
Innovation and Practice of Values Education Through Curriculum in the Course of Electromagnetic Fields and Electromagnetic Waves

Xiaoqing Jiang^{*}, Changzhi Wei, Nianqiang Li, Lingyin Wang, Yue Zhao, Xiaoqian Fu

School of Information Science and Engineering, University of Jinan, Jinan, China

Email address:

ise_jiangxq@ujn.edu.cn (Xiaoqing Jiang)

*Corresponding author

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Abstract: Values education through curriculum is popular in current Chinese higher education and plays an important role in the training of new engineering talents. For the Electromagnetic Fields and Electromagnetic Waves course, there are problems needed to be solved, such as unclear selection mechanism of values or ideological and political elements and cases, and the gap between the fixed knowledge system of classical electromagnetism and the rapid development of telecommunication technology. In this paper, the clear construction and implementation methods of values education through curriculum in this course are proposed, and the value education elements and cases are selected according to both of the actual needs of the country and social and technological development. Through the reconstruction, expansion and modularization of course content, a blended online and offline teaching method is adopted in the class of Electromagnetic Fields and Electromagnetic Waves to achieve deep integration of theory, technology, and values education. The cultivation of students' knowledge, ability, innovation, and value are emphasized in the whole teaching and learning process. Since the implementation of the values education through curriculum, the achievement of student training goals has been significantly improved, promoting the implementation of teaching reform. The mode and experiences of innovation and practice of values education through curriculum in this course is potential to promote to relevant majors nationwide.

Keywords: Values Education Through Curriculum, Curriculum Construction, Blended Online and Offline Teaching

1. Introduction

The Electromagnetic Fields and Electromagnetic Waves course is a fundamental course for students of communication engineering major. This course mainly focuses on the theory of static and time-varying electromagnetic fields, and the laws of electromagnetic wave propagation and engineering applications. This course is closely related to professional courses such as High Frequency Electronic Circuit, Communication Principles, Mobile Communication, and Fiber Optic Communication, and holds an important position in the entire communication engineering curriculum system. It is of great significance for cultivating scientific and technological innovation talents in the field of communication engineering.

The teaching objectives of this course mainly have three levels:

a) Knowledge

College students should be proficient in mastering mathematical models and basic electromagnetic theory for accurate deduction and calculation, be able to independently solve key parameters of electromagnetic fields and waves, and conduct analysis and research on related scientific problems.

b) Capability

College students should improve the ability to solve engineering application problems about electromagnetic field and electromagnetic wave in the field of communication

engineering, be able to propose feasible technical solutions and use simulation software for electromagnetic field and electromagnetic wave analysis.

c) Values

College students should have a lifelong learning awareness, innovative thinking, patriotism, and a sense of professional competence and social responsibility.

Talent cultivation is the cornerstone of national development, and the important significance of values education through curriculum lies in pointing out the direction of talent cultivation. It solves why to learn, proposes how to learn, and cultivates students' awareness of lifelong learning. From 2019, the country pointed out the need to adhere to the unity of explicit education and implicit education, explore the ideological and political education resources contained in other courses and teaching methods, and achieve all-round education for college students [1-4]. Chinese scholars and teachers have made efforts to ideological and political construction in communication engineering major and Electromagnetic Field and Electromagnetic Wave course in order to achieve the teaching objectives mentioned above. In the existing research, the exploration of curriculum ideological and political education from the perspective of major development has been discussed [5, 6]. Some specific values such as the spirit of craftsmanship and new perspectives such as new engineering discipline are emphasized in the construction of the curriculum in communication engineering major [7, 8]. Implementation strategies of ideological and political construction in communication engineering major have also been researched [9, 10]. University teachers have conducted in-depth exploration on the implementation and methods of ideological and political education in the Electromagnetic Fields and Electromagnetic Waves course [11-13]. The proper teaching content and teaching methods for this course are researched in this background [14, 15]. The above research and the corresponding conclusions form the basis of the innovation and practice of values education through curriculum in this paper.

In response to problems in curriculum learning and values education, this course adheres to the student-centered mode, adopts a blended online and offline teaching mode, and expands the course content according to national needs. It deeply integrates various elements of values with knowledge key points of this course, emphasizing the cultivation and improvement of students' study, ability, innovation, and patriotism in the learning process.

The contents of the paper are arranged as follows: Section 2 introduces the learning situation and the main problems of values education of this course. Section 3 proposes the implementation and innovation of values education in the teaching process. Section 4 provides the evaluation and effectiveness of values education through curriculum. And finally, Section 5 gives conclusions.

