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Teaching Reform of Computer Network Course

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Abstract

Computer network is an important professional basic course for network engineering majors. Aiming at the goal of cultivating applied talents in the professional talent training plan and the current situation of learning and learning in computer network courses, this paper analyzes the problems and causes of this course, and proposes teaching content, teaching methods and teaching modes. The ideas of teaching reform were carried out, and some reforms were put into practice. Through practice, we can see that the teaching reform of this course is feasible and can improve the teaching effect.

Keywords

Computer network; Teaching reform; Practice; Applicability.

1. Introduction

Computer network is an interdisciplinary subject formed by the mutual penetration and close combination of computer technology and communication technology. It is generally believed that this course is a professional basic course for network engineering majors, and a professional course for information management and information systems majors[1].

The computer network is a very complex system. Scientists use the idea of modularity to solve the complex problems of this system, and propose two different models for building modules: one is the ISO/OSI model, and the other is the TCP/IP model. The two models have their own limitations. In the current teaching, these two models are usually combined and divided into five modules, called the five-layer model. From top to bottom, they are: application layer, transport layer, network layer, and data link. road layer and physical layer. Judging from the research of the literature, domestic and foreign college teachers usually use two teaching methods when explaining computer networks: one is the bottom-up (usually called bottom-up) explanation, that is, starting from the physical layer, Layer by layer, and finally to the application layer. This teaching method is in line with the habits of people's thinking and understanding. The lower layer is the foundation, and the upper layer builds corresponding functions on the basis of the lower layer. Therefore, to talk about the basic knowledge first, and then talk about the superstructure, can make students have a sense of progressive clarity in cognition. Another teaching method is top-down (called top-down) teaching. This teaching method is a method from the outside to the inside. It talks about the application first and then the theory, which is in line with cognitive psychology, that is, generally speaking, the process of human cognition is often from perceptual cognition to rational cognition. This teaching method starts from the phenomenon (perceptual knowledge first), and then guides students to "see the essence through the phenomenon", so that the learners can easily accept it[2].

Using the layered model to explain the knowledge points of computer networks, whether it is a top-to-bottom teaching method or a bottom-to-top teaching method, has the following common characteristics:

(1) Within each layer, the degree of coupling of knowledge points is high; between layers, the degree of correlation of knowledge points is low. This distribution of knowledge points will

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inevitably lead to the fact that when each layer is taught separately, students feel abstract and difficult to understand because of the dense knowledge points and strong principle; "Independence" is relatively strong, giving students the feeling that the structure is loose and the knowledge points are scattered[3].

(2) The problems to be solved by each layer and the fields of knowledge involved are significantly different. The physical layer and data link layer focus on hardware, involving knowledge of physics, electronics, signals and other disciplines; the network layer, transport layer, and application layer focus on software, involving knowledge of data structures, algorithms and other disciplines. Therefore, in order to learn the course of computer network well, the knowledge reserves of students must have both breadth and depth. Breadth refers to a broad range of knowledge, because this course involves knowledge of many disciplines. Once students are unfamiliar with the knowledge of certain disciplines, it is difficult to learn this course; depth refers to students' mastery of knowledge in these related disciplines To learn more solidly. Therefore, if there is one or some weak subjects in the subject area covered by the course, students will find it difficult to study this course[4].

(3) In general, all the knowledge points of this course are relatively abstract. Due to the quality of our students, most of them have difficulty understanding overly abstract theories. This is an obvious weakness in their learning ability. Therefore, the abstract nature of the course also makes many students feel intimidated[5].

2. Existing Problems

(1) The final exam results are not satisfactory. Based on the above characteristics of computer network courses, this course is recognized by students as a difficult course. The same goes for feedback from previous students on the course. We surveyed 451 students studying this course in the 2020 academic year, and recovered 368 valid samples. 29.9% of students thought the course was "very difficult" and 66.3% thought it was "somewhat difficult". It can be seen that students do have great difficulties in learning this course. What can directly reflect this learning difficulty is that the students' final exam results are very unsatisfactory.

