

Research on Classroom Instruction Methods for Electromagnetic Field and Wave Course

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Abstract

Electromagnetic Field and Wave is one of the specialty basic courses for Electronic Information major. In this paper, from the feature of the course combining the practice in teaching, the current teaching situation is analyzed and thus a series of improvement measures was suggested to enhance the effectiveness of classroom teaching and make students grasp Electromagnetic Field and Wave theory.

Keywords

Electromagnetic Field and Wave, Problem context, Excise design.

1. Introduction

Electromagnetic Field and Wave is an important fundamental course for undergraduate students majoring in the subject of Communication & Electronic. The content which it refers to is a necessary element of the knowledge structure of the students majoring in Communication & Electronic[1]. This course provides the theory foundation for other relative courses such as, microwave technique, Mobile Communication Technology, Fiber-Optical communication, RF Circuit Design, Electromagnetic Compatibility, and so on. While, it is also one of the most difficult courses to teach and to learn in Communication and Electronics Specialties, for it is a strong theoretical and systematic course, involves lots of conceptions and equations which are hard to understand, and needs the knowledge of some other courses such as College Physics, Advanced Mathematics, Complex Variable Functions and so on. It has become an outstanding issue in teaching practice to instruct students grasp and be able to apply the basic theory and analysis method within limited classes.

In order to improving the teaching effect of the course and make it meet the demand of current personnel training better, many colleges and universities are actively exploring, and reaped some of the benefits. X. Cao[2] and L.R. Kong et. al. [3] reported their reform method on the theory teaching of the course Electromagnetic Field and Wave, respectively. T.X. Zhao et. al. explored the reformation of Electromagnetic Field and Wave experimental teaching[4]. L. Wang et. al. designed and developed a virtual simulation system for the electromagnetic fields and electromagnetic wave to help students learning the course Electromagnetic Field and Wave[5]. Recent years, flipped classroom, a new teaching model, based on massive open online courses (MOOC) is applied to teach the course Electromagnetic Field and Wave [6].

In the present paper, the current situation of the course Electromagnetic Field and Wave teaching has been analysed firstly combined with the teaching experience. Aimed on improving teaching quality, some improving measures then have been suggested according to the features of the course.

2. Teaching Status

As far as Electromagnetic Field and Wave is concerned, most of the teachers think it is rather difficult to clarify the course in the class teaching, and most of the students generally arouse

they can hardly grasp it in the learning process. On the one hand, from the teachers perspective, a large number of formula derivation are utilized in the class teaching process, so that most of the students only notice the mathematical experience and ignore the physical meaning of those equations. On the other hand, from the view of the students, knowledges from many other courses studied in the past is needed in learning Electromagnetic Field and Wave, which is a challenge of their background and increases the difficulty of learning. In particular, a part of students are out of touch with the physical conceptions, which have effect on their comprehension of the principles and conceptions in the course. These part of students only can mechanically memorize the formulas, but often have no idea to resolve the specific problems.

With the readjustment and reform of the curriculum system for electronic and communication specialty in recent years, the curriculum class hours of the course Electromagnetic Field and Wave has been adjusted to about 32~48 class hours, which further increased the difficulty in teaching and learning. In order to complete the course in the limited class hours, nowadays the multimedia teaching mode has been applied in most courses class teaching process. Compare with the traditional teaching mode, the information in each lecture has increased, students who receive the knowledge passively can hardly catch up with the pace of the teacher. In addition, it is impossible for students to focus on the teacher's topic throughout nearly one and a half hour, since there are often two classes arranged in succession in most colleges. Thus, the teaching effect is not satisfactory.

3. Some Improvements

To change the present teaching situation and improve the quality of the classroom instruction, it appears to be very important to study and explore on teaching methods so that students can grasp the basic theories and analysis methods of the course better. Through the teaching practice, some suggestions are obtained and presented as follows.

3.1. Set Circumstance of the Problem to Inspire Study Interest

In the teaching processing, teacher should establish relative problem circumstance based on teaching content and students' characteristics of cognition and life practice, and guide students find out and solve the problems with the methods of positive-thinking, active exploring and practice experiment, so as to achieve the goals of making students acquire and apply the knowledges, cultivating students' ability of exploring and creating, and developing students' intelligence radically.

For example, before explaining the conception of polarization, teacher may ask students the following questions: how would you do if your cell phone signal is not clear? or the question: how to adjust the radio antenna can we receive the radio program most clearly? Combine with students' experience, it can be explained as follows: when the signal is not rather clear, we can adjust the position of the cell phone till the receiver antenna of the phone match the state of polarization of the incident wave in certain direction, so as to obtain optimal reception. While the antenna of the radio should be adjusted to parallel to the ground, for the FM radio signal is carried by linear polarization waves parallel to the ground. That leads to the concept of polarization of electromagnetic wave, the characters and relationship of linear, circular and elliptic polarization wave are then introduced, and the principle of the polarized antenna is demonstrated.

