Design and Implementation Scheme of Ideological and Political Infiltration into Science and Engineering Teaching

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Abstract—Based on the goal of "combining knowledge teaching with value orientation" in curriculums in colleges and universities, and combined with the characteristics of science and engineering, the system design of ideological and political education in science and engineering teaching is established and carried out. The system design and implementation scheme realize the value orientation, unifies the curriculum ideological and political idea with the science and engineering related courses. In this context, new teaching mode has been established, which integrates knowledge teaching, ability training and education. Moreover, a series of combination points and penetration points of science and engineering class teaching have been explored and designed, to integrate and refine the educational resources in science and engineering courses, as well as a variety of appropriate teaching methods be designed. The evaluation mechanism of curriculum ideological and political education is constructed to realize the organic unity between ideological education and science and engineering teaching. Combining the value orientation, ability training and knowledge imparting organically, and going against the formation of ideological and political courses, the fundamental task of "cultivating morality and cultivating people" in science and engineering education can be fulfilled to guarantee the quality of personnel training.

Index Terms—science and engineering teaching, ideological and political education, system design and implementation scheme

I. INTRODUCTION

In the new era of construction of powerful socialist country of China, the fundamental task of personnel training in colleges and universities is to fully combine ideological and political education with professional curriculum education, that is, to carry out the high-quality personnel training from all aspects of professional education and ideological and political education [1]. The education philosophy that curriculum ideological and political education be Infiltrated in the subject professional curriculum realizes the new teaching mode of "curriculum bearing ideological and political, ideological and political education in the curriculum" [2].

Science and engineering courses are different from humanities and social sciences courses, in which the

science and engineering contents mainly focus on the knowledge of natural laws, reflect the laws of natural operation and development, and are mainly objective. In contrast, the humanities and social sciences curriculum itself are set up according to the party's and the state's ideological and political views, reflecting the will and requirements of the party and the state, and has distinct ideological guidance [3]. As a result, it is much more difficult for science and engineering courses to realize the goal of "curriculum ideological and political", so efforts should be made to explore the curriculum ideological and political reform in the course teaching. The key problem is to systematically design the teaching scheme of Ideological and moral education, and the new teaching mode and methods.

II. ESTABLISH TEACHING GOALS TO EMBODY VALUE ORIENTATION

Directed by the aim of ideological and political education of science and engineering courses, a new pattern of ideological and political work should be constructed with full staff, whole process and all-round education, and promotes the creative transformation from "Ideological and Political Courses" to "curriculum ideological and political education", gives full play to the explicit and implicit educational functions of ideological and political courses and science and engineering courses, and studies the integration of ideological and political courses into basic and professional courses in the new era of construction of powerful socialist country of China [4]. In this paper, the feasibility of "curriculum ideological and political" teaching is explored in five aspects, namely, the promotion of curriculum ideological and political teaching objectives, the construction of curriculum system integration and education mode, the exploration of curriculum ideological and political teaching process, the construction of curriculum ideological and political elements resources and the establishment of curriculum ideological and political education evaluation system.

In recent years, with the rapid development of Internet, artificial intelligence, cloud computing and relative fields, it is necessary to examine the ethics behind the development of science and technology, and to find a feasible way to cultivate a new generation of engineering personnel by excavating the ideological and political

education resources contained in the natural science curriculum, and to achieve the same frequency resonance of scientific and technological progress and moral education.

As professional Instructors of science and technology, first of all, it is necessary for the instructors to improve cognition of curriculum ideological and political education. If there are misunderstandings about "curriculum ideological and political" or lack of the depth and breadth of understanding, it is difficult to deliver good lessons in the actual teaching process. Therefore, instructors of professional courses need to realize the importance and necessity of curriculum ideological and political education, and this belief comes to the actions of adding elements and contents of "curriculum ideological and political" in the process of professional teaching, deepening the connotation of teaching to enhance the effectiveness of moral education [5]. Secondly, the teaching enthusiasm of professional course Instructors should be stimulated, and carry out the ideological and political education with the attitude of subtle influence on students' characters. Through theoretical study, investigation and research, group discussion, expert guidance and other learning process, the goal of ideological and political education of science and engineering courses is gradually approached. By "curriculum ideological and political" seminar of teaching team, listening and feedback of ideological and political experts, and participating in "curriculum ideological and political" special training, course instructors help the learners understand the important role of "curriculum ideological and political education" in knowledge acquisition, ability cultivation and value formation, and gradually form the internal ideological and political demand combined with the curriculum [6]. Education should be organically combined to form an effective self-motivation mechanism.

