

Research On The Cultivation of Computing Thinking Ability In The Teaching of Computer Network Course

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Abstract

Computing thinking adopts the ideas and methods of computer science to solve problems and design systems, which is the focus of research in the area of education circles at present. In view of the strong practicality of computer network course and the difficulty in effectively combining practical teaching with theoretical teaching, this paper proposes to applying computing thinking in teaching experiments during computer network course; By adjusting the experimental teaching objectives and formulating an experimental teaching plan with the cultivation of computing thinking ability as the core, the experimental effect and the quality of the teaching can be improved. The practice shows that this reform idea is effective.

Keywords

Computing Thinking; Computer Network; Experimental Course; Practical Ability.

1. Introduction

Computer network is an important professional course of network engineering in Colleges and universities. It is difficult to teach because it is very theoretical and abstract, with its contents numerous and complicated. The reason why it is difficult to learn is that it needs to learn the leading courses such as program design, communication technology and operating system in advance, and the text contains more algorithms and technologies; Secondly, in learning computer network courses, it is often easy to make theory and practice disconnected, and students feel hard to understand and master the teaching contents; Thirdly, the traditional teaching mode of "emphasizing theory and neglecting practice" can not meet the requirements of learning. Therefore, how to improve the teaching effect and improve the teaching quality are always a hot issue in the field of Computer Education [1].

This paper introduces the new scientific concept of computer thinking into the experimental teaching of computer network course. On the one hand, it is useful for improving the teaching effect and quality in teaching the computer network course. More importantly, it will help students effectively master the classic realization principles, design methods, algorithms and corresponding data structure knowledge of modern computer networks, help students to establish system level concepts and learn to apply the realization principles and methods of computer networks in development and design of software systems.

The paper is organized as follows. Section 2 briefly introduce the position and function of computing thinking in computer network teaching. Section 3 gives the objectives of computer network experiments based on computing thinking. In Section 4, the scheme of the experiment based on the computing thinking is presented. The paper will conclude in Section 5.

2. Position and Function of Computing Thinking in Computer Network Teaching

The idea of computing thinking was proposed by Professor Zhou Yizhen in 2006. She believes that computational thinking is based on the ability and limitation of the computational process,

with the help of computational methods and models, people and machines can jointly solve complex problems and design large systems [3]. As soon as computational thinking proposed, it has been widely used by the educational circles at home and abroad. Many scientific thoughts contained in computational thinking are worth learning and using for reference. For example, Computational Thinking uses "abstraction and decomposition" thinking to control complex tasks or design huge and complex systems; The "parallel processing" thinking in computing thinking advocates the maximum and rational use of various resources; The "heuristic reasoning" thinking in computational thinking emphasizes planning, learning and scheduling under uncertain conditions, and seeking the best solution through repeatedly research [4].

Many ideas and methods in computer network courses reflect scientific thinking and concepts advocated by Computational Thinking. For example, the idea of layering is the concrete embodiment of the "abstraction and decomposition" method of Computational Thinking in computer networks. By abstracting the complex network system, many complex problems such as computer technology and communication technology are abstracted into independent and easy small problems, and then solved and formed independent functions; The decomposition idea is to split the message into smaller packets and replace the message technology with packet switching technology, so as to reduce the time delay of storage and forwarding and improve the transmission efficiency; The decomposition is also reflected in the distribution of complex and huge network technologies to the design and learning of each network hierarchy, resulting in a seven layer OSI architecture or a four layer TCP / IP architecture; The design of parallel communication technology and parallel network protocol used in computer network to realize the rapid transmission of data is the embodiment of "parallel processing" thinking in computing thinking. For example, the continuous request protocol in the link layer realizes the parallel data transmission between the sender and the receiver, and its efficiency is much higher than the stop and wait protocol without parallel working ability. The "heuristic" thinking in computing thinking is applied in the network layer, resulting in various routing algorithms and optimal scheduling algorithms for communication lines; The "spanning tree" algorithm is an application of heuristic thinking in the data link layer.

3. Objectives of Computer Network Experiment Course Based On Computing Thinking

Network experiments is an important part of computer network course and an important means to cultivate students' professional ability and practical ability. Computer network experiment combines with computer network course. Through a large number of experiments, students can master the working principle and implementation method of computer network and understand the working principle of computer network. Because computer network includes many system level problem solving in computer thinking, computer network experiment course should take computer thinking ability training as the core goal, teaching various network commands, technologies and algorithms as the main content, emphasizing computer practice, emphasizing group cooperation consciousness, so that students can perceive and understand the basic methods and thinking modes of computer problem solving and system design through computer practice and cooperative design, Improve students' comprehensive quality and innovation ability. Accordingly, the experimental teaching objectives of learning computer network experiment course are established as follows.

Taking the cultivation of computer thinking ability as the goal orientation, and on the basis of mastering the basic working principles and implementation methods of computer networks, it is important to cultivate the students' ability to comprehensively use the computer network knowledge they have learned to solve problems, develop systems and design, carry out engineering practice and solve real life problems. The network experiment design aimed at

cultivating computational thinking should start from three aspects: network theoretical knowledge, network technology and computational thinking, and proceed step by step.