2. Learning Situation and Main Problems in the Implement of Values Education Through Curriculum

2.1. Analysis of Curriculum Learning Situation for College Students

(1) Knowledge mastery situation

The theoretical teaching class hours have a decreasing trend with the education reforming. According to the statistics, about 63% of students in our university think that the difficulty of the course learning lies in the calculation and mathematical derivation of electromagnetic fields and electromagnetic wave problems, because this course has characteristics such as difficult theory and abstract concept as well as obvious differences in students' learning and acceptance abilities. Therefore, traditional classroom teaching emphasizes the explanation of theoretical foundations and the improvement of computational and analytical abilities.

(2) Ability development situation

Due to the relatively fixed traditional knowledge system of classical electromagnetic theory, there is a disconnection between the content of existing textbooks and the rapid development of technology. According to the statistics, about 70.4% of students in our university are not familiar with the engineering applications of electromagnetic fields and waves before learning the course. Therefore, this course should focus on cultivating students' practical and research abilities from experiments and classroom knowledge explanation.

(3) Values shaping situation

College students have a diverse tendency in terms of the shaping of values. By investigation, students in our university think that the study of this course is beneficial for the development of their own values, the cultivation of scientific thinking, the improvement of innovation awareness, the training of professional literacy, and the enhancement of their responsibility, shown in Figure 1.

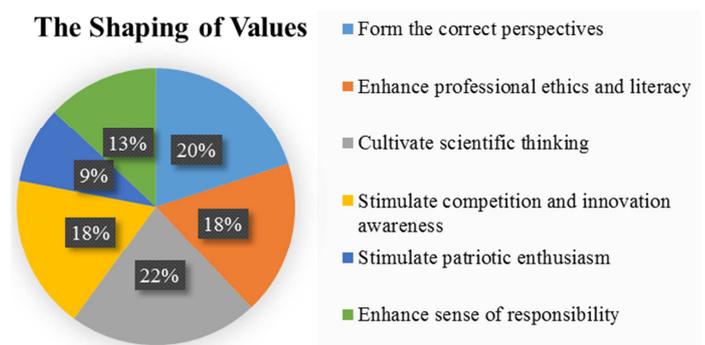


Figure 1. Data on the shaping of values in the course of Electromagnetic Field and Electromagnetic Wave.

2.2. Problems in the Implement of Values Education Through Curriculum

(1) Students have various interests and attitudes or

willingness to accept elements in the values education. The questionnaire survey data of a class in our university fully illustrates this issue, as shown in Figure 2.

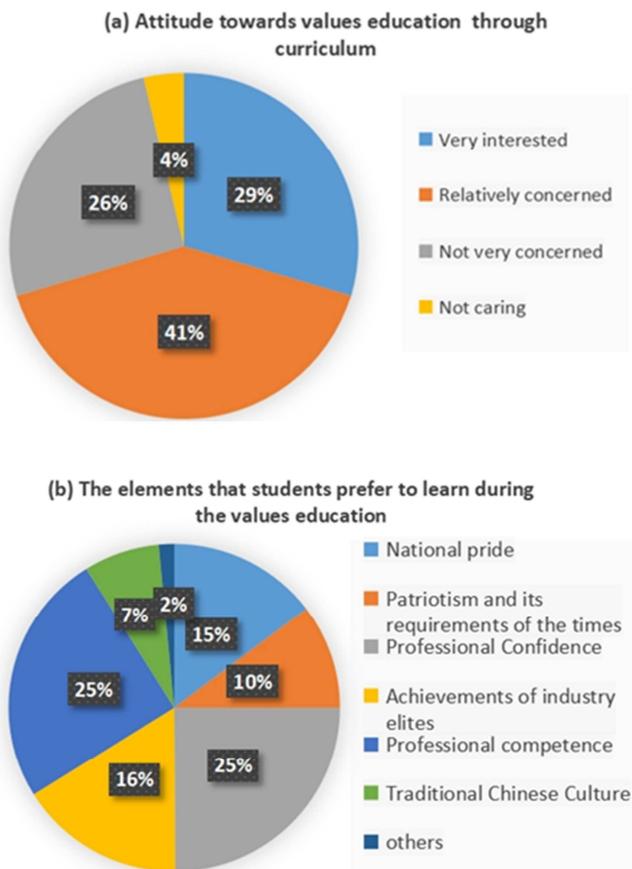


Figure 2. Data on (a) students' attitude towards values education through curriculum and (b) the elements that students prefer to learn during the values education.

