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Research on Project-based Learning Approach with Local Characteristics in Electronic and Information Science Courses

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Abstract: The promulgation of the outline of the 14th Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Long-Range Objectives Through the Year 2035 has clarified the focus of work and put forward new requirements for the training of electronic and information science professionals. The teaching methods and levels can be optimized by focusing on the problems existing in the teaching process of electronic and information science courses, carrying out teaching reform, and putting forward the project-based learning approach with local characteristics.

Keywords: Electronic and information science courses; Project-based learning approach with local characteristics; Teaching reform

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1. Introduction

As a leading, basic, and strategic industry of the national economy, the electronic and information science industry is an important force leading and supporting economic and social development, which is an inherent requirement for building a network power and a manufacturing power in the new era. The rapid development of the electronic information industry has accelerated the demand for electronic and information science talents. Electronic and information science students are mainly concentrated in the field of electronic and communication engineering, which is the field of modern information society engineering that combines electronic technology and information technology. Information technology studies the theories and technologies of information transmission, information exchange, information processing, and signal detection. The training of students majoring in electronic and information science emphasizes engineering, practice, and application, and cultivates application-oriented and interdisciplinary high-level engineering technology and engineering management talents.

The teaching of electronic and information science courses is a vital part of the process of student training, and the quality of teaching directly determines the upper limit of students' ability. High-quality teaching not only requires teachers to have a solid and reliable professional theoretical foundation and a broad range of professional knowledge, but also has high requirements for the selection of teaching-related teaching materials, teaching content setting, and teaching method selection. Through research and practice, it is found that there are many problems in the teaching of electronic and information science courses, so it is imperative to explore more efficient teaching methods.

2. Analysis of the current situation of teaching

The professional courses in electronic and information science mainly include a series of courses such as random signal analysis, digital image processing, signal and system, digital signal processing, communication principles, and so on, which are necessary basic knowledge qualities for practitioners in the electronic and information science industry. The technology it contains is also widely used in daily life. However, the current situation of electronic and information science course teaching and its existing problems make the teaching progress of such courses slow, and the teaching quality is difficult to improve, even after more than two years of teaching attempts. The problems in the teaching process of electronic and information science courses are summarized as follows.

First, there are deficiencies in the curriculum, and the curriculum is relatively scattered. On January 13, 2021, the Ministry of Education in China issued a document on the "Establishment of Degree Categories in Various Majors", which subdivides electronic and information science majors into 12 professional directions, of which the new generation of electronic and information science technology is listed first. On May 11, 2023, the Party Committee of the State-owned Assets Supervision and Administration Commission (SASAC) of China held a meeting, which emphasized the need to guide and promote central enterprises to increase their efforts in the layout of strategic emerging industries such as the new generation of information technology, promote the digital, intelligent and green transformation and upgrading of traditional industries, and lead and drive China's industrial system to accelerate the high-end of the industrial chain and value chain. However, the current construction of electronic and information science courses is not enough to respond to national policies, and there is a lack of construction of a new generation of electronic information technology professional curriculum systems.

Second, the teaching concept is backward and the teaching model is outdated. The teaching practice shows that the teaching concept of teachers and the learning concept of students are incompatible with the goal of cultivating innovative talents. This is because course teaching and course learning are too oriented on scientific research and teachers pay too much attention to scientific research and despise course teaching, which leads to the phenomenon that students despise course learning. The selection of teaching materials for electronic and information science courses also needs to be optimized. According to the survey, the currently selected textbooks have been used for a long period, and they have not been updated and adjusted in time according to the needs of the development of the discipline. The textbooks of some courses focus on theoretical derivation and lack practical cases, which makes it difficult for students to understand and grasp the core content of the course.

