

Characteristic Instructional Methods in the Teaching of Electromagnetic Field and Microwave Technology

Cuizhen Sun^{a,*}, Xiaojun Huang^b, Rong Li^c, Ming Zhang^d

School of Communication and Information Engineering, Xi'an University of Science and Technology, Xi'an, Shaanxi, China

^ascz@xust.edu.cn, ^bhxj@xust.edu.cn, ^c9331336@qq.com, ^d1637420689@qq.com

*Corresponding author

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Abstract: Electromagnetic field and microwave technology course has many features such as abstract concept, the students' low learning enthusiasm. Several characteristic teaching methods during teaching of the related course are proposed, combined with the learning characteristics of contemporary college students. The results show that the proposed methods can make the abstract theory vivid, increase the students' learning interest, improve the students' ability to solve practical problems, teaching effect is improved obviously.

1. Introduction

The development of today's society is inseparable from the exchange of information, and almost all the major technological advances in the field of electronics and information are inseparable from the breakthrough of electromagnetic field and microwave technology. The courses of electromagnetic field and microwave technology mainly include "electromagnetic field and electromagnetic wave", "Microwave technology and antenna" and "Radio frequency and microwave circuit", which are basic courses of electronics, communication and other majors.

The teaching objectives of the course system are to train students to have the ability to analyze the qualitative process and quantitative methods of electromagnetic phenomena, guide students to master the design methods of microwave passive circuits ^[1,2], and lay a foundation for learning related professional courses in the field of electronics and information. This course plays a decisive role in students' subsequent study of specialized courses. The traditional theory teaching method is to explain the theoretical knowledge step by step, theory and application are relatively separated. In order to stimulate students' interest in learning, improve students' ability of combining practice and theory, this paper puts forward several characteristic teaching methods, and carries on a series of reforms to the theoretical and practical teaching links. Through several years of teaching practice, good teaching effects have been achieved.

2. Current Situation and Characteristics of "Electromagnetic Field" Series Courses

Electromagnetic field and microwave technology is a basic course for electronic information majors, which plays an important role in different curriculum systems. For example, the courses of "Electromagnetic field and Electromagnetic wave" and "Microwave Technology and antenna", together with the courses of "Communication principle" and "Mobile Communication", constitute the curriculum system of communication majors. Together with "Circuit Analysis", "Analog Electronic technology", "Digital Electronic technology" and "High-frequency electronic technology" and other courses, a complete electronic professional curriculum system is constituted. In addition, such courses form the professional foundation of the first-level discipline "Electromagnetic Field and Microwave Technology" ^[3].

Through the study of this course, students can be engaged in mobile communication, aerospace,

radar communication and other related engineering research to lay a foundation, so how to improve the teaching effect of this course is very worthy of attention. However, due to the relatively independent system of each course, the teaching content is lack of interaction and communication. For example, the mathematical knowledge required by the electromagnetic field and microwave series courses is scattered in different semesters of mathematics courses. The content of conformal transformation is taught in the complex function, but it is not emphasized enough, which leads to the students' incomplete grasp of knowledge. It is precisely because of the complex course, abstract physical concepts, more mathematical methods, strong theory and other reasons, teachers feel difficult to teach; Because of the lack of perceptual knowledge, students also feel difficult to understand and learn. Especially since 2008, in order to meet the needs of wide-caliber talents training [4], the class hours of this course have been greatly reduced, but the reform of engineering education and the development of radio frequency communication technology have continuously increased the requirements on students' knowledge and ability. Therefore, it is urgent to reform and construct the teaching content, teaching method and teaching means of electromagnetic field and microwave technology. In order to effectively solve the contradiction between the compression of class hours and the cultivation of knowledge, ability and quality, the following characteristic teaching methods can be adopted.

3. Several Characteristic Teaching Methods

3.1. Rational Use of Various Teaching Methods and Means

In view of the characteristics of the Microwave technology course, such as many basic concepts and difficult to distinguish, the comparative analysis teaching method is adopted to teach the contents with similar analysis methods [5,6], so that students can deepen their understanding of the differences and connections between the former learning content and the new learning content. For example, the analysis methods and characteristics of uniform plane waves in conductive media are compared with those of uniform plane waves in ideal media. The contrastive teaching method simplifies the analysis process, makes the teaching content form a whole from the scattered knowledge points, and strengthens the connection between the course contents.

In view of the poor combination of theory and practice in the course of Electromagnetic field and Microwave, combining the composition of radar systems and communication systems, the teaching content of Microwave technology and antenna is introduced [7], so that students can form the knowledge of the system concept. Combining the antenna tuning coupler of high frequency communication system, the working state and impedance matching of transmission line are taught; The wall current in the waveguide is taught by combining the radar antenna. Combined with the communication navigation system, the radio wave propagation law and characteristics of each band are taught. As a result, students' ability to analyze engineering practical problems with theoretical knowledge is cultivated, they are fully aware of the role of the course "Electromagnetic field and Microwave technology" in the curriculum system and professional training objectives. They can pay more attention to the study of the course from the ideological perspective, their motivation and enthusiasm of learning are stimulated greatly.

