

Teaching Reform & Exploration of Communication Principles Course under 5G Background

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Abstract. 5G has put forward new requirements for the cultivation of telecommunications talents. As a core professional course for communication and electronics majors in colleges and universities, Communication Principles requires continuous reform based on the development of new communication technologies. This article analyzes the characteristics of 5G technology and education, taking the course Communication Principles as an example, analyzes the characteristics of the course and the current teaching situation, and carries out reforms and explorations in such aspects as structural adjustment of the key and difficult content of the theoretical course, combination of experimental links with Matlab virtual simulation, 5G communication training, and training and certification of 1+X certificates. Practice has shown that this teaching reform has improved the connection between theoretical teaching and practical application, improved students' ability to analyze and solve problems, and is more suitable for the cultivation of applied talents.

Keywords: communication principles; teaching reform; virtual simulation; 1+X certificate.

1. Introduction

The integration of 5G with core technologies such as artificial intelligence, cloud computing, and educational big data in the future technology field will lead to changes in educational elements such as teachers, students, resources, and the environment. At present, in the exploration literature of Communication Principles in different majors, certain teaching effects have been achieved by adjusting some course content and combining simulation experiments for exploration and auxiliary teaching [1]-[4], but there are still some shortcomings. On this basis, this article further delves into the teaching reform and exploration of the course Communication Principles, and structurally adjusts the course content; The experimental part combines virtual and real elements; At the same time, expansion activities such as practical training, training, and certification have been added. Teaching practice has shown that the exploration of teaching reform in the course Communication Principles described in this article can improve the connection between theoretical teaching and practical application, and can guide students to analyze and solve problems, thereby improving teaching effectiveness.

2. Education characteristics under 5G Background

Compared to the past, education under the background of 5G technology will have more influence and evolution between educational elements such as teachers, students, resources, and the environment, and the teaching content will also be more diverse and colorful.

5G plans to provide services in three typical application scenarios: uRLLC (ultra-reliable low latency communication), eMBB (enhance mobile broadband), and mMTC (massive machine type communication). Based on the network characteristics of 5G, such as ultra-low latency, ultra large connectivity, ultrahigh speed, and the Internet of Things, education in the context of 5G technology mainly has the following characteristics.

The 5G air interface has a latency as low as 1ms and can seamlessly support a large number of educational data packet devices at the same time, to meet the teaching needs of remote control in remote education, such as program-controlled teaching experiments and mechatronics integration.

The ultra-high speed of 5G is sufficient to support 4K or even 8K ultra high-definition videos, support VR virtual simulation teaching, and even assist in creating a good learning environment. It also supports the construction of virtual teaching scenes [6], which has great value in diversified, personalized, and convenient teaching.

The 5G super Dalian Internet of Things also has important applications in teaching. Both teachers and students can interact with devices and systems through REID (Radio Frequency Identification Technology) both inside and outside the classroom, promoting learning; Simultaneously supporting various mobile learning modes. The super large connection of 5G can also be used for evaluating classroom performance, teaching guidance, academic management, and other construction, supporting the combination of online and offline, virtual and real.

3. The Characteristics and Teaching Status of Communication Principles

3.1. Characteristics

Communication Principles is highly theoretical. The course content integrates advanced mathematics, probability theory and other mathematical courses, as well as professional basic course knowledge such as electronic circuit, signal and system. The derivation process of formulas and theorems is complex and abstract, with many knowledge points, many abstract concepts, complex mathematical deduction, and fast technology update [7].

3.2. Teaching Status

There is a lot of course content, and the knowledge of the leading courses is easy to forget; The course is highly theoretical and difficult to understand; Communication technology updates quickly, but textbooks lag behind; The experimental box module is fixed, and the experiment lacks flexibility. In addition, the hardware in the experimental box is prone to aging and damage, seriously affecting the success rate of the experiment and the accuracy of the data. In response to these issues, this article makes structural adjustments to the key and difficult content of Communication Principles, and combines experimental links with Matlab virtual simulation, 5G communication training, and training and certification of 1+X certificates to carry out reforms and explorations.

4. Teaching Reform and Exploration

4.1. Structural adjustment of key and difficult content in the course

The current theoretical teaching content of Communication Principles is too outdated, and most of the teaching content still mainly stays on the communication theoretical framework of 2G and 3G. However, for the mainstream 4G and 5G technologies in current society, the scope of this course is very narrow and not deep enough, and most of the published textbook content lags behind the mainstream communication technologies. Taking Changxin Fan Communication Principles (7th edition) [8] as an example, the teaching content of this course is mainly adjusted from the following aspects in practical teaching.

(1) In the first class, the relationship between Communication Principles and advanced mathematics, probability theory, electronic circuit, signal and system, network technology and other leading courses was introduced; Provide an overview of the relationship between Communication Principles and subsequent courses such as mobile communication, fiber optic communication, satellite communication, etc., to provide students with a comprehensive and intuitive understanding of the course.

(2) Review of knowledge points in the leading course. Review the knowledge points related to Communication Principles in the introductory course.