3.2. Add Introduction of Applications

With the development of science and technology, the electromagnetic field theory has been widely applied in many fields such as the engineering practice, scientific research, even in our daily life. These applications provide many useful examples for teaching. For instance, when electrostatic field is concerned, electric precipitator, capacitance-type probe and other

applications should be introduced; when it comes to steady currents field, the working principle of electrocardiogram and crack flaw detector are explained; when stationary magnetic field is demonstrated, magnetic suspension technique, magnetic sensor and other relative techniques are discussed.

A practical way to making good use of these cases consciously is to ask students some questions encountered or heard of in their daily life. Example, how to make a plane invisible? why the metal vessels is not suitable for the microwave oven? what is the principle of electromagnetic stove? why a shot-wave radio can receive more program in night? By this means, students will learn the course with these questions, and fully realize the importance of the course, thus increase the learning motivation of the students. In addition, introducing some practical application projects will make students know a little bit about the development of the relative subjects and enhance their capability of self-study and the learning effect.

Giving the case of teaching of the conception of polarization as an example also, for the sake of guaranteeing greater comprehension of the concept of polarization of electromagnetic wave, the following questions are left to students to answer after class by search the information on internet or in library: why is the control signal for rocket carried by circular and polarization wave? what is the principle of the stereoscopic film? why should we wear a special glass when watch the stereoscopic film? By analysing these practical cases, students get a deeper understanding on the concept of polarization of electromagnetic wave.

3.3. Increase Exercise Training

During the teaching process, some students often say that they can understand what the teacher saying in the class but can not figure out the exercises. It is a widespread phenomenon among students. Because the electromagnetic problem is not a merely mathematical problem. Therefore teachers should master students' learning situation in time, according to which to adjust their teaching pace, summarize knowledge points timely during expounding the conceptions and principles, and generalize methods of solving problems after explaining sample questions.

Except that, the class-exercise can play a positive role in teaching process, and organizing students do appropriate amount of exercise in class is an efficient way to develop students' problem-solving ability. On the one hand, class-exercise can be used to adjust the classroom teaching rhythm, and there would be a degree of relaxation during class-teaching process. On the other hand, designing reasonable class-exercise can help students deepen the understanding of knowledge points and participate in class-learning energetically. Furthermore, class-exercise can feedback the teaching effect in time, and teacher should take measures to improve teaching at first time. After class, students are encourage to do more exercises, and teachers' guidance are given promptly through various channels including online method.

3.4. Simplified Mathematical Derivation Process

Students, especially those in the application-oriented universities, have so little knowledge of mathematics and physics that they will be frightened when they encounter so many mathematical derivations in the textbook. Even, a little part of the students hear of the difficulty of the course Electromagnetic Field and Wave from seniors, and engender repulsion in psychology. To address this situation, teachers should simplify the mathematical derivation process as possible, and shift emphasis to the analysis mentality. So that the complicated mathematical calculations are decreased greatly. At the same time, teachers should take advantage of the duality relationship between some knowledge points, such as the relationship between the polarization and magnetization in a stable field, the relationship between electrostatic field and constant magnetic field, the relationship between time-varying electric field and magnetic field,

and so on. The comparison between these pairs of duality knowledge points can help students make sense of these knowledges and increase the teaching effect.

3.5. Reform Teaching Methods

One of the main reasons why the course Electromagnetic Field and Wave is hard for teachers' teaching and students' learning is that in this course the electromagnetic phenomena are described in mathematical language, numerous mathematical knowledges are applied in the expounding process, such as Laplace equation, Poisson equation, divergence, curl, gradient, and so on. In traditional blackboard teaching, the derivation of those equations take a substantial amount of time. Due to this, the classroom teaching efficiency is decreased, and students feel boring in the class. Besides, the blackboard teaching can not well display the abstract conceptions and models of physics.

These weaknesses of the blackboard teaching can be made up by means of modern multimedia technology. The mathematical derivations of the important theories can be edited by Equation Editor before class and displayed through the PPT in class, and teachers then can focus on explaining the physical meaning of these equations, so as to achieved the goals of saving class time and enhancing teaching efficiency. Moreover, some software, such as MATLAB, Flash, can be used to draw potential distribution figure, time-varying field map, and so on. Also, simulation software is applied to make the abstract concept become intuitive and increase students' interest in learning. combining the blackboard-writing and multimedia technology can make the pace of the class teaching orderly and improve the teaching effect.

4. Conclusion

In summary, the current teaching situation of the course Electromagnetic Field and Wave , one of the specialized basic courses for the subject of Communication & Electronic, is analysed in this paper. And a series of improvement measures are suggested from multiple points of view, such as, the view of raising students' interest in learning, the view of improving students' analytical skills , the view of controlling teaching pace in class, and so on. It is believed that these measures would be helpful for enhancing the quantity of class teaching and giving students a great base in further study.

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