A Integration Model for Teaching Introduction to Electrical Subject

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Abstract. Based on the analysis of the challenges faced by the training of electrical engineering talents under the background of country, industry, education environment and subject, this paper combs the difficulties existing in the teaching of introduction to electrical subject, and puts forward the integrated teaching model of pluralistic curriculum content, innovating teaching methods, optimizing assessment methods and integrating social practice. The practical results show that this model can effectively improve professional confidence, clarify the path of students' career planning, effectively reduce the number of students who failed professional courses, and optimize the structure of talent training.

Keywords: introduction to electrical subject, career education, integration model

1 Introduction

In the field of electrical engineering, the caliber is wide and the knowledge is updated quickly[1][2]. Compared with other subjects, the coupling of theory and practice is relatively high, and the teachers' teaching ability is also high. Introduction to electrical subject has an important role in guiding college students to perform academic transition, enhancing subject confidence. Universities with electrical engineering at home and abroad have set up subject introduction with campus cultural characteristics[3]-[6]. This paper analyzes the new situation faced by the introduction to electrical subject, and proposes how to improve the richness of the teaching content, further increase students' participation, and enhance the guidance of students' electrical professional learning and employment.

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2 The Challenges Facing the Training of Electrical Talents

2.1 Adjustments of National Development Strategies

In September 2020, China officially put forward the "3060" double carbon target[7], which marks the "14th Five-Year Plan" period of China's energy strategic focus needs to anchor the double carbon target to accelerate the green and low-carbon energy transformation. The 14th Five-Year Plan and the Outline of Vision 2035 issued on March 12, 2021 (hereinafter referred to as the Outline) fully embody the new development concepts of innovation, coordination, green, open and sharing. For green development, the Outline further specifies that China will formulate an action plan for carbon peak before 2030. In the report of the 20th National Congress of the Communist Party of China, Chinese leaders proposed to speed up the green transformation of development mode and promote the formation of green and low-carbon production mode and lifestyle. We will promote carbon peaking and carbon neutrality actively yet prudently, based on China's energy and resource endowments, implement carbon peaking actions in planned steps, further promote the energy revolution, strengthen the clean and efficient use of coal, and accelerate the planning and construction of a new energy system. The energy revolution further accelerates the structural transformation of the new power system.

2.2 Structural Adjustment of The Power Industry

The new power system is characterized by clean and low carbonization of power supply, flexible and intelligent power grid, diversified load flexibility, safe and economical energy storage[8]-[16]. The complex structure of AC-DC hybrid power grid puts forward higher requirements for electrical technology. The main technical characteristics of the new power system are as follows:

1) Low system moment of inertia
2) High proportion of new energy and high proportion of power electronic equipment
3) Morning and evening double peak-cold and summer double peak
4) Power supply and load bilateral random fluctuation.

2.3 Continuous Changes in The Educational Environment

In the development history of China's higher education, electrical engineering has a high coupling with mechanical, power, engineering and other majors[17]. The wide radiation surface of the electrical industry leads to the training of talents in the electrical engineering subject also upholding the direction of wide caliber training. The development of the Internet, the advancement of data technology, and the dissemination of large-scale online learning educational resources have broken the boundaries of traditional physical classrooms. It is an important link of curriculum reform and design to

use network education resources efficiently, improve teaching efficiency and enhance teaching effectiveness.

2.4 Adjustments of Electrical Discipline

To fully reflect the importance of the subject foundation and meet the requirements of the intelligent era, China Academic Degrees Committee has adjusted the first-level subject of electrical engineering and the secondary subjects have been adjusted into 10 secondary subjects, including Electrical Theory and New Technology, Electrical Materials and Dielectric, Motor Systems and Control, Intelligent Electrical Appliances and Electrical Equipment, Electrical Power systems and Automation, Power Information Technology, High Voltage and Insulation Technology, Power Electronics and Power Conversion, New Energy Generation and Storage, and Bioelectromagnetic Technology. Compared with the previous five secondary subjects, electrical machinery and electrical appliances have been refined, power electronics has been further extended and expanded, which will have four new directions, including power information, electrical materials, new energy and storage, and biological electromagnetic, making electrical science, materials science, and computer science integrated more deeply.

3 The Construction of Introduction to Electrical Subject Is Facing a New Situation

Subject is a scientific field or a branch of a science while major is the academic category divided by colleges and universities according to the need of social division of labor[18]-[20]. The two are different in objectives, constituent elements and division principles:

1) The core of the subject is the discovery and innovation of knowledge, the basic feature of which is academic, and it aims at the research results of the subject. The major is to train all kinds of specialized talents at all levels of the society as its own responsibility, to meet the needs of the society for talents at different levels.

2)The constituent elements of the major are training objectives, curriculum system and the major's participants. The constituent element of the subject is the knowledge unit, and the systematization of the knowledge unit constitutes the knowledge system.