Over the years, our department has also paid special attention to this issue. In order to eliminate the reasons for teachers, we have selected experienced teachers and adopted various teacher collocations and teaching methods. The result of the exam is still that most students fail. Therefore, it can be considered that the main reason for this result is not the teachers.

(2) Theory and experiment are out of sync. According to the positioning and requirements of the talent training program, the experiments of computer network courses are mainly designed as "applied experiments", while it is difficult to design suitable application experiments for the underlying theory of computer networks, but there are more applications of knowledge in high-level networks. Therefore, the bottom-up course content arrangement will inevitably lead to no experiments corresponding to the theory in the first few weeks, and a large number of applied experiments in the follow-up. The practice has always been to arrange the subsequent applied experiments forward, which will lead to the situation that the theoretical knowledge has not been explained, but the corresponding experiments have been completed. This kind of asynchronous situation between the theory and the experiment will inevitably lead to students completing the experiment but not understanding the experimental principle, unable to analyze and understand the experimental phenomenon and data, and even less likely to understand the "why" and "when to use" of these knowledge. The purpose of being able to draw inferences from one case is obviously unattainable, and the effectiveness of experimental teaching is greatly reduced.

(3) The course teaching team is unstable. The computer network course is a compulsory course for two majors. The number of students is large, and one teacher cannot complete all the

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teaching work of the course. Over the years, the teaching of this course has been held by a number of teachers. The course has been in operation for more than 10 years, and the course leaders have changed several people, and the course teaching team members have been adjusted almost every year. The course teaching team is unstable, and it is difficult to form a consensus and tacit understanding of teaching. As we all know, even teachers who teach the same course, there must be differences in cognitive level, teaching methods, problem perspectives, etc., so there must be differences in the cognition of the teaching organization and teaching content of the course, and even There are big differences. It is impossible to form a consensus and tacit understanding on the teaching of this course only by a few collective lesson preparations and teaching and research meetings. For example, network subnet addressing is a very important knowledge point. Due to the limitation of class hours, large classes are generally arranged to explain the concepts and principles of subnet addressing. Due to its complexity, small classes need to further explain subnet addressing. method, sum up the steps of subnet addressing, which is convenient for students to understand. If the teachers of the major class and the minor class are not the same person, there are often two situations: one is that the minor class teacher reviews the subnet addressing principle explained in the major class and starts to practice and experiment; the other is that The teacher of the small class thinks that the teacher of the large class has already explained it and directly arranges exercises and experiments. Neither of these two situations is suitable, which is caused by the lack of teaching experience in this course and the tacit understanding between teachers.

(4) It is difficult to explore a teaching mode that conforms to the learning situation. The instability of the teaching team makes the teachers have a temporary substitute mentality for teaching this course, and the heavy teaching tasks make the teachers have no intention or energy to consider the reform of the course. The weak atmosphere of teaching and research causes teachers to have no motivation for curriculum reform; the limitation of teachers' energy also restricts teachers' research on curriculum teaching content and teaching system, and it is even more impossible to explore the effectiveness of teaching methods and teaching methods. All these make teachers lack systematic research on curriculum teaching, and it is even more difficult to explore an effective teaching mode that suits the learning situation.

3. Reform of Teaching Content

The purpose of reforming the teaching content of the computer network course is to reduce the difficulty of the course as much as possible. Our hospital mainly carries out reforms from two aspects: theory and experiment.

3.1. Reform of the Theoretical Content of Computer Network

(1) From the point of view of application, all theories are taught as long as they are "enough". This requires cutting out all "useless" or "useless" theories as much as possible. The so-called "sufficient", one is to analyze the follow-up courses, to lay a solid foundation for the follow-up courses; the other is to analyze the employment positions, to lay a good foundation for students' future career reserves. Based on the general idea of theoretical content reform, based on the most well-known domestic textbook "Computing Network" (written by Professor Xie Xiren of PLA University of Science and Technology, and won the National Textbook Award), the teaching content was sorted out and some of the content was cut out on this basis. , such as cutting the entire content of "SONET/SDH", because the network engineering major of our school does not set up follow-up courses in optical fiber networks, students will be able to contact optical fiber fusion at most in their future jobs, and will not involve the design and construction of optical fiber networks. .