Firstly, we can design some simple basic tests, such as some confirmatory tests which is necessary to clarify the steps, results and the thinking. Through experiments, students can deepen their understanding of theoretical knowledge.

Secondly, designing comprehensive experiments can improve students' ability to use network tools and apply network technology, and improve their understanding of the network as a whole. The teacher tells the students the network equipment, network tools and network technology needed in the experiment, so that they can experiment with the functions. Through these experiments, students' computational thinking ability in all aspects can be effectively trained.

Thirdly, through the designed experiment, students can independently use the method of computational thinking, establish an effective teaching model, and construct and design the experimental process. For example, the teacher only gives the requirements, and the students finish the model design and network configuration planning of the network topology after thinking

4. Scheme of Computer Network Experiment Course Based On Computing Thinking

According to the five important knowledge points that the computer network course should master, namely, the physical layer, the data link layer, the network layer, the transmission layer and the application layer, the teaching scheme based on computational thinking is designed. The whole experiment process is divided into five stages, corresponding to the above knowledge points. At the same time, the types of experiments at each stage are determined at different levels. According to the design principles from foundation to synthesis, and then to design and innovation, the types of experiments at each stage are divided into three categories: verification experiments, comprehensive experiments and design experiments. The characteristics of experimental teaching plan design at each stage are as follows:

(1) Validation experiment. Establish actual operating system such as Windows or Linux as the experimental environment to help students learn network commands, and basic network configuration. This kind of experiment is characterized by its simplicity, no programming, and a lot of memorization and memory, such as the production of network cables, basic network operation commands, and network server configuration.

(2) Comprehensive Experiments. Comprehensive experiments are often combined with multiple knowledge points learned before, which require students to use various network tools and network commands flexibly. For example, the Packet Tracer simulator is used to configure the basic functions of the router and realize the routing protocol, the basic configuration of the switch and realize various functions of the switch, and the virtual LAN and NAT network address translation functions.

(3) Design Experiment. Design experiments usually require teachers to give questions and reference suggestions, while students design experimental schemes, select experimental equipment, arrange experimental steps, conduct data processing and analyze experimental phenomena. In the computer network, students can carry out algorithm design and simulation experiments, such as stop and wait protocol, continuous ARQ protocol, C language implementation of triple handshake, Windows socket programming and web page writing; In addition, students can also be required to complete the topology and network planning of a small network, or to construct an e-commerce website.

The three types of experiments in the teaching plan belong to the hierarchical relationship. Students actually play different types of roles in these experiments, as shown in Figure 1. Students can participate in computer network experiments from different perspectives, with different identities and perspectives, so as to exercise their computational thinking and better understand modern computer networks. Figure 1 shows the roles of students in the different stages of experiments.

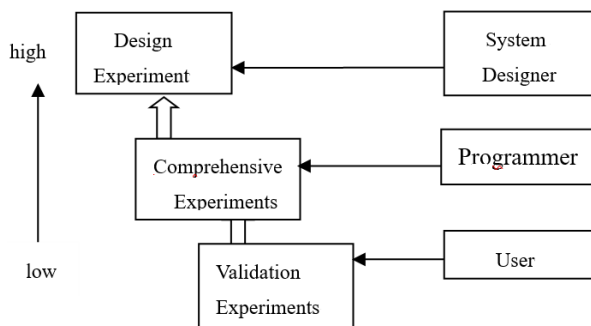


Fig 1. Roles of students in the different stages of experiments..

5. Conclusion

The emergence of computer thinking provides a powerful tool for training applied talents and innovative talents in today's education circle. This paper applies computational thinking to the experimental teaching of computer network courses, which not only helps to cultivate students' practical ability to analyze and solve practical application problems by using the theoretical knowledge they have learned, but also helps to solve the problems of computer network experimental courses, such as difficulty in learning and teaching, failure to effectively combine practice and theory, and improve the teaching quality and teaching effect of computer network courses. After the teaching practice of computer network course for network engineering specialty in our college, it is concluded that the computer network experiment teaching ideas and teaching plans based on computational thinking are feasible and effective. The next step is to continue to improve and improve the experimental teaching program, and try to promote and practice it in other courses of other majors in our college.

References

- [1] Chen Huajie, Dai Lijuan. Experimental Teaching of Programming with the Core of Cultivating Computational Thinking [J]. Experimental Technology and Management, 2011, 28 (1): 125-127.
- [2] Liang Zhengping, Li Yanran, Wang Zhiqiang. Teaching Reform of Computing Thinking Oriented Operating System Course [J]. Computer Education, 2012 (9): 31-34.
- [3] Wing J M. Computational Thinking [J]. Communications of the ACM, 2006, 49 (3) , 33-35.
- [4] Liu Daowen. Research on the construction of practical teaching platform based on the cultivation of computer thinking ability [J]. Computer Education, 2014 (7): 92-95.