3) The division of subjects follows the development logic of the knowledge system itself, thus forming a tree-like branch structure. Majors are set up according to the needs of the society for specialized talents in different fields and positions. The actual work of specialized talents in different fields requires what kind of knowledge structure, which can be met by organizing related subjects of the major.

Subject and major do not exist in isolation, but depend on each other and promote each other. From the point of the major, the subject plays a basic supporting role for the major, which is mainly reflected in the aspects of teachers, bases and teaching content. From the perspective of subject, major is the base to undertake the training of talents, and it puts forward the requirements of the era for the teaching staff and teaching content of related subjects.

3.1 The Importance of Curriculum Construction

According to different tasks and objectives of course, introductory subjects can be divided into four levels: academic introduction, subject introduction, profession introduction and course introduction [21]-[23]. The introduction to electrical subject is a basic course for freshmen majoring in electrical engineering and automation. The course plays a role in connecting senior high school education with higher electrical education. It mainly teaches the history and development trend, training mode and goal, curriculum system, discipline structure and other related contents of the development of electrical subject, helping students to fully understand the basic concepts, theoretical framework, typical solutions to typical engineering problems of electrical subject, clear the path of academic planning and career development, and build professional confidence. The introduction course is the core of the whole curriculum system, and the specific structure is shown in Fig.1.

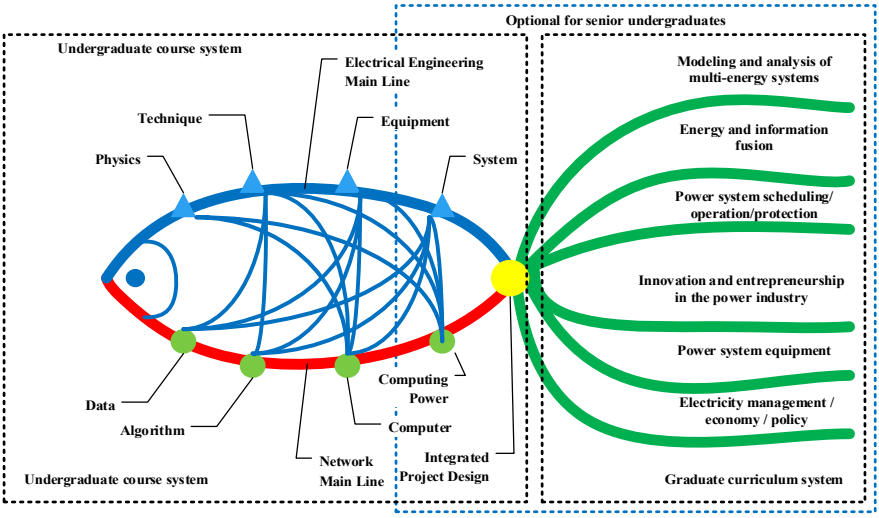


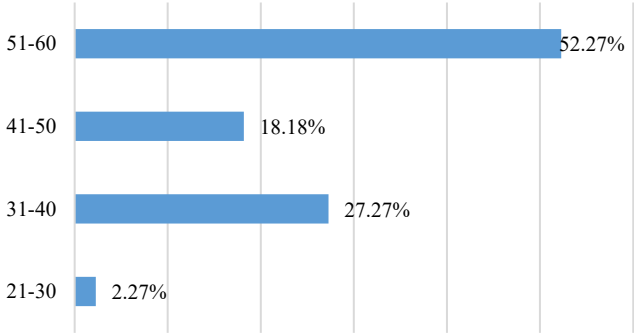
Fig. 1. Electrical Education Curriculum System

3.2 The Imbalance in the Structure of Teaching Staff

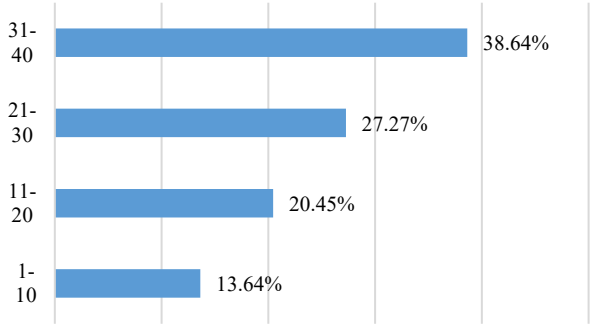
Through the investigation of the teaching staff in an electrical college, it is found that the close homology of the teaching staff is serious, especially the personnel trained by the school account for a relatively high proportion. The specific distribution of teachers' characteristics is shown in Fig.2.