(2) Only introduce the "what" of the underlying theory, and do not delve into its "why". From the perspective of user application, the amount of mastery of the underlying theory does not

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affect the high-level application operation. The undergraduates trained by our school are not positioned as talents engaged in the research and development and technological transformation of the underlying communication system, so they can radically simplify the underlying theory without delving into its technical details or reasoning process. For example, when learning the "CS-MA/CD" of the data link layer, the complex algorithm details are summarized into sixteen words that are easy to understand: "listen first, then send, listen and send, stop conflict, and delay retransmission" , and the details of the algorithm, such as delay algorithm, enhanced interference, utilization, etc., are only mentioned so far, and do not go into the why. This simplification is not only convenient for students to understand the idea of the principle, but also convenient for students to remember.

(3) Strengthen the logical connection between knowledge. In order to organize the seemingly scattered knowledge points among the layers, we try to use a visual and simple question to connect the knowledge of each layer. The question is: How does an application on host A communicate with the same application on host B? Obviously, the programs (processes) on the two hosts need to communicate, the premise is that the two hosts can communicate; if the two hosts can communicate, the two adjacent devices between the hosts must be able to communicate; the adjacent devices must be able to communicate; To be able to communicate, it is necessary to use a network cable (transmission medium) to connect two adjacent devices and transmit signals.

This process is actually just a very simple logical common sense. This communication process is easy to understand even if the student has not learned computer network knowledge. If students understand the communication process, they will be able to easily understand the relevance of the knowledge in each chapter of the course, because the explanation of the knowledge in each chapter is based on the problems that need to be solved at all levels in the communication process: the process (process) in the end How to communicate is a problem that needs to be solved at the transport layer; how to communicate between hosts is a problem that needs to be solved at the network layer; how to communicate with adjacent devices is a problem that needs to be solved at the data link layer; and how the network cable converts data into signals for Transmission is a problem that the physical layer needs to solve.

In fact, the logic of this communication problem, if understood from a macro perspective, is a macro understanding of the computer network architecture. Therefore, if students can grasp the logic of this problem at a macro level, it will be of great help for them to learn and understand the technical details of computer network architecture. In the course teaching design, we should clearly put forward this logic, and repeatedly emphasize this logic in the follow-up course content according to the needs of knowledge points.

3.2. Reform of Computer Network Experiment Content

On the basis of not changing the existing teaching mode, a small number of verification experiments are added to make up for the deficiency of the lack of low-level experiments in the computer network, and to solve the problem of asynchronous theory and experimental courses. Based on the actual situation of students, we use various protocol analysis software or simulation software to design relevant verification experiments, instead of using other universities based on circuit board programming or protocol programming. It will be very difficult to say.

New experiments such as "Network Performance Test" and "Ethernet Frame Recognition and Analysis" are added to verify the theory through experiments, so that students can gain an intuitive understanding of the theory, consolidate the theoretical knowledge they have learned, and also make the experimental and theoretical courses. Synchronize.

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4. Reform of Teaching Methods

(1) Using the analogy method. The computer network course is very theoretical and very abstract. However, after careful analysis of these theories and concepts, we find that their basic principles are the same or similar to some phenomena or things in real life. Therefore, if in the teaching process, we can find the similarities or similarities between them, we can use the analogy teaching method to teach. This makes very abstract teaching content easier to understand through analogies that students are familiar with from everyday life.

For example, when teaching a shared local area network, an analogy can be made to the situation where a four-person student dormitory shares a bathroom in reality: how a network host uses shared media, such as which student uses the bathroom first and how to use it. The solutions to these two problems are similar. As long as teachers guide students to think about how to use shared toilets, they will migrate to how to use shared media, which not only trains students' thinking, but also enables students to better grasp related networks. Knowledge. Another example is when teaching IP addresses, it can be compared to the problem of personal ID number; when teaching the domain name system DNS, it can be compared to the problem of the correlation between personal names and ID numbers.

In addition, we will also use the causal analogy method, the symmetrical analogy method, etc. in the teaching. Through these analogies, complex and abstract theories can be made popular, vivid and easy to understand, and students can be changed from passive acceptance to active thinking.