III. INNOVATE TEACHING MODE TO HIGHLIGHT THREE QUALITIES

The teaching mode of ideological and political education in science and engineering is to integrate the elements of ideological and political education into all aspects of professional courses, give full play to the educational function of the course, and finally achieve the goal of ideological and political education. Defining the elements of ideological and political education and clarifying the educational value of curriculum are the basic premise of curriculum integration. The elements of ideological and political education contained in the curriculum of science and engineering come from the essential attributes and characteristics of the major [7]. Science and engineering major, including physics, chemistry, biology, engineering, astronomy, mathematics and the application and combination of these disciplines, makes that it has unique ideological and political elements and educational values, that is, to cultivate students' three qualities: scientific / technological quality, humanistic quality and professional quality [8]. The connotation, characteristics and requirements are shown in Table I.

TABLE I: COMPARISONS AND CONNECTIONS OF THREE QUALITIES

Qualities	Connotation	Features	Requirements
Scientific / technological quality	The ability to use scientific knowledge to identify problems and draw evidence-based conclusions to understand and make decisions about the natural world and its changes through human activities.	Solid engineering theory and practical knowledge, open mind, innovative ideas, and capabilities of practice.	Sufficient technical ability, necessary engineering practice training, ability to analyze and solve practical engineering problems, bear hardships and stand hard work, adapt to the more difficult working environment.
Humanistic quality	A comprehensive quality or degree of development in the humanities，such as physical, psychological, political, ideological, moral, and cultural, aesthetic quality.	Emphasizes humanism which pays attention to human life, value and meaning, and people's spiritual pursuit.	"Scientific and practical" and "humanistic ideal" are two indispensable value dimensions for human survival and development.
Professional quality	The basic qualities that play a decisive role in professional activities, scientific professional, social communication and adaptation, learning and innovation quality.	Comprehensive reflection of workers' understanding and adaptability to social occupation.	It is formed and consolidated through practical and operational skills training, professional practice or repeated practice.

IV. CLASS CONTENT DESIGN SCHEMA

Combined with the objective and pragmatic characteristics of science and engineering, the unique characteristics of ideological and political education are highlighted, shown as "Five combinations": the combination of curriculum teaching with dialectical materialism education, patriotism education, innovation and development education, legal and moral education, and craftsman spirit education. Through teaching activities such as teaching content design, case preparation, course group preparation, educational content is added to the professional course teaching, so as to improve students' humanistic knowledge accomplishment, optimize the teaching content of professional courses, add value education, cultivate the awareness of integrity, cooperation and responsibility, and complete the full integration of the five aspects, which is elaborated in Part V.

The design scheme is based on the overview as the main line, and takes the history, characteristics, application and future of computer system development as four branches to organize knowledge, with clear trunk, clear context and progressive improvement.

Excavate the humanistic connotation. Through the description and comparison of a large number of actual cases, the paper explores the values, thinking modes and

cultural significance behind knowledge and technology [9].

Promote in-depth thinking. Through the analysis of the cases, the instructors can guide the students to think about the national development and life perception, cultivate the good quality of students, and become the new generation with ideals and beliefs and dare to take responsibility.

Create atmosphere and highlight scientific spirit. Using the rich educational resources of the history of computer science, giving play to the leading role of outstanding figures, and using their course of pursuing truth and excellent quality to inspire students to work hard and achieve their youth.

In the selection of teaching content, rich resources by big data analysis are taken to optimize and integrate moral values, pay attention to the dynamic, expansibility and research nature of the teaching content, and avoid the static, shrinking, limitations and confinement of a single textbook. Taking curriculum knowledge as carrier, the tasks be carried out including evacuating ideological and political elements, establishing moral education theme, and giving ideological and political significance and vitality to the theoretical knowledge. The theme and material of moral education should be organically integrated with the mainstream of current social development, and effectively combined with the actual life of college students [10].

V. IMPLEMENTATION OF COURSE TEACHING

The teaching content is combined with the objective and pragmatic characteristics of science and engineering specialty, and the design highlights the unique characteristics of ideological and political education, elaborated below.

