Research on Teaching Reform of Computer Networks Course

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Abstract—**Computer networks is an important course for the specialty of computer science and technology. At first, the characteristics of computer networks course is analyzed. Then, in order to adapt to high speed developing in computer fields and solve the problems in teaching activities, a teaching reform in computer networks course is performed from aspects of both theory teaching and practice teaching, by means of arranging teaching contents reasonably, reforming teaching methods and means, adopting bilingual teaching, scientifically planning the experiment content, using various computer simulation tools and opening laboratories regularly.**

Keywords-Computer networks course; teaching reform; theory teaching;practice teaching; bilingual teaching

I. INTRODUCTION

Computer networks is a new-rising discipline combined by computer technology and communications technology, has been widely applied to various areas of current social. The social requirement of talents who master computer network technology is increase sharply; At the same time, the computer science graduates are not welcome in the job market, mainly because they often need to work for 1~2 years in the enterprise before generally entering the working state. So reforming the teaching mode of the curriculum to meet the demand of job market has become an urgent problem in our teaching experience. As a professional foundation course in computer science major, the teaching reform of computer networks is imperative.

II. CHARACTERISTICS OF THE COURSE AND EXISTING PROBLEMS IN TEACHING

A. Characteristic Analysis of the Course

Computer networks curriculum has strong comprehensiveness and overall content, which involves software engineering, electronic technology, communication technology, computer coding techniques, and so on, characterized by strong theoretical property and fast speed of the renewal of knowledge. The course requires students to know the basic principles as well as why they are, which requires teaching contents selected by teachers not only include current mainstream technologies, but also reflect the latest technological developments.

At the same time, practicality, applicability and complexity of computer networks curriculum become more highlighted, in particular, the networking technology and network management technology in the course can't be mastered entirely until hands-on practical training. All these require teachers having a wealth of theoretical knowledge and practical experience, and focusing on theory and practice equally in teaching.

Vast majority of new knowledge and technologies in computer networks are from developed countries in Europe and the United States, almost all protocols and famous papers are in English. So using English to learn renewal network knowledge is necessary.

B. Existing Problems in Teaching

- Obsolete Teaching Model

At present computer networks course in the institutions of higher education still use traditional teaching modes, adopt simplex teaching methods and means; Being teacher-centered, lacking of teaching and learning interactions between teachers and students, so did not fully mobilize the enthusiasm of students. Together with the course's own characteristics, students generally reflect it is more difficult to learn than other courses.

At the same time the computer network technologies include many contents and develop with each passing day, but teachers only have limited class hour to teach the content of textbooks, they can not include all major aspects of the current network technology in the class, can't keep up with technology advances when choose teaching content. In addition, the textbooks rarely explain the hardware technical aspects of equipments used in computer networks, so the graduates are not trained to quickly adapt to operational needs.

Traditional teaching in computer science are all in Chinese, students are not good at using English as the language for learning, so as to facilitate the future work and communication. Doubtlessly these conditions have positive significance for the students.

- Disjoint of Theory and Practice

There are a lot of basic knowledge and basic principles in computer networks course, but the class hour is limited. In order to complete the teaching tasks, teachers often pay more attention to theoretical knowledge, but ignore practice links. This led directly to the students can not be a good combination of theory and practice. In addition, since there are no clear

experimental teaching objectives, the setting of experimental content is often arbitrary, not systematic, and non-standard [1].

III. REFORM SCHEME IN THEORY TEACHING

A. Reasonably Arranging Teaching Contents

As a core course of computer science, teaching content optimization of computer networks is the basis and prerequisite of teaching reform.