(2) Analyzing the theory through animation. In order to make it easier for readers to understand the theory, the textbook "Computer Network" is often accompanied by some images to illustrate. It should be said that images can indeed help learners better understand the theory. When we were making courseware, in addition to the images in the textbook, we also designed a lot of other images. However, the process of computer network communication is a dynamic process, and a static image can only reflect the state of computer network communication at a certain moment, and it is difficult to express the changing process of computer network communication. For this reason, using PowerPoint to design animations in the lecture, and analyzing the theory through animation, can make the theoretical description more intuitive and easier for students to understand.

(3) Do more practice. "Speaking intensively and practicing more" is an important principle of traditional teaching in our country. We believe that this teaching principle should be followed when teaching a basic course with strong theory such as computer network. The minimum requirement for learning is memorization. If students do not even have the ability to memorize, let alone understand, master and apply knowledge. Computer network courses have many knowledge points, concepts, and principles, so the best way to memorize is to do more exercises. We have compiled a workbook of computer network exercises according to the teaching content, and each chapter has designed a large number of exercises, including multiple-choice questions, true-false questions, fill-in-the-blank questions and comprehensive questions. Students are required to complete a chapter of practice every time they finish a chapter, and they are required to hand in the examination, which will be included in the normal score. We have planned to further expand and improve this workbook in preparation for the construction of the problem bank.

5. Reform Plan of Teaching Mode

If the effectiveness of the course teaching is to be improved under the condition that the course content, teachers' abilities and students' quality cannot be changed, in addition to the above-mentioned reforms, the reform of teaching mode is also worth trying.

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(1) Implement a teaching mode that combines online and offline. The new crown pneumonia epidemic in 2020 has further promoted the online teaching model. We surveyed students' acceptance of the online teaching model. Among the 368 valid samples, 78.8% of the students indicated that they could adapt to online teaching; among the choices of classroom teaching and online teaching, 42.1% of the students chose online teaching. It should be said that contemporary students have grown up with the Internet, and they have formed Internet thinking unconsciously. Therefore, in the future teaching process, if online teaching and classroom teaching can be organically combined, it is possible to produce the best teaching effect. And if you can use the experience and materials accumulated in this online teaching, the computer network course can be built into a course that closely combines "online" and "offline", using SPOC (Small Private Online Course) teaching mode , should be able to further improve the teaching effectiveness of the course. Of course, the specific implementation scheme remains to be further explored.

(2) Adopt a "top-down" teaching method. In the teaching plan of the network engineering major of our college, computer network is a basic course, which is offered in the second semester after students enter the school. The students only learned two basic courses of office software and programming foundation in the first semester, and they did not learn other prerequisite courses related to the knowledge of computer network courses. This obviously causes some difficulties for students to learn computer network courses. So, on the premise that the semester cannot be changed, is it possible to change the teaching method of teachers? This is obviously feasible. In the absence of necessary prerequisite courses, the "top-down" teaching method may improve the effectiveness of course teaching and is more suitable for the acceptance ability of first-year college students. This will not be repeated here. In this regard, we have organized teaching teams to discuss, and also conducted research with relevant institutions that adopt a top-down teaching method for this course.

6. Conclusion

The computer network course was launched in our school in 2019, and three rounds of teaching have been carried out so far. Although courses such as bilingual teaching have been constructed during this period, the course construction is still not perfect, especially in recent years, the students have responded strongly. Therefore, the teaching reform of computer network courses is imperative. However, the reform of curriculum teaching is a huge project, and it cannot be promoted and achieved overnight. According to the teaching reform plan of computer network courses, it should be promoted from 2020. However, due to the new crown pneumonia epidemic, it was changed to online teaching. Due to the restrictions of online teaching, the teaching effect after implementation cannot be fully tracked for the time being. Judging from students' evaluations of teachers and interviews with some students, the teaching reform has achieved good results, but due to the incomplete investigation, it is not enough to draw conclusions, and follow-up must be continued. From the feedback from the teaching team and the teaching supervisor, it can be seen that the teaching reform of this course is appropriate and feasible.

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