Meanwhile, there are significant individual differences in students' expectations as well as the uneven educational resources in urban and rural regions, which also lead to obvious differences in students' professional perspectives and learning abilities. However, the selection mechanism of cases and elements for values education through this course in most of universities is unclear enough, which affects the effectiveness of teaching practice and implementation. Meanwhile, some cases in values education through curriculum do not align well with the needs of talents training of communication engineering currently.

The above factors have produced challenges in selecting more effective values education contents and implementation methods for professional courses in higher education. These are common problems in professional course teaching and are not just limited to Electromagnetic Fields and Electromagnetic Waves course.

(2) There is a contradiction between the relatively fixed knowledge system of classical electromagnetism and the rapid development of communication technology. There is a gap between the cultivation of students' ability and the

updating of industry technology. How to improve students' learning interest, stimulate students' scientific thinking and expand their learning initiative are problems that cannot be solved just through professional teaching and must be combined with values education through curriculum.

The cultivation of communication engineering talents is related to national development. The application of electromagnetic fields and electromagnetic waves involves fields from household appliances to great technological inventions. How to enhance students' interest in learning, stimulate their scientific thinking, and make better use of classroom teaching, a synergistic effect that formed by the integration of values education with professional education organically requires careful design and consideration. The research about the method emphasizing the combination of classic knowledge systems with cutting-edge technologies and engineering applications in limited classrooms time is a key issue that urgently needs to be solved to truly stimulate students' interest and learning enthusiasm.

(3) The construction ideas for values education through curriculum of Electromagnetic Fields and Electromagnetic Waves are not very clear in a lot of universities, teachers often adopt storytelling mode in the implementation of values education in the class, which cannot stimulate students' internal driving force for learning really and results in the inadequate effect of the course's values education.

The survey also found that with the impact of the COVID-19 epidemic on economic and social situation in the past three years and the increasing employment pressure in 2023 [16], some college students have "Lying flat" problems, which means learning adaptability has declined and lack of learning motivation. In the questionnaire survey, only 25.9% of students in a class stated that they just listened casually to the values education provided by teachers. In the survey on the biggest internal driving force for learning in a class, 51.9% of students only study for graduation and employment. They do not have higher life goals and pursuits. These phenomena and student issues propose practical requirements for the construction of curriculum values education system.

3. Implementation Mode for Values Education Through Curriculum

3.1. Overall Design of Values Education for Implementation

In 2021, the Chinese Academy of Engineering released the "Fourteen Trends of China Electronics Information Engineering Science and Technology Development", pointing out that the application of electromagnetic fields and electromagnetic waves will continue to emerge a large number of basic research problems and emerging technology research needs, and promote the solution of related technical bottlenecks in China with the rapid development of related technical fields and interdisciplinary integration. Therefore, the selection of cases and elements for values education in this course always puts the national talent cultivation needs at the forefront. The overall implementation design is shown in

Figure 3.

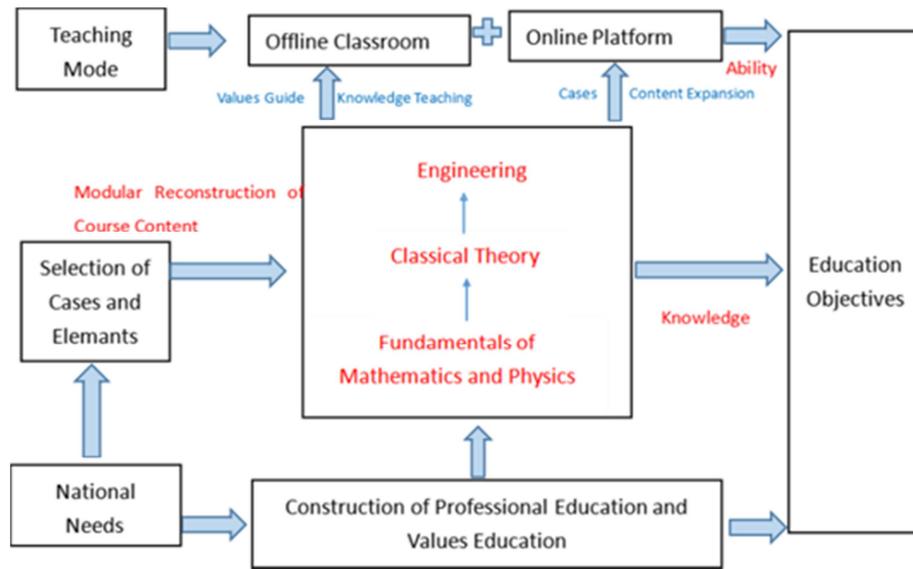


Figure 3. Overall implementation design of values education through curriculum in the teaching of Electromagnetic Fields and Electromagnetic Waves.

