

Research on Dynamic Visual Teaching Method of Computer Network Engineering

Fan YANG¹, Li-zhen ZHAO²

¹*School of Computer Science, Zhaoqing University, Zhaoqing, Guangdong, China .*

²*Information Center Zhaoqing University, Zhaoqing, Guangdong, China*

Abstract: In view of the problems existed in teaching computer network engineering for network engineering major of Applied Colleges and Universities, the visual and interactive features of virtual network technology are studied and analyzed, and a typical network case is constructed by using the virtual network environment, which can concentrate on the main network design technology and protocol. In the classroom teaching, the dynamic operating visual network is used instead of the simple static network topology. Through the interactive tool software, the network state and data flow control process can be checked at any time, and the network operating situation can be displayed in a timely and visual way, so as to analyze network performance parameters. Combined with the rational use of mind mapping courseware, the curriculum content is more diversified, more intuitive and interactive. The teaching practice proves the feasibility and effectiveness of the dynamic visualization teaching method.

Keywords visualization; dynamic interaction; teaching method; virtual network; network cases

INTRODUCTION

The main problems of computer network engineering course are as follows: one aspect is the course content is wide, the technical standard is various, the students' learning load is huge [Chang, et al., 2005]; another aspect is the separation of network design technology and network business, the data flow classification is complex abstract. It is difficult to express its control process; the third aspect is that is the lack of integrity and the content of teaching materials. It is difficult to make the students understand the knowledge points correctly and comprehensively [Yi, 2012]; The fourth aspect is the high requirement of the experimental training environment, the number of equipment, the rapid update of technology, the pressure of the updating of the experimental teaching environment, which is difficult to adapt to the changing needs of the rapid development of computer network engineering design technology. At the same time, the requirement of the curriculum system for "employment-oriented" and "network engineering vocational qualification certificate" also has a challenge to the teaching of course [Cao, 2012].

The dynamic visualization teaching method proposed in this paper is on the basis of fully studying and understanding the teaching objectives of the course, using the virtual network environment, constructing the different teaching cases of network engineering, combining the knowledge map and the mind map courseware, and using the visualization method to display the concept, so as to design technology and access control of network engineering.

With the dynamic operating visual case network instead of the simple static network topology, through the interactive tool software, it can check the equipment information, network service state, network routing, network protocol, network port, data packet content and the specific data flow control process, showing the operation of the network in time and in a interactive and visual way. Combined with the rational use of mind mapping courseware, the presentation of the course content is more diversified, more intuitive and interactive, assisting students to quickly understand the related design technology and the practical application scenes.

ANALYSIS ON TECHNICAL ELEMENTS OF VISUAL VIRTUAL NETWORK

The dynamic visualization teaching of Computer Network Engineering mainly uses the virtual technology tools such as the mind mapping courseware, eNSP or GNS3 network simulator, the VirtualBox virtual machine, the Wireshark packet capture analysis software and so on.

Technical Analysis of Network Simulation

ENSP (Enterprise Network Simulation Platform) is a Huawei (Huawei) Network equipment as the simulation object of Network simulator, it integrates Winpcap, VirtualBOX virtual machine, Wireshark and some other softwares, AR huawei router, Huawei S series switches, Huawei, firewalls and all kinds of terminal and wireless devices are embedded, which can provide the simulation ability of Huawei's Network technology. GNS3 is a network simulator if

Cisco network equipment as the simulation object, it integrates Winpcap, Dynamips, VPCS, Qemu virtual machine, VirtualBOX virtual machine, Wireshark software, as well as other software, which can provide simulation ability for Cisco network technology.

The use of network simulator can effectively solve the problem of dynamic operation and visualization of network equipment, network link, simple network host, network configuration process and testing process.

Technology Analysis of Virtual Network Host Computer

VirtualBox is a free virtual machine platform issued by Oracle, which can virtualize 32/64 - bit series of virtual machines, such as Windows client / server, Linux client / server, Mac OS X client / server and so on. From the perspective of networking capability, VirtualBOX virtual machine can provide six different networking modes, which can realize multiple connections with GNS3 network simulator and real network. VPCS is a virtual machine technology embedded in GNS3 network simulator. It is divided into two types: Multi-Host and independent VPCS. Multi-Host is a "conjoined" host computer, which can open the console through the Tools menu of GNS3, so as to provide 9 virtual hosts in a continuous way to test the connectivity of the virtual network.

