode and

barriers between colleges and universities, realizes the sharing of high-quality teaching resources between different schools of the same discipline, and meeting the needs of students' personalized learning. Practice has proved that the electromagnetic field and electromagnetic wave course after the implementation of intercollegiate credit teaching mode, students' interest in learning increased significantly, students actively participate in the classroom tasks, the number of participants in the discussion of interactive activities increased significantly, students no longer put aside the problem but boldly ask questions, students' grades steadily improved, and also achieved good results in the various innovation competitions.

There is no end to curriculum reform, which requires continuous innovation and improvement. In the future course construction, we will adhere to the student-centered online and offline teaching, improve the teaching quality of teachers, ensure the quality of teaching resources, and realize the deep integration of online and offline teaching modes of intercollegiate credit.

### Acknowledgments

This paper is supported by 2022 Liaoning Province General Higher Education Undergraduate Teaching Reform Research Quality Teaching Resources Construction and Sharing Project (No. 2022-192 , 2022-182). 2022 Electromagnetic Field Theory and Microwave Technology Liaoning Province First-class Undergraduate Programme.

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