A. Combination of Curriculum Teaching with Dialectical Materialism Education

As well known, nature and society are different forms of the material world, which are unified in the materiality of the world. Scientific imagination, exploration, measurement and other activities are the means for human beings to understand the world. Taking the course of biological instrument as an example, through the changes of various instruments such as chromatography, mass spectrometry, nuclear magnetic resonance, electrophoresis technology, laser fluorescence technology, people can learn the existing forms and change rules of substances, so as to get to know the material world more comprehensively and accurately. The diversity of the material world and the unity of the material world, that is, the composition of different materials is different, and dozens of elements that constitute the material can be found in the nature throughout the teaching process of the course [11]. With the development of transmission electron microscopy, biosensor, mass spectrometry, electrophoretic analysis, immune analysis and other technologies, human understanding of life has gradually deepened from the macro level to the cell and molecular level, and the morphological structure, functional characteristics, anabolism, change rule and regulatory mechanism of biological macromolecules such as proteins, nucleic acids

and sugars have been studied more and more thorough in recent time. During the class teaching, the instructors should guide students to understand the essence, origin and evolution of life objectively and comprehensively, to respect life and appreciate life, and establish a materialistic world outlook.

B. Combination of Curriculum Teaching with Patriotism Education

Taking the software industry as an example, due to historical reasons, the instructors admit that the research and development of software industry in China started later than the western nations, with weak scientific and engineering foundation. But by years of self-improvement struggle of Chinese people, China have been gradually filling the big gap in aspects of basic theoretical research, application system development, network architecture and product between the developing and the developed countries. After years of catching up, the great progress of software industry in China turns out a new look. In 2019, China's software industry gained business revenue of 6.3 trillion yuan, with an increase of 14.2% annual average of three years; the total profit reached 807.9 billion yuan, a yearly increase of 9.7%, and the industrial structure continued to optimize; the software definition developed in-depth and fully integrated into various fields of economy and society, and the role of software innovation engine was more prominent. The active international cooperation of our software industry has made remarkable contribution to the development of science and technology and national economy by purchasing and importing foreign software from scratch to the independent innovation and going to the international market. The navigation satellite, spherical radio telescope, unmanned combat aircraft, HUAWEI operating system, Alipay and online shopping systems, are outstanding examples of the rapid development of China's science and technology industry. When teaching the relevant knowledge, the instructors make it assure that students have an objective understanding of the development status and national conditions of Chinese software, and help they to build up national confidence, national mission and urgency as well as the determination of domestic development, and the belief of building national software brand.

C. Combination of Curriculum Teaching with Innovation and Development Education

Innovation is the soul of national progress and the main thrust of national development. Cultivating college students' innovation ability is the starting point of modern education and the basic requirement of modern quality education. Science and engineering courses play a vital role in the cultivation of students' innovative ability. The development of science and engineering is a typical example of the application of scientific thought and innovative consciousness to new tools and methods and to solve new problems. Therefore, the teaching process of the course should always implement the innovative concept of encouraging students, and cultivate their innovative thinking and innovative ability. In the teaching process of various principles and technologies, Instructors should pay

attention to the continuity of the content before and after teaching, guide students to realize that method innovation is the source of discipline development. On the basis of reference and negation of traditional methods, bold assumptions and careful verification are carried out to produce breakthrough and innovation. For example, the update of program language is the result of continuous innovation and application of software method, operating system and hardware technology. Scientific spirit, scientific attitude and scientific methods should be integrated into course contents. In the process of theoretical teaching and practical teaching of programming, students come to know that parameter setting, test scheme, programming platform, code writing habits affect the software function and performance, so as to cultivate rigorous scientific attitude and meticulous work style. There's a lot of truth behind every aspect of the inspiring story of the development of the spheres. Some anecdotes be inserted appropriately to increase the interest and humanity of teaching, enlighten students' scientific spirit, and encourage them to cultivate the scientific spirit of pursuing truth, daring to challenge, daring to explore, perseverance, unity and cooperation in their study and work.

D. Combination of Curriculum Teaching with Legal Moral Education

Moral education is the soul of education, and law is the baseline. Taking the teaching of programming language as an example, it organically combines the education of legal consciousness, personal morality, social morality and professional ethics. It is not worrying that a person's technical level lags behind temporarily. As long as he has moral merits, and is enterprising and loyal, he will achieve the requirements of the enterprise through hard work. When engaging in the research and development of a product or taking over a project, it is necessary for people to keep confidential the information related to the product or project, such as source code, documents and user confidentiality agreement. A respectful and modest programmer are tending to listen to customers' suggestions carefully, take the initiative to contact with customers, cultivate mutual loyalty and trust in his work. Cases of dishonestly use their position or power for their own advantages can be quoted to show warning signals by negative examples, such as programmers' stealing business data, leaking email user information, modifying lottery information. The "patriotism, dedication, integrity, and friendliness" in the socialist core values can be penetrated into the teaching process to guide students to realize the social responsibility and sense of mission of IT technicians by attaching importance to profession honest, abide by morality and law, and scientific fair and just.

