

# *Analysis on the Course Design and Development of Freshman Seminar of Telecommunication Engineering*

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**Abstract**—The Freshman Seminar is a student-centered, problem-oriented, seminar-based course and has unique value. To rationally choose the topic of discussion, design teaching content, and combine student research and teacher guidance from the actual needs of communication engineering students can improve the enthusiasm of students' independent learning and classroom participation, and effectively improve the quality of teaching. As a Double First-Class university, it can solve serious problems such as insufficient supporting teaching resources and students paying too much attention to utilitarian learning objectives by concentrating resources to build demonstration courses and strengthen refined management.

**Keywords**—freshman seminar; demand orientation; teaching quality; teaching method

## I. INTRODUCTION

Since Tsinghua University took the lead in opening a freshman seminar in August 2003, most of the universities in China have opened new seminars. The course has distinct teaching characteristics and unique educational value, and has gradually become a highlight of undergraduate teaching reform in universities. [1]"Communication and the Future" is a seminar for freshmen of the College of Communication Engineering, Jilin University in 2018 for the first time. The property of the course is a limited course in the professional education program with a total of 16 hours and 1 credit. The goal of the course is to enable freshmen to plan their lives from the beginning of entering the university, to be an university student with ideal and morality; to give college students a deeper understanding of the professional field and direction, and to stimulate their interest in communication technology learning; to extend students' imagination and creativity; to improve students' language expression skills and ability to make courseware; to enhance in-depth understanding and friendship among students, as well as between students and teachers. The core content of the course is based on the ideals of life, the history of communication technology, communication equipment and devices, and the impact of emerging communication technologies on human life. The course enables freshmen to fully understand the nature, characteristics, training objectives, teaching content, learning methods and employment prospects of their majors, so that they can look forward to professional learning, stimulate

interest in learning, enhance professional recognition, build professional confidence, and improve Learning motivation.

Our communication engineering major draws on the experience of teaching reform of freshmen's seminars in other universities in China, and designs the content of teaching based on demand. The main teaching method is research-based teaching, and actively explores the teaching practice of freshmen's seminars. During the teaching process, we focused on answering questions and interacting between teachers and students, and achieved good teaching results.

In general, the teaching practice of freshmen's seminars in China's universities is still in the exploratory stage, facing practical difficulties and problems such as low teacher start-up rate, scarcity of curriculum resources, difficulty in changing traditional teaching methods, and inactive student speech. How should a freshman seminar be conducted to discuss topics? How should a freshman seminar choose a discussion topic? How to transform the traditional "teacher teaching, student listening" teaching method into a student-centered "teacher guidance, student research"? What factors are the key factors affecting the quality of teaching? Combined with the teaching experience of this year's communication engineering major in our school, this paper is summarized as follows: The design of teaching content should be oriented to the needs of students. The teaching methods should be based on seminar-based teaching. The key factors affecting the quality of teaching are curriculum orientation, lecturers and teaching methods. In addition, the school's support policy is unstable, such that, students pay too much attention to utilitarian learning objectives, and the lack of relevant supporting teaching resources is a real dilemma facing curriculum construction. Concentrating superior resources to build demonstration courses and strengthen the refined management of courses is an effective countermeasure to break through the predicament.

## II. DEMAND-ORIENTED TEACHING DESIGN OF FRESHMEN SEMINAR

Due to the limited class hours, the topics should be chosen appropriately. It should be clear whether the focus of teaching is on academic guidance and research-based learning, or

answering questions and helping students integrate into university life as soon as possible.

However, if we only introduce these things in our classes, it is possible to return to the traditional “instructor-speaking, student-listening” teaching mode of communication introduction courses. Then it would be difficult to conduct seminar-based teaching, and it would be difficult to inspire students’ innovative thinking, and it also would be difficult to train students to get some international talents.

Considering that the total number of freshman seminar for the communication engineering major is only 16 class hours. It is difficult to achieve two goals at the same time by not only introducing the whole course to the students, but also trying to help them establish a better ideal. At this point, how to scientifically design topics of discussion becomes a problem.