The proportion of aging in the team is over 50%, and the digital literacy is low. Most of the personnel are from the unified distribution of personnel in the period of national reform and opening up. The major of the teachers is mainly electrical engineering, which is coupled with mechanical engineering, control engineering, water conservancy and hydropower engineering, instrumentation and other subjects. With the acceleration

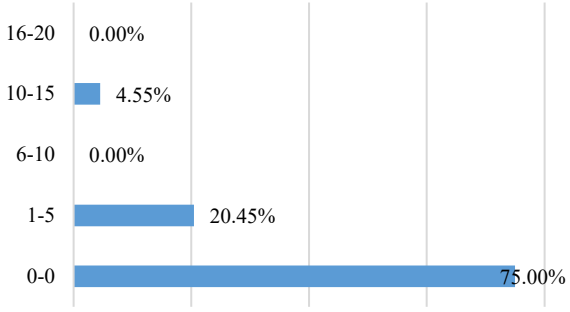
of talent introduction, the structure of teaching staff continues to be improved effectively, and the proportion of experienced personnel in engineering application is reasonable.



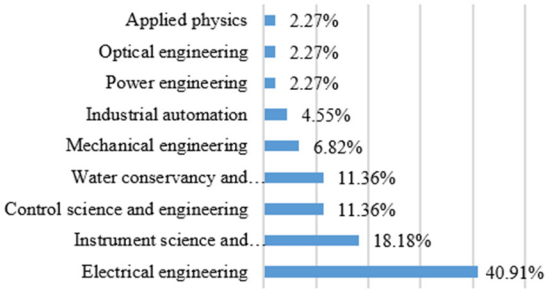
(a) The structural distribution of pysiological age



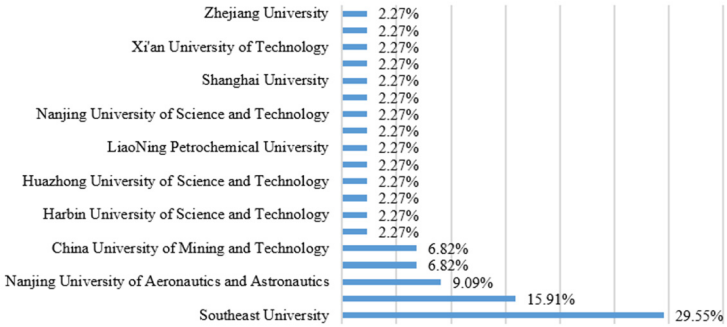
(b) The structural distribution of wrking age



(c) The structural distribution of engineering experience age



(d) Professional distribution of teachers



(e) Distribution of teachers' graduation schools

Fig. 2. Characteristics distribution of teaching staff

3.3 The Development Consciousness of Educational Object is Strengthened

The accelerated transformation of Chinese society directly affects the expectations of college students of Generation Z on the job market environment and their own planning. In the face of the rapid iteration of knowledge and technology, students have more diversified beliefs, more respect for self-development, and the realization of life value. During the period of campus study, students can enhance the competitiveness of career development through systematic professional knowledge learning, cultivation of ability, and innovative thinking.

3.4 The Construction of Course Materials Is Lagging

The content of the textbook of Introduction to electrical subject involves the generation and development of the subject, the production, transmission, distribution and use of electric energy, electric equipment and control technology. Most electrical schools mainly use school-based textbooks, whose content is only a part of the course teaching,

effectively maintaining the openness and development of curriculum knowledge, but the integration of courses with other subjects as well as ideological and political elements is less, and lacks forward-looking guidance.

3.5 The Teaching Methods and the Assessment Methods are Single

At present, the teaching methods of introduction to electrical subject are mainly lecturing, assisted by discussion and reading guidance. The teaching methods are relatively simple and the teaching effect is not obvious. In the early stage of the introduction course, the examination is mainly used to assess professional knowledge points. And in the subsequent stage, the examination is gradually adopted to examine students' papers on electrical professional thinking and understanding of scientific and technological project regulations. The assessment methods are relatively simple, the assessment of electrical professional knowledge is relatively reduced, and more attention is paid to the understanding and cognition of electrical subject.

4 Curriculum Integration Teaching Model

Based on the analysis of the situation of the above course construction, the course adopts the method of combining process oriented and object oriented, and highlights the integration of electrical engineering with career education, engineering education and scientific research in accordance with the gradual teaching idea of "electrical basic knowledge - career planning - frontier scientific research - engineering application". The technical diagram of the integrated teaching mode is shown in Fig.3.

Through the arrangement of the course content, students are guided to learn the development history, cutting-edge technology and basic theory of electrical science, and organized to conduct self-exploration on the basis of mastering the methods of career education. Students complete a personal career planning report on the basis of self-knowledge and environmental knowledge. According to the career report, students choose course assignments to explore learning according to the development path of engineering application and scientific research.