E. Combination of Curriculum Teaching with Craftsman Spirit Education

Craftsmanship spirit is the necessary professional quality of engineering talents under the background of "new engineering". The professional philosophy of craftsman spirit includes dedication, excellence, preciseness, dedication and innovation. It is highly consistent with the professional ethics of engineers and helps engineering practitioners form professional quality and professional ethics. In the process of personnel training, the "craftsman" (professional skills) and "spirit" (professional quality) are often separated, and the cultivation of professional ethics and cultural quality is relatively insufficient.

Instructors focus on the cultivation of craftsman's spirit of excellence, preciseness, and meticulousness in practice teaching, with the implementation of in-depth investigation of enterprises and universities, the collection of technical enterprise project examples, edition of special videos. Students are encouraged to participate extracurricular development groups, various related competitions and seminars, and to write research reports and papers on ideological and political education of engineering training courses.

For example, in Java programming language course, students are required to perform the scientific spirit of being meticulous, careful and improving in learning and writing code. They learn to develop patience, perseverance and determination to complete all the tasks, in which they have to meet the requirement that the code be correctly executed, and assess the code from two aspects of time complexity and space complexity. They learn from practice that "Success belongs to those who are brave and resolute", get the core of discipline to be honest and trustworthy.

VI. FLEXIBLE AND COMPREHENSIVE APPLICATION OF TEACHING METHODS

In the teaching practice, various education methods should be combined according to the specific situation, and highlight the distinctive characteristics of science and engineering specialty to meet the education goal, that is, hoist the discussion from the perspective of curriculum knowledge to the socio-economic level, and upgrade to national development and national revitalization, which can stimulate students' independent thinking, encourage scientific thinking ability and stimulate the sense of mission for the rejuvenation of Chinese civilization.

A. Case Teaching

Case teaching has been proved to be capable to combine theory with practice, close to life while keeping academic and giving consideration to education and interest. A large number of principles and methods in science and engineering courses contain rich philosophical principles. It has unique advantages to use the practical application cases of principles to run through the whole teaching content. For example, in the analysis of big data, the government work report of the State Council, the national report on the reform of agriculture and rural development, and the report on the planning of new industrial structure in Guangdong Province are used as the text materials for analysis, which not only reflect the practicality of technology application, but also imperceptibly carry out education on national policies and development direction for students.

B. Online and Offline Blended Teaching

The traditional face-to-face teaching and information technology are organically integrated. It is strongly recommended to make full use of high-quality network resources to guide students' outlook on science and humanities in an all-round way, arrange students to watch domestic excellent documentaries related to the course content in real time, to acquire knowledge and enhance their patriotic feelings. Based on the "online" resources and the "offline" classroom, the in-depth learning field integrating situation, interaction, experience and reflection can be well constructed to enhance students' self-learning awareness, innovative spirit, and practical ability.

C. Group Discussion Teaching

Under the guidance of teachers, the course content is discussed in whole class or in groups, opinions expressed, and conclusion drawn. The application of discussion method can make students inspire each other, learn from each other, help themselves to explore knowledge in depth, activate thinking, and give full play to the initiative and enthusiasm of learning. In the process of discussion, students can gradually get used to be good listeners, active thinkers and proper speakers. They learn how to respond on the analysis of other people's views, and how to express relevant information in appropriate verbal and non-verbal ways, such as eyes, gestures, facial expressions, how to treat different views with a rational attitude, and perceive their own existence from other people's responses in the constant sharing, argument and cooperation.

VII. EVALUATION SCHEMA

TABLE II. ITEMS OF THE IDEOLOGICAL AND POLITICAL EVALUATION

Evaluation Items	Evaluation details	Weight
Classroom learning performance	Learning goal, attitude, participation	10
Online learning performance	Technical literature completion, practice completion, ideological and political experience	10
Case analysis	Analysis, viewpoint and argument, language utility, depth and breadth of cognition	10
Course projects	Project requirements design, system architecture, platform tools, program structure and standardization, test cases and test results, organizational ability	10
Course thesis	Technical consciousness, technical ability, academic thinking, paper structure and logic, organizational ability, cooperation, academic moral integrity	15
Final test	Knowledge system structure, memory accuracy, explanation rationality, problem solving ability, examination discipline	45