#### *A: University - a new starting point of life*

In order to design the teaching contents and select topics for discussing, we conduct a serious and all-round empathy. What are the core needs of students for freshmen's seminars? According to our survey, we find that students' needs are different. As follows, we sort out and list those needs according to their importance: firstly, do they want to take the postgraduate exam and what need to be done to take the postgraduate exam? Secondly, do they want to obtain certificates and how to obtain certificates? Thirdly, what is the employment situation in the future and which skills are needed for employment? Fourthly, how to think of "artificial intelligence"? And what are the future trends in communication and information industry and whether it is optimistic? Fifthly, in the era of Chinese companies are going abroad, what international talents are needed urgently by enterprises? Students hope to get the answers of above questions from teachers.

First of all, we need to help students integrate into university life as soon as possible. So we design the first unit of freshmen seminar course as: **University - a new starting point of life.**

- **Unit Goal:**

Through the discussion of this unit, freshmen can understand what the major of communication engineering is and what professional curriculum we have. Moreover, this unit can inspire students' forward-looking, help students plan a good four-year university life, establish a good life goal, correct learning attitude, and fully understand the significance of four years of university for the future life.

- **Theme of the Seminar:**

- 1) Introduction of communication theory;
- 2) Course design of communication engineering;
- 3) Introduction of the resources of University libraries;
- 4) How to conduct literature retrieval and scientific research;

#### *B. Wading into information and communication*

If the orientation of the freshman seminar is to stimulate interest, focus on academic awareness training and research study, then in the communication engineering profession, the focus of the seminar is on the hot issues and frontier topics in the current generation of information science. For example, the development of information technology has affected every aspect of human daily life. Technologies such as smart homes, smart wearables, and driverless cars [2] have become or will soon become an integral part of our lives. Let students learn about information and communication systems through the examples around them and inspire their enthusiasm for learning. However, in order to fully understand these issues, it is necessary to have certain professional knowledge and analytical skills. However, freshmen often do not have these conditions, which may make the topic discussion only in the form of a brief experience. If the orientation of the freshman seminar is to let the students fully understand the majors they have studied, and to understand the nature, characteristics, training objectives, teaching content, learning methods and employment direction of the major, so that they know what the majors are doing, and what they are enrolled in. If the orientation of the freshman seminar is to let the students fully understand the majors they have studied, and to understand the nature, characteristics, training objectives, teaching content, learning methods and employment direction of the major, so as to know “what would they do” in their major, “what would they learn” after enrollment, “what would they deal” after graduation, the theme of the seminar should be the evolution and current status of communication engineering disciplines, professional training objectives and talent quality requirements, professional knowledge systems, professional teaching arrangements and learning methods, postgraduate entrance and employment. Based on the above considerations, we designed the second unit of the freshman seminar: wading into information and communication.

- **Unit Goal:**

Helping freshmen understand professional concepts through daily life cases, so as to establish a panoramic understanding of information and communication systems, and to build perceptual knowledge of the principles of typical technologies.

- **Theme of the Seminar:**

- 1) Brief history of communication development [3];
- 2) Wireless communication and intelligent learning [4];
- 3) Optical communication and information photo electronic functional devices;
- 4) Walk into wireless laser communication [5];

#### *C. 5G communication and Internet of Things technology*

Based on the needs of the era, we integrate the professional navigation with the nature of explaining doubts and solving puzzles into the topics of the seminar. In addition, we have identified two seminar topics, which correspond to students' different curriculum requirements. The third unit of freshmen seminar is "5G communication and Internet of Things technology"[6].

- **Unit Goal:**

The development of information technology affects all aspects of human daily life, such as smart home, smart wearing equipment, driverless cars and other technologies have become or will become an indispensable part of our lives. We must help students understand the information and communication system through the examples around them, and arouse their enthusiasm for learning.

- **Theme of the Seminar:**

- 1) Driverless cars;
- 2) Intelligent life and smart home;
- 3) Interconnected factories;
- 4) Digital image processing and application;
- 5) Eye of Machine (Machine Vision) [7];

#### *D. Information Technology Development and Future*

The forth unit of the freshmen seminar is "Information Technology Development and Future".