- Standing Out Teaching Emphasis

From actual conditions of the teaching, considering the characteristics of many teaching contents and little teaching hour, making basic principles and concepts clear should be taken as the first aim. To archive this goal, teachers should use a variety of teaching means and methods to lecture the basic concepts and the basic principles thoroughly, while dilute the specific calculation and derivation process as well as those brief description and introductory contents. To take mainstream LAN and WAN as emphasis in the course, and combine with the main applications and future direction of computer networks. The mainstream LAN focuses on Ethernet, from 10M to Gigabit; the mainstream wide-area network should be take IP network as a clue to introduce IP, ARP, OSPF, TCP and other protocols and their applications, and analyze the evolution of IP addresses, the prospects of IPv6, and so on.

- Update Teaching Content

Update teaching content, and constantly follow up on advanced technology, to adapt to new developments in computer networks. Teachers in the teaching process should simplify obsolete technologies such as X.25, frame relay technology in part, increase currently more popular, mature and practical network technologies in time. For example, the theoretical teaching content can be divided into four parts: basic knowledge of computer networks, local area network technology, network interconnection technology and network applications. Among them, the basic knowledge of computer networks introduces data communication technology and network architecture; LAN technology focuses on Ethernet technology and switching and virtual local area network technology; network interconnect technology highlights the wide area network technology; network application part focuses on TCP/IP protocol architecture, and network systems and services, etc. On the basis of these four parts, introduce the appropriate Internet access technology and network security technology, so the whole theoretical system will be more complete, more rational.

B. Reforming Teaching Methods and Means

It is a sharp question for the specialized course teachers to let the students play a main role and improve the teaching quality. It must fully exert the leading role of teachers and subjective role of students in teaching, implementation the various kinds of teaching methods to help students to develop innovative ability.

- Combination of Using Leading Problem and Heuristics Teaching Method[2]

In the beginning of teaching, a leading problem is very important. Most of the students are very familiar with how to use the Internet before learning computer networks course, so in the first class we can allow students to discuss practical problems encountered when they go online or build their own networks in groups freely. Starting from these issues, teachers can stimulate students' learning interest in networking theory, and improve enthusiasm for learning theory. These efforts will play a multiplier effect on teaching the principles behind.

Meanwhile, in the beginning of each chapter, teachers should raise issues in the communication process at first, and then inspire students to think: How to solve these problems? Which mature technologies can be used to solve these problems? How to achieve these technologies using concrete protocols? How protocols work? After learning each chapter, come back to see if the issues proposed have been solved.

- Adopting Analogy Teaching Method

Makes the real-life things which people are familiar with analogy with abstract concepts and basic theories in computer networks, to help students understand and master theoretical knowledge visually and vividly, and to stimulate students' interest in learning. For example, makes the postal system analogy with architecture and protocols in computer networks; when talking about TCP and UDP, analog with playing a cell phone and carry out paging; when speaking with FDM and TDM, use multiple cars on the highway and on the one-way street to analogy, etc.

- Applying Network Teaching

It's necessary to apply network teaching and integrate the network education into the tradition education during the stage of undergraduate education. Aiming to solve the problems that some students' learning consciousness is not high but meanwhile the new network technologies and new network products continuously appear, let students using Internet to consult commonly used network products (such as network cards, switches, routers, firewalls, wireless networking products, etc.), network application software, network management software and web development tools, to understand their performance, relevant technology and their applications. Teachers can also put forward some questions which are more closely with reality, enable students to solve those questions by accessing information through the Internet. In this way, not only the enthusiasm of students can be greatly mobilized, but also the understanding of students to the network knowledge can be enhanced, the good habits of students to active learning can be trained and finally the ability of students using what they have learned to solve practical problems can be improved.

- Using Participating Teaching Method

Teachers set a number of teaching topics or issues according to teaching objectives and teaching contents, meanwhile, have a choice to accept the issues raised by students in the class as a new subject of discussion. Explain and discuss all these themes or problems thoughly to let students fully participate into the teaching process. In addition, encourage students to conduct class presentation on some topics. During this period, teachers need to choose good themes guiding students to gather information, forming their own point of view, presenting to other students. In this teaching model, it's better to say that teachers are mentor and promoter rather than instructor and organizers. Active and effective participation can significantly improve student' learning motivation and learning ability.