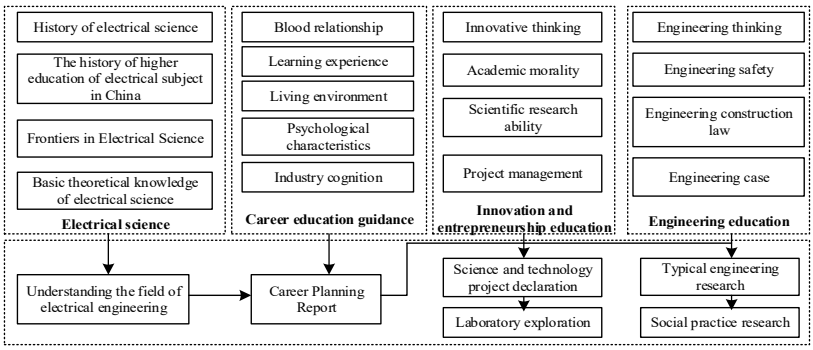


Fig. 3. The technical diagram of the integrated teaching mode

4.1 Enriching the Course Content and Stimulating Students' Learning Motivation

The course content retains the original basic knowledge of electrical education, and integrates career education, training programs, scientific and technological exploration procedures, academic ethics and other contents. Firstly, based on the development history of electrical science taught in the original course, the history of the development of Chinese electrical higher education is introduced to enhance students' sense of identity with the people's electrical industry concept. Secondly, in the course of career education, it mainly guides students to explore the path and planning of academic career and career development from the five dimensions of blood relationship, learning experience, living environment, personal psychological characteristics, industry cognition. Thirdly, it adds college students' innovative thinking of science and technology, academic ethics and other contents in the curriculum, which help strengthen the guidance of students' development of scientific and technological innovation thinking, and enhance the awareness of academic norms and academic ethics.

4.2 Innovating Teaching Methods to Enhance Visualization and Immersive Experience

In the knowledge teaching link of basic concepts, professional terms and typical phenomena, it combines the teaching method with the demonstration method to give full play to the auxiliary role of on-site pictures, audio and video materials of network data, enhance the visual communication of professional terms, and ensure the accuracy and vividness of basic concepts. The methods of classroom teaching, special lectures and practical exploration are used to enhance students' participation. The online platform is used to increase the openness of the course, guide students to base themselves on the classroom and actively explore, enhance students' sense of experience in the course and enhance their learning interest.

4.3 Optimizing the Assessment Method and Enhancing the Actual Guidance of the Course

Curriculum assessment is an important part of teaching activities, which plays an important role in guiding students' learning motivation and can have a long-term impact on students' learning behavior. On the basis of combining teaching objectives, our curriculum adopts the method of combining process assessment and result assessment. It mainly includes the following four aspects:

1) Normal performance (assessing students' usual learning attitude and performance, accounting for 20%);

2) Career report (assessing students' awareness and quality of planning their study life and career, accounting for 30%);

3) Scientific research application and engineering investigation report (assessing students' ability and awareness to carry out scientific research or engineering investigation on the basis of career planning, accounting for 30%);

4) Course learning summary report (assessing students' ability to comprehensively apply the knowledge they have learned, accounting for 20%).

Through career education, students are provided with methodological guidance. On the basis of career exploration, students are given directional career guidance and career exploration to help establish professional confidence, learning confidence and career development confidence.

4.4 Integrating into Social Practice and Enhancing Industry Sensitivity

It is a systematic task to write the scientific research application and engineering research report in the course assessment, which requires students to visit and investigate enterprises and industries during the holidays, understand the current industry development trend, understand the development needs of enterprises, the dilemma of power technology, and the manufacturing and technology of power equipment. As a result, it will enhance students' understanding of social economy and enhance students' sensitivity to developments in the electrical industry.

4.5 Construct the Gradient Teaching Material System to Enhance the Extensibility of the Course Content

Teaching materials are the main media used in teaching activities and an important part of the course form. Teaching materials cannot fully reflect the teaching content of the course, having obvious lag. The content of the introduction to electrical subject is extensive, which follows the frontier of the development of electrical science, and constructs the gradient teaching material system of main, practical and auxiliary teaching materials according to the goal and content of the course. The main teaching materials mainly include lecture materials, teaching reference books, and study guides. The practical teaching materials are the instruction manuals, project introductions and other materials which are required by the practical practice. Auxiliary teaching materials are supplements to main and practical teaching materials, including electronic teaching plans, problem sets, multimedia and network teaching resources.

5 Conclusion

Through the integrated teaching mode, the number of transferred personnel of electrical engineering majors had decreased by 0.63%, compared with the previous students. The number of students who failed professional courses decreased by 10.63%, compared with the previous session, and their professional confidence was further improved. Meanwhile, students had a clear understanding of the curriculum system, talent training plans and training goals. The structure of gradutes' employment, entrepreneurship and further study was further optimized, and students were more clear about the path of personal development and had more clear long-term plans and action plans.

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