- **Unit Goal:**

This unit will start with some emerging technologies such as artificial intelligence, big data, robotics, biotechnology and quantum communication, which can help students understand the current development status of communication technology, encourage students to give full play to their imagination, look forward to the far-reaching impact of emerging technologies on the future of human society, and encourage students to work hard to learn theoretical knowledge and professional skills to meet the great challenges brought by the new communication technology revolution and adapt to the rapid development of times.

- **Theme of the Seminar:**

- 1) The mysterious world of robots;;
- 2) Will robots replace humans? [8];
- 3) Communication technology and the future of mankind;
- 4) Embracing the era of big data [9,10];

### **III. RESEARCH-BASED TEACHING METHOD COMBINING STUDENT RESEARCH WITH TEACHER GUIDANCE**

In order to allow all students to participate in the freshmen's seminars in depth, we emphasize that the inquiry questions originate from the hot topics or practical problems that students are interested in. The inquiry needs come from the students' curiosity and self-motivation. "Teacher Guidance" is combined with "Student Research" to organize discussions and find answers in the process of teacher-student interaction.

Student research runs through the whole process of :asking, analyzing and solving problems". In the question-raising stage, we ask students to use their spare time to think independently and ask questions that are of interest to them. After summing up these questions, the teacher sorts and refines them forming 20 questions, which are sent to the students in the form of tasks, thus realizing the topic of "from the students to the students". In the analysis phase of the problems, every research team is formed of 4 students in student order, and

then try to analyze the problem and solve the problems which are selected on a group basis. For example, when we started the discussion of the first unit communication theory, students raised the problem of transmitting image signals on mobile phones. I said that the explanation of this problem is quite complicated. It is necessary to learn the principles of CCD image sensor, image compression coding, communication theory, digital communication theory, data communication and computer network, digital microwave and satellite, optical fiber communication, multimedia technology and digital signal processing, in order to understand this principle clearly. To understand these professional courses thoroughly, the student must also learn the basics of college English, advanced mathematics, linear algebra, probability theory and mathematical statistics, university physics, electronic circuits, digital circuits, circuit analysis foundations and signals and systems. In this way, we can stimulate students' curiosity and enthusiasm for learning.

Teacher guidance is also very important. In the question-raising stage, the teacher will filter, refine, sort, and process the various questions raised by the students, and finally form the tasks to be completed and distribute them to the teams. In the analysis phase of the problems, the teacher should be the staff of the students to analyze and study the problems, and guide the students to overcome difficulties, step by step, and gradually find the correct answer taking less detours. In the task reporting and discussing stage, teachers should organize seminars and discussions, grasp the rhythm of seminars, adjust the atmosphere of seminars, praise students' unique thinking and opinions, encourage students' desires and attempts to express. It not only points out the achievements of the students in completing the tasks, but also points out the shortcomings that need to be improved, which promotes the development of the research to a deeper level, so that students can gain knowledge and ability to improve through problem research. For example, when discussing 5G mobile communication technology, students raised the issue of wireless communication band allocation, licensing, and license-free. I explained to students that the frequency band allocation means that if a certain frequency band is allocated to a certain service, this frequency band will be occupied by this service independently and other services cannot occupy the frequency band. The frequency band is like a lane. The permitted frequency band is like a fixed lane. It has already been allocated and run the designated vehicle and the other vehicle (unlicensed services) cannot occupy the lane (band). Further I explained this problem with the channel division of cable digital TV. The unlicensed band belongs to the public shared lane, as long as the lane (band) is empty and anyone can occupy it. For example, WLAN (WiFi) wireless broadband technology dominates the 2.4 GHz unlicensed band. Personal computers, game consoles, MP3 players, smart phones, tablets and printers, and computer notebooks can all use the WiFi device to occupy this frequency band for wireless Internet access. It is one of the most widely used wireless network transmission technologies. Although Bluetooth and Zigbee also use this band, its market size and influence are far less than WLAN. The frequency resources have always been extremely tight and expensive than gold. The concept of sharing spectrum resources by various technologies has

gradually been accepted by the industry, and the frequency mode is undergoing a huge transformation. These questions and answers connect the seminars to the communication scenarios in our lives, making the seminars deeper and more thorough.

