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Teaching Reform of "Electromagnetic Field and Electromagnetic Wave"

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Abstract

High-quality compound talents with strong ability of practice and innovation are important indicators for the construction and development of new engineering disciplines, which puts forward new requirements for professional curriculum education. In the context of the new engineering discipline, this article has conducted an in-depth analysis and reflection on the reform of the teaching mode of the course "Electromagnetic Fields and Electromagnetic Waves" for the major of Electronic Information Engineering. The article analyzes the necessity of the curriculum reform of the major of electronic information engineering, analyzes the problems existing in the teaching mode of "Electromagnetic Field and Electromagnetic Wave". Aiming at the characteristics of "Electromagnetic Field and Electromagnetic Wave", we think about teaching reform from the teaching content, teaching methods, teaching methods and assessment methods. Through practice, students 'enthusiasm for studying the basic laws of electromagnetic fields and electromagnetic waves can be stimulated, and students' engineering application ability in the new engineering background can be cultivated.

Keywords

New Engineering, Electromagnetic Field and Electromagnetic Wave, Teaching Reform.

1. Introduction

In order to cope with the new opportunities and challenges faced by the new round of scientific and technological revolution and industrial reform, the Ministry of Education has proposed the "new engineering concept", that is, the purpose of the construction of new engineering is to cultivate outstanding engineering technologies that will lead the future technology and industrial development Talents provide talent guarantee for China's industrial development and international competition. Academician Zhong Denghua of Tianjin University pointed out that the connotation of the new engineering discipline is: taking the concept of responding to change and shaping the future as the main approach, inheriting and innovating, crossing and integrating, coordinating and sharing as the main ways to cultivate future diversity innovative and outstanding engineering talents [1]. Compared with the traditional engineering talents, the new engineering talents emphasize the cultivation of engineering practice ability, interdisciplinary ability and innovation ability [2].

Information technology is the main thrust of economic development. The electronic information industry is an important strategic industry in China's national economy, while the electronic information engineering specialty is its important supporting specialty. It has a significant demand for high-quality application-oriented talents. According to the requirements of the talent training program, graduates of electronic information engineering majors should have solid basic theory, strong computer and foreign language application skills, and they should be proficient in engineering practice in electronic design, signal processing, and

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information transmission. In the process of cultivating these abilities, professional core courses play a very important role. In order to better achieve the "thick foundation, wide caliber, and high quality" training goal of the electronic information engineering specialty, it is necessary to make corresponding changes to the teaching mode of the core courses of the specialty to meet the needs of the construction of new engineering [3]. "Electromagnetic Field and Electromagnetic Wave" as an important core course of this major, in the context of new engineering, how should its teaching model change?

2. Analysis of the Teaching Mode of the “Electromagnetic Field and Electromagnetic Wave” Course

The "Electromagnetic Field and Electromagnetic Wave", as the core course of electronic information engineering, is closely related to the core courses of microwave technology and antennas, modern communication technology, RFID principles and applications. Through the study of this course, students can lay a certain theoretical and practical foundation for engaging in related work after graduation [4], and it is also a compulsory test course for graduate students of "electromagnetic field and microwave technology" in major universities [5]. However, the learning content of this course is relatively abstract, the formulas are complex and changeable, electromagnetic fields and electromagnetic waves are invisible, and a large number of mathematical derivation processes are required. Students are often not easy to understand and master, and the engineering practice ability is slightly lacking [6].

Under the new engineering concept, the course "Electromagnetic Field and Electromagnetic Wave” has the following problems in the teaching mode:

(1) In terms of teaching content: The teaching content includes a large number of abstract concepts, theorems and formulas. During the lectures, students should be introduced to a large number of formula theory derivation and calculation processes. The teaching process is too theoretically focused, and the practical application and engineering practice introduction are relatively less.

(2) In terms of teaching method: The students are in a completely passive state, can not keep up with the teacher's rhythm, and cannot interact with the teacher. This leads to the lack of enthusiasm for students' learning, which is not conducive to original development of student thinking.

(3) In terms of teaching tools: The teaching tools are mainly a combination of multimedia and blackboard writing. Students reflect that the electromagnetic field formulas and theories are too abstract, it is difficult to imagine invisible electromagnetic fields, and cannot understand related principles and phenomena.

(4) In terms of assessment ways: The assessment ways are mainly the usual scores plus the final exam scores. Students only obtain the usual scores through high attendance and assignments, and the discrimination is not high; the test papers cannot truly evaluate the students' grasp of the course content. In some cases, students' ability to apply engineering practice has not been cultivated.

3. Thoughts on the Teaching Reform of Electromagnetic Field and Electromagnetic Wave

The new engineering disciplines need to establish new concepts, construct new structures, explore new models in higher engineering education, and fundamentally cultivate new types of engineering talents for the rapid development of the new economy. With the goal of cultivating new engineering talents, in view of the problems existing in the above teaching modes, the author deeply considers the teaching mode of the "Electromagnetic Field and Electromagnetic

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Wave" course and reforms the teaching content, teaching methods, teaching tools and assessment ways. Hoping to promote students enthusiasm for studying courses, and cultivate students' engineering application ability in the new engineering background.