The use of virtual host computer technology can effectively solve the problem of simultaneous installation, which can use multiple operating systems at the same time. It is easy to display the functions of various network hosts in the network system, which can also visualize the configuration and operation process of the main network services.

Analysis of Data Packet Capture Technology

Wireshark is a network data capture and analysis software, which calls WinPCAP components to obtain network packets directly from network card or virtual network, so as to realize visual detection and analysis of network data packet traffic and types by visual graphics. Through Wireshark, you can directly define the packet type (filter condition) to capture, so as to display different packet structures according to the network level model. The most practical value is that through the statistical analysis of captured

packets, various network performance indicators can be displayed in different charts. Therefore, the introduction of Wireshark packet capture analysis technology in the classroom, which can not only help lower grade students to understand the concept of network level intuitively, but also can help the senior students to analyze and design the network.

SocketTool Debugger

SocketTool is a transmission layer protocol debugging tool, which can simulate and test the functions of TCP client / server, UDP broadcast and multicast, as well as other functions, using tree like Socket visual interface, supporting multi Socket parallel testing, supporting data circulate and repeating multiple automatic transmission functions, so as to save the received data and provide transmission data conveniently, as well as statistic function of the amount of bytes.

Using SocketTool tool, TCP connection, TCP port, UDP port as well as the service state can be visualized, with the Wireshark protocol analysis, which greatly enhances the working process of the transport layer protocol, especially the visual display ability of TCP connection establishment, the sliding window mechanism and the release connection process, so as to improve the dynamic and intuitive information of information of course.

CONSTRUCTION OF TYPICAL NETWORK CASES

Based on the teaching content and teaching objectives of the course of Computer Network Engineering for network engineering major, combined with the needs of dynamic visual teaching, based on the interconnected network of the park, according to the different technical emphasis, setting up cases of general park network (case 1) and cases of the reliability of general park network (case 2). Highlighting campus network case of safe design (case 3), as well as campus network case of network performance control (case 4), together four different typical network cases. In the course of teaching, according to the different needs of the course teaching content, different network cases are chosen flexibly. Table 1 gives the key points and main techniques in each case.

Table 1 Key Points and Main Techniques in Typical Cases of Computer Network Engineering

Type of network cases	Key points	Main technology
General park network (case 1)	Demand analysis and description, network device brand and performance, network topology design and construction, sub-network partition and IP address allocation, VLAN division, loop inspection, routing technology, ACL definition data flow, network service connection,	Type of Network equipment selection, network module configuration, three layer network topology construction, configuration of information annotation, CLI configuration technology (router, switch, VPCS host, cloud), spanning tree, static routing configuration, dynamic routing configuration, policy routing configuration, default routing configuration, configuration check, virtual host installation and matching. Configuration of host IP parameters, DNS, FTP, WWW network service configuration and connection,

	connectivity testing, network application simulation operation, network packet analysis and so on.	all parts or part of network, segment testing, Ping/Tracert, application layer simulation access, selecting links, capturing specific packets, statistical analysis and so on.
Reliability of Network (Case 2)	Basic Knowledge of General Park Network	Basic Technology of General Park Network
	Design of blocking and non-blocking, device and link redundancy, link aggregation, routing redundancy, load balancing design and so on.	Core routing (Switching) dual center design technology, link aggregation technology between two centers, link redundancy design of the aggregation layer to core layer, multiple sets of VRRP configuration, load balancing realized by using DNS or NAT.
Security Network (Case 3)	Basic Knowledge of General Park Network	Basic Technology of General Park Network
	Network access control and ACL, firewall and DMZ design, encrypted transmission and VPN, internal and external network addresses and NAT, definition of interest flow, etc.	The access control configuration of routers, basic configuration of firewall, security policy of DMZ, the definition of ACL interest flow, the configuration of NAT, the VPN configuration of IPSec, the port application of security policy and so on.
QoS Control Network (case 4)	Basic Knowledge of General Park Network	Basic Technology of General Park Network
	Bandwidth and traffic design, QoS design, network multicast, classification of network traffic, business flow limitation, network main performance testing methods, etc.	Multicast source configuration, multicast member configuration, link bandwidth and traffic configuration, ACL definition of network services, business flow restriction, IP SLA job configuration method, main performance of IP SLA job testing network.

DESIGN AND PRACTICE OF DYNAMIC VISUALIZATION TEACHING

During the course of teaching network engineering in recent years, the author used virtual network environment and the above network cases, combined with teaching content and teaching purpose of the computer network engineering and the professional skill training computer network engineering, exploring the more effective knowledge performance and classroom teaching methods.