(3) Reduce the learning requirements for analog communication. At present, in most of the Communication Principles, the analog communication section accounts for a large space; But analog

communication was the earliest communication technology in the 1970s. If more class hours were allocated to learn old and gradually outdated technologies, it would not only be a waste of time, but also easily reduce students' learning enthusiasm, and the gains outweigh the losses.

(4) Add content on 5G technology. 5G technology is currently the mainstream communication technology, with breakthroughs and innovations in multiple fields of communication. In teaching, it can be emphasized that China has played a significant role in the development of 5G, which is integrated with the ideological and political curriculum to enhance students' sense of national pride and patriotism; The research and development, construction, and maintenance of 5G technology require a large number of talents, which is related to student employment.

4.2. Experiments and practical training

(1) Combining virtual simulation experiments. At present, most universities are equipped with experimental boxes for experiments on communication principles. However, the fixed module of the experimental box and the lack of flexibility in the experiment result in poor effectiveness in enhancing students' autonomous learning ability. In addition, if the hardware in the experimental box is aged or damaged, even if the experimental operation is copied, the results cannot be obtained, which seriously affects students' learning interest and autonomy. Therefore, it is particularly important to conduct virtual simulation experiments outside the laboratory environment. Taking the 2PSK experiment as an example, the schematic diagram of the 2PSK system is shown in Figure1. In addition to using an experimental box in the laboratory to operate this experiment, it can also be achieved through Matlab programming implementation; Or Simulink modeling implementation.

(2) 5G training base. In the process of cultivating 5G communication talents, the 5G communication training base plays a significant role. In view of this, our college has collaborated with China Mobile Guangxi Laibin Branch to successfully establish the "5G

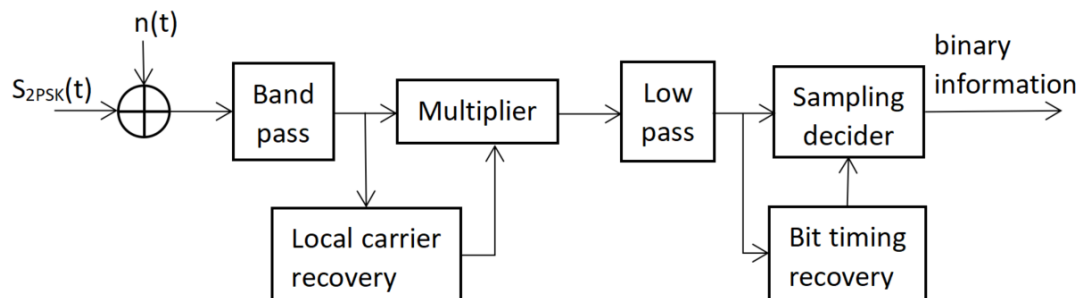


Fig 1. 2PSK system

Communication Training Base of the School of Mechanical and Electrical Engineering" in October 2022. The "5G Communication Training Base" integrates the latest 5G communication technology, provides excellent professional course practice environment for students majoring in communication engineering and electronic information engineering, and provides practical training scenes in the direction of 5G network construction talents, 5G base station construction and maintenance talents, so that students can deepen their understanding of theoretical knowledge in the "learning by doing" environment and hands-on practice, while improving students' systematic analysis of problems Ability to solve problems and improve professional quality.

4.3. Expanding knowledge after class

In addition to completing the teaching content of Communication Principles, we hope to further enhance students' understanding of theoretical knowledge of communication principles and enhance their enthusiasm and interest in self-directed learning through various extracurricular communication technology knowledge expansion activities.

1+X certificate training and certification. In January 2019, the State Council issued the "Implementation Plan for National Vocational Education Reform". The plan points out that starting from 2019, pilot work will be launched on the "diploma+several vocational skill level certificates"

system (referred to as the 1+X certificate system) in vocational colleges and applied undergraduate universities in China. The course study of electronics and communication majors, combined with the supplement and strengthening of the module of X certificate training and examination, will make it possible for students to master the corresponding abilities and obtain vocational skill grade certificates, so as to prepare for employment and entrepreneurship.

Our college has been applying for a pilot program for the vocational skill level certificate for the construction and maintenance of 1+X 5G base stations since 2020, has been approved. The full-time teachers the college have participated in enterprise practice and 1+X certificate teacher training on "5G base station construction and maintenance" in the past two years. Among the 2018 and 2019 students majoring in electronic information engineering, we carried out the teaching reform pilot work of 1+X certificate training and certificate examination. After two semesters of pilot testing, good teaching results have been achieved. Compared with previous students, the learning enthusiasm and initiative of electronic information engineering majors in 2018 and 2019 have significantly improved.

5. Summary

Communication Principles is highly theoretical and widely applied. Based on the analysis of the characteristics of 5G technology and the characteristics and current situation of the Communication Principles course, the article explores and reforms communication knowledge expansion through structural adjustments to the course content, the use of experimental boxes combined with Matlab virtual simulation, 5G communication training, and 1+X certificate training and certification. Intended to enhance the connection between the teaching and practical application of the current Communication Principles course. Practice has shown that through the reform and exploration described in the article, the connection between theoretical teaching and practical application has been improved, which can guide students to analyze and solve problems, enhance students' interest in learning this course, enhance their ability to connect theory with practice, and is more suitable for the cultivation of applied talents.

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