In the above design, guided by national needs, the selection of values or ideological and political elements and cases in the curriculum is carried out to promote the reconstruction of course content, achieve the unity of professional education and values education in the curriculum. The reconstructed knowledge content structure that ranges from physical and mathematical foundations to classical electromagnetics and electromagnetic wave theory, and then engineering applications is built. At the same time, combined with offline classes and online learning platforms, a blended teaching mode is adopted to realize comprehensive cultivation of college students' abilities, knowledge and value, and to achieve the educational and teaching objectives.

3.2. Deeply Integrate Modular Course Content with Cases for Values Education

The course contents of Electromagnetic Fields and Electromagnetic Waves are reconstructed into six modules: vector mathematics, classical electromagnetic field theory, static and time-varying fields, propagation laws of electromagnetic waves, guided electromagnetic waves, electromagnetic radiation theory and applications. The elements for cultivating values in the course are fully integrated with the six modules. Cultivating the students' tenacity, dedication, scientist spirit, serious and correct academic attitude, meticulous work style, and rigorous and pragmatic craftsman spirit is the goal of this design.

3.3. Practice of the Blended Teaching Method Based on the Online and Offline Teaching

We focus on the foundation learning, enhance capabilities, and promote innovation through the integration of online and offline teaching methods. Applications are combined with the

classical theory and research to achieve the education goals of the course, and the course teaching process is carefully designed.

Taking the explanation of knowledge about electromagnetic waves transmission and reflection in course Electromagnetic Fields and Electromagnetic Waves for example, the analysis of reflection and transmission phenomena when uniform plane wave incident on the interfaces of two different medias is an important section in the electromagnetic wave part, which is the key point for students to combine theory and application after mastering the basic propagation rules of uniform plane. This part of teaching will enable students to further understand the important applications and analysis methods of electromagnetic wave in the field of communication, by combining experimental simulation of electromagnetic wave reflection and transmission characteristics, designing specification for practical products and application technologies. The aim of this class is cultivating students' professional interests, deepen their understanding and mastery, and values in the future research or technical work. The framework of corresponding course process design is shown in Figure 4.

The online and offline resources are reasonably allocated, and various classroom and after-school activities such as group discussions, research reports, and knowledge Q&A are adopted to enhance students' interest in course participation and depth of thinking. In the process of implementing values education through curriculum, there are also various activities such as online topics, grouping tasks, classroom exercises, chapter testing, questionnaire surveys, etc., which can be carried out based on common online learning Apps.

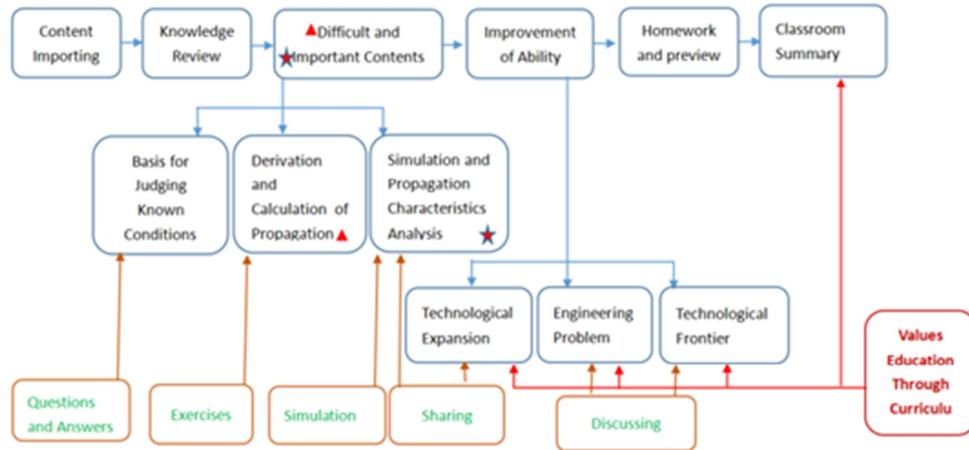


Figure 4. The framework of teaching process designing.

4. Evaluation and the Implementation Effect of Values Education Through Curriculum

4.1. Evaluation of Values Education Through Curriculum

The implementation evaluation of values education through curriculum is carried out from two aspects: the evaluation to students' learning effectiveness and the evaluation to teachers' teaching.