In view of the characteristics of compressed class hours and unchanged teaching tasks, in order to allow students to master the theoretical knowledge of electromagnetic field and microwave technology in a short period of time, we change the traditional teaching ideas of large and full, so as to explain less content but fine. First of all, in the course of lesson preparation, through various ways, a large number of relevant pictures, videos and animation materials were collected, made and summarized. In the actual teaching process, we elaborate multimedia CAI courseware, use the CAI courseware with picture, shape, sound and other effects to explain abstract and difficult problems, instead of a lot of complicated text instructions, the purpose of saving time and improving efficiency are achieved. For example, the real-time changes in the waveforms of traveling and standing waves, the polarization of electromagnetic waves can be demonstrated through vivid multimedia animations.

3.2. Heuristic Teaching Method

Heuristic teaching method is a teaching method which takes students as the main body and teachers as the leading, it guides students to study independently through questioning, experimental demonstration and teacher-student interaction, so as to make students develop in an all-round way.

According to students' knowledge level and the difficulty of teaching content, teachers can apply heuristics method in different stages of teaching. When to interact, teachers should make reasonable teaching design. For some certain problems, through putting forward questions by teachers, students' learning motivation can be inspired, this method trigger students to actively start thinking, active thinking and learning, so as to obtain the effect of analogy. From the beginning of the "breakthrough", we must try to arouse the interest of students, which is the implementation of the "heuristic" teaching principle of the basic guarantee. When asking questions, we should be good at setting up problem scenarios, put forward relevant questions after stimulating the exploration of problems, so that students are willing to think, eager to think, and easy to think. For example, when talking about the "electromagnetic wave propagation", the sending and receiving of cell phone signals are put forward firstly, then the propagation of electromagnetic wave is introduced by analogy; At the same time, students can observe the transmission process of "water ripples".

3.3. Theoretical Courses Integrated with Specific Projects

Specific projects can be used to drive teaching. Teachers and students complete corresponding teaching activities by jointly implementing a complete project^[8]. The project here is mainly directed to a certain teaching content and designed to be completed by students independently, it can receive a good teaching effect of the task.

This paper takes "the design of microwave cavity filter" as an example to illustrate the implementation process of project-driven teaching method in the whole teaching process: First of all, before the implementation of the project, the teacher put forwards the design requirements of the project to the students. Guiding students to independently consult relevant literature and complete the formulation of technical plan, students' self-study ability is cultivated; In the process of project implementation, teachers should give appropriate guidance to students after completing the selection of project tasks combined with the teaching content, which mainly includes the explanation of new knowledge and the specific implementation of the project, then guide students to collect the information needed to complete the project.

3.4. The Use of Computer Technology

Computer technology has developed rapidly, the running speed has also developed from MHZ to the current GHZ. Computer has become an indispensable tool for engineering researchers, it has been widely used in various engineering fields, including electromagnetic field and microwave technology.

The electromagnetic field and microwave series, which consists of rigorous mathematical proofs, precise experiments and scientific abstractions, is both difficult to teach and difficult to learn. It requires a lot of mathematical methods, which are often daunting for undergraduates. Electromagnetic field and microwave series courses are some engineering and practical courses, which need a lot of theoretical knowledge and practical skills. The teaching effect of these courses must be verified by practice. However, in order to solve the contradiction between the lack of experimental funds and the cultivation of students' practical ability, software can be used to assist teaching.

4. Conclusion

Electromagnetic field and microwave technology is a very theoretical, practical and comprehensive professional basic course, not only to consolidate the theoretical basis of students, but also to cultivate students' practical ability. Because of the large amount of mathematical knowledge involved, students find it difficult to learn. In order to visualize the concept of the abstract, make the theory class teaching easy to understand, we are constantly in the actual teaching attempt and explore the features in the process of teaching means and methods, the traditional teaching method are

combined with specific project, computer technology. By introducing the "heuristic method of teaching" and other means of teaching. Our visual teaching method has paid off through the pilot inside the class gradually. It can not only use modern teaching methods to carry out comprehensive exercise of knowledge, but also play the leading role of teachers and embody the main role of students in the whole teaching process.

In the teaching process, different characteristic teaching methods can be introduced according to the basis and specialty characteristics of students of different majors. In the early stage of teaching, the workload of teachers is relatively heavy, because the new teaching content is introduced in the classroom, and teachers need to design large and small topics and tasks. But the investment of time and effort by teachers is well worth it. The learning initiative of the students has been mobilized, and the ability of all aspects has been greatly improved. Electromagnetic field and Microwave technology series course is no longer difficult to teach, no longer difficult to learn. This also fully demonstrates the value orientation of "ability-based" in higher education.

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