Third, the teaching methods and assessment methods are rigid. There is still a teaching method based on lectures, and there is a lack of course teaching effect evaluation and incentive mechanisms to a certain extent. Teachers teaching knowledge poorly in class cause students to avoid the course by arriving late and leaving

early in class. The emergence of such phenomena is exacerbated by the rigid form of classroom teaching. A rigid teaching method is not easy to stimulate students' enthusiasm for learning, which leads to unsatisfactory teaching results. Besides, scientific research results are an important factor in the evaluation and evaluation of teachers. Under this evaluation system, teachers and students devote a lot of time to scientific research, so there is a phenomenon of attaching importance to scientific research results and ignoring the teaching effect of courses.

3. Exploration of project-based learning approach with local characteristics

To better cultivate the ability of the students majoring in electronic and information science in engineering, practice, application, innovation, and other aspects, the teaching of electronic and information science courses should be innovated and seek breakthroughs so that students can adapt to the quality needs of industrial development more quickly. This paper explores a project-based teaching method with the characteristics of local colleges in electronic and information science courses. The teaching methods and reform are optimized from the following three aspects.

3.1. Integrating the characteristics of local universities with the project-based teaching approach

Project-based teaching methods have proven to be an effective teaching model and have been widely promoted in the field of education worldwide [1–5]. The main idea is to improve students' comprehensive ability by allowing them to use the theoretical knowledge learned in the course to solve real problems faced in real life. The project-based approach requires teachers to design projects that are practical and match the learning objectives. At present, the project-based teaching model has been widely used in the teaching reform practice of electronic and information courses, but there are few cases of integrating the characteristics of local colleges and universities in the existing project-based teaching reform for electronic and information science courses. As a vital part of China's higher education, local universities play an important role in cultivating local talents and serving local development. Therefore, the teaching of electronic and information science courses should also be combined with the characteristics of local colleges and universities, to cultivate talents who are more suitable for the development of local industries.

Taking Three Gorges University as an example, it is located in Yichang City, Hubei Province, backed by Gezhouba and Three Gorges Dam, two major national projects, by the former Wuhan University of Water Conservancy and Electric Power (Yichang) and the former Hubei Three Gorges University on May 25, 2000 merger and establishment, successively affiliated to the Ministry of Water Conservancy and Electric Power, the Ministry of Energy, the Ministry of Electric Power Industry, the State Power Corporation, is a local university with distinctive characteristics of water conservancy and electric power. According to the survey, the employment units of the graduates of the electronic and information science major of China Three Gorges University are mainly local water resources departments and power companies. Secondly, the electronic and information science major of China Three Gorges University will also recruit a certain number of overseas students every year, and the source countries of international students are mainly developing countries such as India, Pakistan, Indonesia, and so on. The knowledge level of international students is relatively weak, and their language level is also uneven. After graduation, most students choose to continue their studies in China, studying water conservancy and electric power-related graduate majors. Therefore, it is very important to design a project-based teaching method that combines the local characteristics of China Three Gorges University and the problems existing in the teaching process of electronic and information science courses. Taking digital image processing as an example, in the process of project design, more practical cases related to local characteristics

should be designed, such as ground crack detection in the dam area and transmission line insulator detection. In the high-voltage power system, insulators are important components in transmission lines to increase the firing distance and fix the wires. Unmanned aerial vehicle imaging has become a common method to check the status of insulators. However, the automatic detection of insulators with complex backgrounds is still a challenging task. By designing the automatic detection project of transmission line insulators in UAV images under complex background conditions, students' learning interests can be effectively enhanced.