The evaluation of the ideological and political effect of the course mainly uses process assessment, writing course essay, examination and other methods to evaluate the effect of the course construction. Table II lists some of the most frequently used items of the ideological and political

evaluation in the teaching process. Using the data obtained from the assessment, a reasonable model is established to analyze whether the students have formed a correct world outlook, outlook on life and values, so as to evaluate whether the students have effectively acquired knowledge, cultivated ability, possessed socialist core values and improved moral cultivation in the process of education. The craftsman spirit of continuous improvement, rigorous concentration and meticulousness is incorporated into the students' evaluation system, and the evaluation standard is evaluated by the project adherence and completion quality. We should not only evaluate the students' professional skills through the final evaluation, but also evaluate the cultivation of students' craftsmanship spirit through formative evaluation.

According to the results of analysis and evaluation, timely feedback to the teacher team, put forward improvement measures, so as to form a closed loop of continuous improvement. Table III shows an example of the evaluation set of the ideological and political evaluation of the course.

TABLE III. STUDENTS' FEEDBACK ON IDEOLOGICAL AND POLITICAL EDUCATION OF CURRICULUM (IN PERCENTAGE)

Evaluation Aspects	Excellent	Good	Fair	Poor
Clear teaching objectives	74	17	9	0
Substantial teaching content	76	15	7	2
Upright teaching attitude	78	21	1	0
The logic of teaching	68	23	8	1
The organization of content	73	18	7	2
Vivid cases and examples	68	21	8	3
Related to national and international hotspots	72	22	6	0
Improve your innovative consciousness	71	17	9	3
Enhance your ability to understand and analyze problems	73	13	7	5
Great help in the achievement of your major study	72	15	11	2
Promote your core values	76	17	4	3
Improve your sense of social responsibility	72	24	4	0

VIII. REFORM EFFECTS

Teaching supervisors of Guangdong University Alliance have made confirmation that the proposed "Design and Implementation Scheme of Ideological and Political Infiltration" has innovated the technology curriculum and ideological and political education mode, implemented the reform of "case teaching", "incentive inquiry" and "Research-And-Discussion Teaching", which is of positive significance to carry out ideological and political education. The reform has significantly improved students' learning consciousness compared with pure ideological and political education. Through the course of ideological and political education, the youth can learn from the facts of the strength and development pace of our motherland, which is of great help to enhance national self-confidence and cultural self-confidence.

Students response can be evidently shown by the survey. A total of 1600 questionnaires were distributed and 1570

valid questionnaires were collected. The statistical results are listed in Table III.

As overall feedback, more than 95% of the students are satisfied with the reform of ideological and political infiltration into Science and Engineering course. About 93% of the learners show great enthusiasm for the ideological and political content of the course. Over 90% of the learners think that plays an important leading role in the formation of their world outlook. Students generally believe that the abundance of ideological and political education cases in the science and technology courses are in great need. This kind of education is not preaching, but natural integration of the learning process. While learning science and technology, students consciously shape their outlook on life and values.

The teaching reform program of this paper has won a number of awards, including the second prize of 2020 National Medical College Course Ideological and political case evaluation, the second prize of 2020 Guangdong undergraduate college online teaching excellent case, the second prize of 2020 Guangdong undergraduate college cultural quality education steering committee Course Ideological and political cases, and the third prize of 2020 Southern Medical University online teaching case.

IX. CONCLUSION

Colleges and universities are important places to enlighten and educate people. The fundamental task of curriculum teaching is morality cultivation. In the teaching reform of this paper, the innovation of Ideological and political education concept of technology curriculum has been realized. It accurately grasps the key problems, breaks through the limitations of science and technology courses, and carries out teaching reform design based on "science and technology are closely related to ideological and political education in essence", "the common carrier of scientific spirit and humanistic spirit" and "moral cultivation and information technology learning resonance at the same frequency", so as to solve the education difficulties.

The innovation of Ideological and political education mode of science and technology curriculum has been realized. Under the guidance of "Ideological and political education of science and technology information course", knowledge teaching combined with value guidance, fully embody the humanistic spirit, value concern and strategic positioning behind information technology.

The innovation of teaching methods, resources and environment has been realized. The comprehensive use of heuristic, interactive, inquiry, open, case based, network-based, task driven, digital learning and network platform, show rich learning resources, carry out a variety of discussion, speculative activities, make ideological and political education vivid and popular.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

All the authors conducted the research of s teaching mode for graduate students, and carried out the teaching practice.

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