- Practicing Bilingual Teaching

In order to face the challenge of integration with global economy, the ratio of bilingual teaching is improving step by step in Chinese higher education. Bilingual education means students should learn with two languages, namely, English and Chinese when necessary. The goal of bilingual education is to provide an access to acquire and utilize information in English. Bilingual education is hard to both the teaching and the taught, especially for the students who are no good at English. So it is very important to motivate and encourage the students to learn. A practice of bilingual education includes how to choose education objects, to select courses, to make plan, to arrange time, to collect book and to take lectures. At beginning, the English lecture takes less time, about 1/5 to 1/4. When students are used of English discussion on the class, English lecture can take 1/2 class time.

IV. REFORM SCHEME IN PRACTICAL TEACHING

Realizing the practice can promote the theory teaching, which is connected with practical teaching. Practice teaching is an important way to train students in professional competence and technology applications.

A. Planning Experimental Content Scientifically

Network experiment should have three basic functions: Firstly, to help students understand sophisticated network theory; Secondly, to improve the skills of using the network; and thirdly, to train innovation ability. According to theory teaching content, practice teaching can be divided into four phases[3]: the teaching objectives of the first phase are: familiar with network architecture, identifying commonly used network equipment; The teaching objectives of the second phase are: skillfully mastering producing and testing technologies of twisted-pair, construction, installation, configuration, testing techniques and sub netting technology of Ethernet and VLAN; The teaching objectives of the third phase are: mastering configuration technology of routers and switches; The teaching objectives of the fourth phase are: mastering the application of network technologies, including DNS configuration, FTP configuration, Web site configuration, e-mail system configuration technology and simple network programming, etc. Teachers should have a clear request for each part of experiments. The purpose of each experiment, points of each experiment, problems encountered when make experiment and how to resolve each problem have to all be reflected in students' experiment reports.

B. Using Various Computer Simulation Tools Flexiblely

Network simulation is a kind of technology that simulates the network behavior through mathematical modeling and statistical analysis method and then obtains the specific parameters which reflect the characteristics of the network.

Using simulation tools in network experimental teaching can greatly enhance the efficiency and quality of experiments. For example, before using actual equipment to make experiments, let students simulate the experiment content through the virtual network experiment platform first, to make students have a preliminary understanding on the content and purpose of the experiment; Then when students conduct the actual experiments, if they find that the results of the experiment and simulation are different, they will inevitably examine immediately, through these steps the students' ability to think and analyze problems can be developed. A variety of simulation tools can be used, such as VMware, used for network operating systems and the network simulation; NetSim, used for simulating network devices such as routers and switches; Qualnet, supporting for complex network modeling and NS2, for network simulation environment[4], etc.

C. Open Network Lab Regularly

Draft different experimental subjects and release to students to apply. If the subjects applied been approved, students can work on them after-school. At the same time network laboratory can open regularly, so after school students can go to the network lab to do experiment according to their own problems and ideas. So students can design network experiment independently according to subjects provided by teachers or projects directly from the actual network. Advocate independence study in computer networks teaching, pay attention to experiencing teaching and put emphasis on querying consciousness, train students' innovative spirit, innovative ability and innovative thinking, and finally improve students' innovative quality.

V. CONCLUSIONS

Computer networks is a theoretical and practical discipline, the contents of class teaching and practice teaching must be arranged reasonable, through using a variety of teaching methods and means to strengthen interaction between teachers and students, to mobilize the enthusiasm of the students, then can achieve better teaching results. In this paper, effective teaching approaches especially including bilingual teaching are explored from both theoretical teaching and practical teaching aspects, the purpose is not only enable students to master the basic concepts and basic communication principles of computer networks, but also to achieve the goal of cultivating

innovative talents, in order to meet the country's demand for network professionals.

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