Teacher guidance can achieve good teacher-student interaction, but more importantly, teachers should pay full attention to and encourage those special students who are not active in the process of guiding. The common phenomenon is that when discussing a topic, some students repeatedly speak and perform extraordinarily active, but some students rarely speak or even say nothing. They often remain silent and free from the atmosphere of discussion. If a small number of activists are allowed to speak repeatedly and take up a lot of discussion time, which will reduce the average of the activity of the entire class, and let most students develop bad habits of silence and onlookers violating the original intention of the seminar. Therefore, the teacher has to find out why these "bystanders" do not speak. If the student's language ability is limited, the teacher can ask questions many times to let the students improve their ability and enhance the information in the process of answering the questions. If the students are not willing to participate in the discussion, the teacher should analyze the psychological reasons and behavioral motives. If the students are unfamiliar with the topic of the seminar or have insufficient preparation, the teacher should urge them to learn and try to improve their data collection ability, data analysis ability and insight. In most cases, students are not actively speaking because they are used to "listening" rather than "speaking". Over time, they are lazy and accustomed to it. This is very different from the hot atmosphere of classroom discussions in the United States when I was in the computer department of the University of North Carolina at Greensboro. Breaking the habit of this Chinese-style classroom requires teachers to deliberately guide and create a heated seminar-style teaching atmosphere.

#### IV. KEY FACTORS, PROBLEMS AND COUNTERMEASURES AFFECTING THE IMPROVEMENT OF TEACHING QUALITY

##### *A. Analysis of the Key Factors Affecting the Teaching Quality of Freshmen Seminars*

Course orientation, lecturers and teaching methods are three key factors that influence the effectiveness of freshman seminars.

The quality of teaching will be better if the course orientation is clearer and the purpose is guiding as well as inspiring the interests of students. If the course is oriented as an explanation of professional knowledge or professional skills, it will be subject to the objective reality of students' insufficient, limited basic knowledge and extremely limited learning hours; the teachers do not have enough time to complete the explanation task, and the students cannot accept it in a short time. Therefore the established teaching goals cannot be achieved. The main purpose of the freshman seminar is not the infusion and transmission of knowledge, but the development and innovation based on inheritance.

The lecturer determines the quality of the teaching. There is no doubt that the freshmen seminars are short and succinct.

They must not only scan the profession for panoramic scanning, explain doubts, but also stimulate interest, cultivate research consciousness and innovative thinking. Therefore, its requirements for teachers are very high. The lecturers should be the professional leaders or academic leaders with profound academic attainments, rich practical experience and vivid teachings skills. They have broad horizons, great personality and are attractive and passionate in teaching.

An interactive teaching method can effectively improve the quality of teaching. Course teaching should adopt problem-oriented inquiry and seminar-style teaching methods, paying attention to answering questions and the interaction between teachers and students. The topic of the seminar should be inspiring and closely related to reality, which can arouse students' interests and attention. The atmosphere of the seminar should be relaxed and lively. It should encourage students to speak, guide students to explore the ins and outs of the problem, appreciate the students' independent thinking ability and insights, pay special attention and care to students who speak less, and void indoctrinating teaching, general discussion as well as formalism.

##### *B. Analysis of the condition affecting the teaching quality improvement of freshmen seminars*

As a research university of double-class universities, Jilin University has been attaching great importance to the freshmen seminar. However, due to the first start of the seminar, the time arrangement for the freshman seminars was not reasonable enough, the students paid too much attention to the utilitarian learning objectives, and the related supporting teaching resources were seriously inadequate.