3.2. Multidisciplinary and multi-level teaching

The teaching of electronic and information science courses in the new era should adhere to the student-centric teaching concept, replace the traditional teaching method, explore multidisciplinary and multi-level teaching models, and fully combine the local characteristics of colleges and universities [6–11]. At present, the teaching of electronic and information science courses in China Three Gorges University is relatively simple, and there is little interaction between different professional courses. To optimize the teaching effect, a multidisciplinary and multi-level teaching method can be adopted. Taking the two core courses of electronic and information science, digital image processing and random signal analysis, as an example, there is a strong interactive relationship between the two courses, but the current teaching is carried out separately, so it is difficult for students to establish the cognition of the complete architecture of the professional courses. Taking image editing operation in digital image processing as an example, its principle is closely related to the knowledge of mean function in random signal analysis, so the two pieces of knowledge can be mixed in the teaching process of the two courses, which is helpful for students to better understand and master. In the teaching process of random signal analysis, the course is more theoretical, the definition and derivation of mathematical formulas are relatively high, and the teaching content is relatively abstract, which makes it difficult for students to understand. Through the multidisciplinary and multi-layer teaching model, part of the content of digital image processing is appropriately introduced into the course teaching of random signal analysis, which can make the teaching process meet the requirements of engineering and practice. In the process of analyzing the definition and characteristics of random signals in the second section of Chapter 2 of the explanation of the random signal analysis, the pixel value of the digital image is used as an instantiation of random variables, and the digital expression of the digital image is used as an instantiation of the random signal so that the concept of random signal is more concrete. Secondly, the digital image is modeled as a joint expression form of the knowing signal and the noisy random signal, and the prior information of the noisy signal is introduced as the Gaussian white noise in the typical random signal, and the theoretical basis for the image editing operation to effectively remove the superimposed noise is guided through theoretical derivation so that the students can better understand the abstract concepts introduced in the random signal analysis course and the theoretical basis involved in the digital image processing course. Secondly, the characteristics of the local universities of China Three Gorges University have attracted a large number of international students from developing countries to study electronic information-related majors. The student's language proficiency is uneven, and the professional foundation is relatively weak. At the same time, Chinese students majoring in electronic and information science at China Three Gorges University have an urgent need for foreign language learning. Based on this, it is possible to establish mutual learning groups for Chinese and foreign students with different language levels and ability levels.

3.3. Computer-aided teaching

As a new teaching method, computer-aided teaching has been widely promoted in different stages of education and teaching [12–15]. The new computer-aided teaching can not only enhance students' interest and enthusiasm

for learning but also greatly improve the quality of students' learning. In recent years, the rapid development of artificial intelligence technology has promoted leaps and bounds in various fields in the world, especially the large language model ChatGPT and the general visual mode Stable Diffusion XL released in early 2023 have attracted widespread attention around the world. As an important part of university education, the teaching of electronic and information science courses should introduce these new artificial intelligence technologies and design effective computer-aided teaching methods. With the advent of computer technologies that can be used to support teaching and learning, in recent years, especially the rapid development of artificial intelligence technology, more and more educational researchers have begun to focus on reframing teaching as an act of design and continuous reflection. Research on the use of AI tools to enhance educational effectiveness often focuses on teacher orchestration or understanding how AI tools can support teachers in coordinating complex classroom interactions across multiple aspects. The effective use of AI tools in the classroom can help with reflective practice. The first is to collect real-world and valid data on what is happening in the classroom. Second, to analyze and evaluate this data, and finally to explore how this data relates to teachers' teaching practices and can provide customized information for each student's teaching. Taking ChatGPT as an example, in the process of electronic and information science teaching, students can build a personal knowledge graph, and evaluate their personal learning situation and learning effect utilizing auxiliary text answers. In addition, large language models can also be used to build an effective analysis system to assess students' understanding and mastery of the textbook. The textual data of the course papers completed by the students were collected, the causal structure of each student's answers was analyzed, and quantifiable analysis conclusions were given, to guide teachers to better evaluate the learning effect of students.

4. Conclusion

To solve the problems of scattered curriculum settings, backward teaching concepts, outdated teaching models, and rigid course teaching and assessment methods of electronic and information science majors, this paper proposes a project-based teaching method with local characteristics to carry out the teaching reform and discussion of electronic and information science courses. Comprehensively cultivating students' engineering, practice, application, and innovation abilities can encourage students to better adapt to China's future electronic information industry.

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Disclosure statement

The authors declare no conflict of interest.

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