3.1. Adjust Teaching Content

The main contents of "Electromagnetic Field and Electromagnetic Wave" include vector analysis, electrostatic field, constant magnetic field, constant electric field, time-varying electromagnetic field, propagation of uniform plane wave, electromagnetic radiation, etc. Most of these contents are abstract concepts and theorems. Students just memorize theoretical knowledge points, and they are rarely related to engineering practice [7]. After thinking, we think that we should adjust the content of the course, weaken the theoretical explanation, attach importance to engineering application, support the actual engineering case, explain the process of theory used in practice, and cultivate students' engineering application ability.

For the specific electromagnetic theorem, the source and content of the theorem are briefly introduced, the advanced mathematical derivation process of the theorem is ignored, the application conditions and application occasions of the theorem are emphasized, and the case examples are used to explain application examples related to the theorem. For example, when explaining Gauss theorem, the focus is on the spatial electric field distribution of conductor balls and charged spheres with uniformly distributed charges, and to analyze whether such electric field problems can be solved using Gauss theorem, so that students realize that only charge sources are symmetrically distributed. Only the theorem can be used to solve electric field problems, and students' grasp of the application conditions and occasions of the theorem is strengthened.

For another example, when explaining the reflection of plane electromagnetic waves, in combination with the thickness design of the airborne radome, the design principle of the half-wave dome is explained, so that students recognize the role of the repeatability of the equivalent wave impedance in the thickness design process. Through the adjustment of such teaching content, students can clearly understand what the theoretical knowledge taught by the teacher is, where it is used, and how to use it, so as to lay a solid foundation for the students' later study and work.

3.2. Apply Problem Based Learning Method

Since the teaching content of "Electromagnetic Field and Electromagnetic Wave" is too theoretical, the teaching method is mainly adopted by teachers, which leads to students' enthusiasm for learning and lack of active thinking. The author believes that the use of problem-based learning theory (PBL) [8], by means of problem introduction, can improve students' enthusiasm. Set questions for students before class, let students collect information about the problems, prepare discussion content and materials. Through group discussions, the students could display their views in the classroom, and finally acquire the ability to obtain knowledge. It also transfers and transforms knowledge as needed to develop students' innovative thinking. Teachers are no longer actively imparting knowledge. Their main role is to set up problems, organize and guide classroom discussions.

For example, to set up the question of "why aircraft is radar stealth", it is easy for students to search the Internet for common aircraft stealth measures. By consulting the information and combining the theory taught in the classroom, students will realize the role of radar scattering cross section and scattering power density. Discussion in the classroom can enhance students' in-depth understanding of the materials. Combined with the theory of oblique incidence of plane waves to the medium and the laws of reflection and refraction, students can understand the role of phase matching conditions. After the discussion, the teacher summarized and deepened the content of the discussion, guided the students to understand the electromagnetic

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wavelength and the effects of single and dual station radar on stealth, and derived the technical principles of anti-stealth.

3.3. Add Electromagnetic Field Simulation Software

The difficulty for students in learning the course of "Electromagnetic Field and Electromagnetic Wave" comes from the high requirements of mathematics and physics knowledge in the course itself. On the other hand, the course is too abstract and not intuitive enough to understand. Abstract theoretical derivation cannot arouse students 'enthusiasm. The increase of simulation and experiment can not only increase students' interest in learning, but also consolidate the knowledge framework through hands-on and observation, promote the absorption of theoretical knowledge and transform it into engineering practice. In addition to the use of multimedia software to display the animation effects of some content, a variety of simulation software can also be introduced for auxiliary teaching, such as HFSS and FEKO software. For example, when teaching the content of a dipole antenna, a corresponding antenna model can be established in the HFSS software, so that students can intuitively observe the surface current distribution at the resonance frequency point and understand the change law of current with time.

At the end of the course, students can also master the operation process of simulation software through the course design. For example, the subject of the course design can be set as the simulation design of a multi-element side-fire array. Students are required to understand the theory of multi-element arrays and design according to the design requirements for radiation direction, lobe width, and side-lobe levels in engineering practice. The geometric arrangement of the half-wave oscillator array, and the simulation of the radiation pattern of the edge-emitting array could be achieved using simulation software. By setting different simulation parameters, students can observe the influence of the simulation parameters on the design indicators, summary the completion of the design indicators of the model, and master the basic laws and design points for engineering design.