(1) The learning effectiveness of students

The assessment or evaluation of values education through curriculum mainly adopts a process evaluation mode, which includes diversified assessment and evaluation methods such as group discussions, research reports, homework, knowledge Q&A, and phased examinations. It emphasizes the evaluation of students' patriotism, innovation spirit, and other values aspects. The evaluation subject includes students and teachers, where the evaluation subjects of team cooperation projects are students and the evaluation subjects of homework, Q&A, and phased assessment are teachers.

The specific evaluation indicators are:

- 1) The assessment results of group discussions and research reports are conducted through peer evaluation among group students (accounting for 30%), overall student evaluation (accounting for 50%), and teacher evaluation (20%).
- 2) The completion of homework, knowledge Q&A, and phased assessment are evaluated by the teachers (100%).
- 3) The phased examinations consist of professional knowledge questions and open questions by online and offline tests, which can examine students' mastery and comprehensive application of course content, as well as their rigorous and pragmatic spirit, patriotism, political identity, legal awareness of adhering to industry rules, teamwork, and innovation.

(2) Teaching evaluation of teachers

Teachers are evaluated by students and supervision experts of the academic departments in colleges or universities. The

main aspects of assessment include clear teaching objectives, prominent key and difficult points, the abilities of guiding students to deeply explore the knowledge points, the class designing which can effectively stimulate students' enthusiasm for learning. The teaching method can comprehensively adopt problem-driven, heuristic, simulation, and discussion to create doubts and inspire or strengthen students' autonomous learning.

While teaching knowledge and practical abilities, teachers also are evaluated from the aspects whether they could pay attention to cultivating students' values, such as patriotism, scientific innovation and awareness of contribution to society.

At the same time, teachers need to persist in teaching reflection after class, and continuously optimize teaching design based on classroom effectiveness, student learning situation and the achievement of teaching objectives.

4.2. Implementation Effect of Values Education Through Curriculum

The innovation and practice of values education through curriculum in the course of Electromagnetic Fields and Electromagnetic Waves promote the implementation of teaching reform in this course, the reconstruction of teaching content, the innovation of experimental methods, and the construction of online course resources. At present, more than one hundred teaching videos with a total duration of 3198 minutes have been constructed on the learning platform. And a total of page views for this course reaches more than 170,000 in our university.

Through the analysis of the evaluation of the achievement of curriculum goals for two consecutive sessions of students, the innovation and practice of values education through curriculum is also benefit to the achievement of talent cultivation goals and the quality of student training.

The effectiveness of curriculum teaching has been recognized by experts and students because of the implementation and innovation of values education through curriculum in our university. The mode and experience are potential to radiate to relevant majors nationwide.

5. Conclusions

This paper explores the practice and innovation in the values education through curriculum of Electromagnetic Fields and Electromagnetic Waves course. In response to the current problems in course teaching, solutions are proposed from reconstruction of course content, course construction, cases and elements selection for values education. The main contributions of this paper are listed from the following aspects.

(1) This paper focuses on selecting cases and elements for values education according to needs for the development of the country and the training of communication engineering talents.

According to applications, values education and professional education are integrated effectively. Blended teaching mode based on online and offline is adopted in the education process. Offline classrooms provide guidance and typical case about values education, while online resources provide real-time updates on extensions related to course contents for multiple students' interests. Discussions and research both on offline and online are organized to drive the overall progress of the class. Combining with the construction of class learning and academic atmosphere, the values education through curriculum can be comprehensively improved.

(2) This paper expands the course content on the basis of modular reconstruction content, combines simulation experiments, solution of practical engineering parameters, and problem analysis, to achieve comprehensive coverage of course knowledge points by multiple means.

The course content is modularized and reorganized, emphasizing the research ability of simulation analysis and solving practical engineering problems, and the cultivation of scientific and innovative thinking. Each course content module combines multiple elements of values education. At the same time, in-depth analysis of the practical issues related to the development of communication technology in China will inspire students to think about how to apply what they have learned in engineering problems.

(3) This paper proposes a clear idea for the construction and implementation for values education through curriculum in Electromagnetic Fields and Electromagnetic Waves course.

This course plays an important role in forming a complete communication engineering knowledge framework for students. From the perspective of students' professional development and professional literacy cultivation, students' mastery of basic knowledge of this course is consolidated with other communication engineering courses, which provides the foundation for their subsequent learning of professional classes about microwave radio frequency, antennas, radars, satellites, mobile communication, and fiber optic communication. In this paper, emphasis is also placed on guiding students to establish ideals from the perspectives of patriotism and political identity, faith and responsibility, and stimulating students' higher level learning motivation and

cultivating qualified communication engineering talents for the country.

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