The first problem stems from the unreasonable time arrangement of the freshman seminar. Let's take our school as an example. In the fall semester of 2018, the school made the stipulation while establishing the professional training program. It says that in the first semester, each major offers a freshman seminar of 1 credit, which is taught by well-known experts in this field. It aimed to guide students to recognize the subject and stimulate their interest and motivation. Because it was the first round of classes, and it needed to arrange lecturers, curriculum content plan, unified teaching mode and performance assessment methods according to different colleges, the preparation work was complicated and cumbersome. It would not be officially started until mid-October, and it had been around the end of the semester when the course went around Units 3 or 4. At that time students were also under much pressure from the final exams of other modules, so that they did not put enough effort into the process of selecting the topic, collecting data and writing the paper. It was found that the quality of the paper was not satisfying, and the content of PPT was not thoroughly. The atmosphere of the discussion was not active either.

The second problem is that students pay too much attention to utilitarian learning goals. In the teachers' opinion, the goal of the freshman seminar is to guide professional learning and development planning, stimulate learning and research interest, which is a broad-based, problem-oriented and exploratory study. However, the student's course learning



goals may be completely different, such as 'how to pass the exams' and 'get a good grade'. These goals were short-sightedness and utilitarian and the outcomes were very limited. Although, the final score would neither affect the access of post-graduate study nor the student's academic achievement ranking, all the students got the good grades, which is not conducive to the long-term construction and development of the freshman seminar course.

The third problem stems from the serious shortage of related supporting teaching resources. First of all, the school should formulate a mature and complete freshman seminar teaching norms and incentive system; the college should have a long-term, systematic freshman seminar course construction plan, and establish a resource platform for all freshmen, so that all freshmen and the lecturers can share the teaching resources. In addition, in order to make students know the current development of China's communications industries, we can also arrange to visit China Unicom, China Mobile and China Telecom's computer room to get a close look at the current development of communication equipment and technology.

### *C. Suggestions on Effectively Improving the Teaching Quality of Freshmen's Seminars*

The freshman seminar is the highlight of the current talent training model innovation and undergraduate teaching model reform in China's dual-class universities. It advocates heuristic, inquiry, discussion and participatory teaching. It allows students to truly become the main body of learning and help students learn to how to learn. It has a unique curriculum opening value. In the national key undergraduate colleges that are oriented as double-class research universities, although the freshmen seminars have received sufficient attention and resources, the curriculum construction has just started. Nevertheless, in order to meet the need of adaptive transformation and academic transformation of freshmen, the school can concentrate on superior resources and take effective measures to build a group of demonstration freshman seminars. Therefore, the following two suggestions for effectively improving the quality of teaching are proposed:

First, concentrate the superior resources, and build a group of demonstration freshmen's seminars according to the curriculum design ideas and concepts of the excellent courses, and lead the curriculum construction with typical examples. The most important of these is the select, training and encouragement of the teacher. Generally speaking, the lecturer should be delivered by the famous teachers and outstanding scholars, who have excellent academic attainments, can clearly explain the problems, and have superb teaching skills, which can guide students to think positively. Behind the lecturer, there should be a complete teaching team and service platform. The school should establish a school-level teaching service platform, summarize the teaching materials and related information inside and outside the school, organize teaching seminars and experience exchanges, conduct teacher training

and teaching outcome investigation, and develop new seminar manuals. In terms of incentives, special financial support should be set up, and the amount of teaching work in the seminar should be allowed to be recognized as a certain amount of scientific research task.

Second, strengthen the refined management of freshmen's seminars. In terms of teaching content, we must be short and succinct, and strive for excellence. It is necessary to proceed from the actual needs of the students and to summarize the topics. In the aspect of teaching management, different types of freshmen seminars should be classified and managed. The seminars aiming at adaptive transformation should focus on understanding the profession, analyzing and interpreting of professional training programs; and the seminars based on academic conversion should focus on inspiring academic research, cultivating of inquiry and innovation consciousness. The school should conduct a dynamic assessment of the effectiveness of the course, continuously carry out the survival of the inferior and metabolism of the course, strengthen the refined management, and improve the quality of teaching.

### V. CONCLUSION/SUMMARY

In short, carefully designing the teaching content from the actual needs of the students, adopting a discussion-based teaching method combining students' study and teacher-led learning, and concentrating the resource to construct demonstration course, can enhance the teaching effect of the freshmen's seminars, make the teaching content not boring and avoid formalism. It can also help freshmen change the learning mode and do a good job in career and progression planning in advance.

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