Diversification Development of Curriculum Knowledge

The course of computer network engineering mainly includes nine knowledge units, such as outline of computer network engineering, user requirement analysis, network structure design, network routing technology, network performance design, network reliability design, network security design, integrated wiring and equipment interconnection, network engineering acceptance and identification and so on. These knowledge units are classified into five types: concept knowledge and common knowledge, design method knowledge, control principle knowledge, operation skill knowledge and comprehensive knowledge. In classroom teaching, different ways of expression are adopted for different types of knowledge.

Designing Mind Mapping Courseware

According to the course content, the scope of knowledge point is rationally divided, knowledge is stratified according to the relationship of knowledge development and evolution, and the connection

between knowledge points is established to form the knowledge map of Computer Network Engineering course, the integrity of knowledge and the logical dependence of are strengthened [Liu, 2007]. Using NovaMind to design thinking map courseware, knowledge of concept common sense, design methods and teachers' comprehensive knowledge can be presented to students directly, image and so on, the dynamic connection of the process of knowledge explanation is strengthened [Zhao, 2012]. In class teaching, by clicking on the "+" or "-" behind the knowledge points in the map, the content of the following knowledge points can be expanded or taken up in time in the form of animation. At the same time, the scope of the field of view can be displayed by switching the knowledge points. The process of switching can maintain the logical consistency between the knowledge points, which can facilitate the thinking of the students.

Interactive Teaching Practice Based on Cases

In the course of teaching, the corresponding case network is selected according to the content, and the design ideas and methods are clearly explained and displayed. In the design of the teaching link, the dynamic interactive operation or network case based on the virtual network environment is timely added to the network, and the different levels of network are displayed during the dynamic operation of the network. The state point of each device port in the topology diagram is red, indicating that the device is not energized in the hardware configurable state. At this time, the selection of hardware equipment and the content of module selection can be displayed; the state point of each device port becomes green, indicating that the device is in the operating and

software configurable state. At this point, the software configuration method and process of the device can be displayed. The connectivity of network layer can be detected and displayed by ping command; TCP/UDP port state can be detected and displayed on the network host by running the SocketTool tool on the network host; the network service or the client program can be configured, detected and accessed through the virtual host to display the operation effect of the corresponding layer; through the number of Wireshark according to the function of packet capture analysis and chart display, the network classification data flow and its access control effect can be displayed intuitively. Based on IP SLA operation, the performance index of RTT of analysis network can also be detected.

CONCLUSION

After the classroom teaching adopts the virtual network environment and the network case, teachers will choose the different cases or the different parts of the cases according to the different contents of courses, which can carry on the specific explanation, operation demonstration and display results. In particular, we can try different possibilities at any time, produce different control results, so as to add knowledge map and dynamic thinking. The rational use of courseware of dimensional map can make classroom teaching content display "quiet" and "dynamic" and show diversified ways of expression. Conceptual knowledge and comprehensive knowledge can be mainly expressed through the knowledge map and mind mapping courseware. The principle knowledge is mainly performed by the operation case and the interactive operation. The skill

knowledge is mainly controlled by the virtual network experiment platform and the case operation training. The teaching practice shows that the dynamic visual teaching method can enhance the dynamic and intuition of the classroom teaching content. It is easy to understand for the students so as to find out the problems and discuss easily. The discussion will help stimulate the students' interest in learning, activate the classroom atmosphere and improve the teaching effect.

ACKNOWLEDGMENT

This work has been supported by the practice teaching reform project of Zhaoqing University (sjjx201628)

REFERENCES

- Chang Xin, Wang Pei. Application and Enlightenment of Cognitive Load Theory in Instructional Design [J]. Psychological Science, 2005, 28 (5): 1115-1119.
- Yi Jian Xun. Computer Network Design (The Second Version) [M]. Beijing: People's post and Telecommunications Publishing House, 2012:1-330.
- Cao Jienan, Xu Ming, Jiang Zongli, Chen Ming. Research on Orientation and Professional Ability of Network Engineering Specialty [J]. Education in Chinese Universities, 2012 (9).
- Liu Xin. Research on Implementation of Knowledge Map of Intelligent Website [D]. Jilin: Changchun University of Technology, 2007.
- Zhao Huichen. Designing Method for Visual Representation of Knowledge Visualization [J]. Research on Open Education, 2012, 05:25-30.