3.4. Change Assessment Way

The original assessment way consists of ordinary grades and final grades. Attendance and homework determine ordinary grades, which is difficult to distinguish students' classroom learning status. Final grades are given only by test papers, and more focus on assessing students' theoretical knowledge points. Mastery of engineering practice ability of students can not be assessed. In teaching reform, it is inclined to increase the evaluation of classroom discussions, assess the student's participation in learning and the seriousness of preparing discussion materials [9]. At the same time, increase the evaluation of curriculum design, and assess students' ability to solve engineering problems using simulation software. This promotes the development of students' ability to translate theoretical knowledge into applied abilities, and objectively reflects their learning effects.

Integrate the students' learning process and performance, and set up a reasonable assessment method. The assessment content includes: classroom attendance and completion of homework assignments; collection of problem learning materials and participation in classroom discussions; final exam papers; and Course design research reports, hands-on abilities in simulation exercises, etc. The main need to design is the evaluation mechanism of problem learning and curriculum design. In the PBL learning process, group work and division of labor are used to record the work done by each member of the group on the entire problem, their performance in the classroom, and the collation of the materials. The evaluation method is to score and record, and also the group score is included in the final score as the group member's score.

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In the course design process, it is also possible to use a group approach, which mainly records the role of the team members on the design ideas and framework of the course design topics and then each team member is responsible for the completion of part of the design content. In the process of setting up the assessment methods, special attention must be paid to the fairness and objectivity of the evaluation mechanism. The participation and contribution of each student must be accurately recorded, and strive to make an objective evaluation of the learning effect of the students.

In summary, if we want to increase students' interest in the curriculum and cultivate students' engineering practice ability, we must reform the teaching contents, teaching methods, teaching tools and assessment ways in order to cultivate the development of students' original thinking and improve the ability to understand core theories. The main content of teaching model reform can be represented by Figure 1.

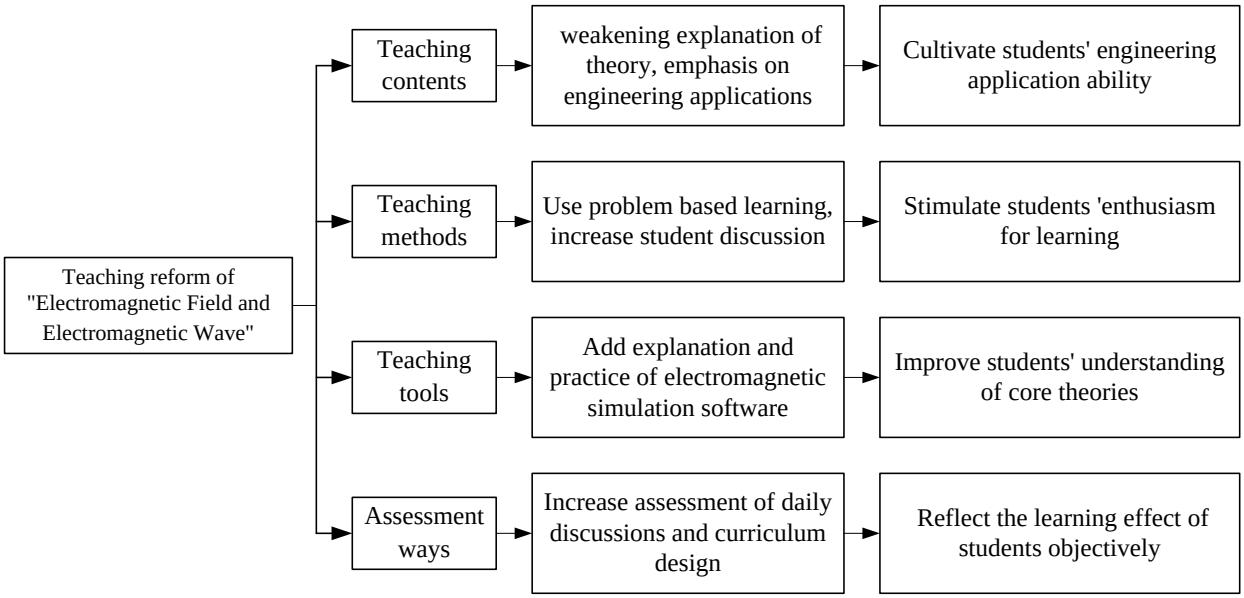

Fig 1. Main contents of the teaching reform of "Electromagnetic Field and Electromagnetic Wave"

4. Conclusion

The new engineering disciplines need to establish new concepts, construct new structures, explore new models in higher engineering education, and fundamentally cultivate new types of engineering talents for the rapid development of the new economy. Aiming at the training goals of students majoring in electronic information engineering, combined with the new engineering concepts, by analyzing the problems existing in the teaching mode of "Electromagnetic Field and Electromagnetic Waves", we reform and think about the teaching content, teaching methods, teaching tools and assessment ways involved in the teaching process. Through practice in the subsequent teaching process, we hope to improve the teaching effect and learning effect, and train application-oriented talents with industry background knowledge and engineering practice ability to meet the requirements of new engineering.

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