

An Overview of Distance Learning on Information Security in Zhejiang University

Chen Tianzhou, Chen Du, Wei Hu, Xueqing Lou

College of Computer Science

Zhejiang University

Hangzhou, Zhejiang, 310027, P.R.China

{tzchen, xiaoyin, ehu, xqlou}@zju.edu.cn

Abstract—Computer network has been in increasingly rapid development in recent years especially the prevalence of the Internet. The information exchange and transmission among the computers have become the inevitable trend in contemporary society. At the same time, information security also becomes the hot topic and is more significant in computer network. When the problems of information security are emerging, it is a great challenge that how to teach the knowledge and skills to the students in different disciplines, which have close relationship to information security. Distance learning is based on the application of computer network and related technologies in education field. Such teaching mode has higher efficiency compared with the traditional teaching mode. Many universities have adopted distance learning as one of the necessary solutions. In this paper, we describe the overview of distance learning on information security in Zhejiang University and share our experience in the curriculum design and construction.

Keywords-computer network; distance learning; information security

I. INTRODUCTION

Computer technology is in continuous progress. Computer network and the Internet have become more and more popular in recent years. More information is provided and shared through computer technology and computer networks and the Internet provide more convenient communication ways. At the same time, they also bring the threats of information on computers and networks including the Internet. The computers have been widely used in industries, business and the daily life. However, the computers and computer networks are not in safe. As illustrated in [1], the infrastructure of the computer networks is not designed for the security from the beginning. How to protect the information security becomes more important. Thus with the availability and popularity of network technology and application, there has been an increasing demand for the education of the concepts and skills in the area of Information Security.

There are many universities, which have shared their teaching experiences in information security education including University of London, Carnegie Mellon University, James Madison University, Purdue University and so on [3-6].

They described the curriculum design or the design of distance learning platform according to their backgrounds in research and the design target of the curriculum respectively. Their experiences will provide the effective references for the other universities, which have the potentials to design their own curricula for information security education.

Distance learning has been proposed early [7] as a new mode of education. With its powerful advantages with the support of computer technology, distance learning offers a platform for self-directed learning. This platform needs fewer resources, saves in time and space, has instant content updating, provides more convenience and it has higher efficiency compared with the traditional mode of education. Distance learning provides rich personalization and friendly interfaces to the users. The students can carry on the study in the distributed physical places. [8 - 10] also discussed on how to construct the distance learning platform.

In this paper, we describe the curriculum construction of information security in Zhejiang University. The architecture of this curriculum has been designed first and the remote learning has been taken into accounts. At the same time, a specific distance learning platform is designed and implemented for this curriculum. The design of the curriculum and the remote platform are complementary to each other.

The paper is organized as follows. Section 2 describes the targets of information security curriculum in Zhejiang University. Section 3 depicts curriculum design. Section 4 depicts our distance learning platform for this curriculum. Section 5 shows the teaching effects of this curriculum in Zhejiang University. Section 6 offers conclusions.

II. TARGETS OF INFORMATION SECURITY CURRICULUM IN ZHEJIANG UNIVERSITY

Information security is not a new subject for information security always plays an important role with the computers emerged. It covers a wide range area of computer sciences, communications, electronics, mathematics, physics, law and education. At the same time, new concepts, methods and technologies continue to arise. Basically topics in information security education include security policies and standards,

This work is supported by MOE Model Curriculum of China with granted as "Information Security Management Curriculum".

computer security model, firewalls, network intrusion detection [11], denial of service (DoS) and distributed denial of service (DDoS) attacks, detection and protection, computer cryptography, virus propagation and protection, traffic analysis, secure routing protocols, hacking technology, e-commerce security and advanced techniques for reacting to network attacks [12]. Increased levels of risks and threats are emerged with the rapid growth in utilization of computer network technology and the globalization of the information environment. Information security based education is now the focus according to increasingly widely used computers and related devices. All these factors decide that the information security education must be designed carefully. [13 - 17] focused on information security education and discussed on how to design the information security curriculum for different aspects of information security.

As information security curriculum is constructed in Zhejiang University, the targets of this curriculum are proposed first. This course is mainly for adult education of the students who will confront the information threat in the future. Learning information security curriculum enables the students to master the application of information security knowledge and partial practical skills of information security systems. The main contents of information security curriculum include theoretical and technical knowledge of information security systems, physical security and hardware technology, computer security technology (cryptographic identity authentication and data encryption), network security technology, software security technologies (operating system, databases, application software security), as well as the related technology infrastructure in the e-commerce. Through learning this curriculum, the students can understand and grasp security technology and the current problems in information security system. And through the practical case studies, the students can learn how to find potential safety problems in the security system and improve the information security system.

III. INFORMATION SECURITY CURRICULUM DESIGN

This curriculum is the professional foundation of e-commerce, information management and information systems majors. In these majors, although introducing the large scale of information security curriculum will increase the complexity of the contents of these majors, this will also help the students prevent the potential attacks and threats. There is no need to teach the underlying principles of information security at the point of view of computer science to the students. The students should master the practical skills and related theories to protect important information. This curriculum has been opened since 2003.

A. The Teaching Contents and Arrangement

This curriculum covers the basic principles of information security. According to our curriculum targets, the theory knowledge of whole curriculum consists of security policy, information management, secure computing systems, network security and cryptography etc. The whole teaching contents and arrangement of this curriculum is shown in Figure 1.

Introduction of Information Security	Computer Security Model	Computer Cryptography	Hacking Technology
Security Policies and Standards	Operating System Security Model	Communications Security	Intrusion Detection
Computer Environment Security	Operating System Security	Internet Protocol Security	E-commerce Security
Computer Reliability Design	Computer Viruses	Firewall	Security Management

Figure 1. Teaching contents arrangement

B. Curriculum Resources

Information security curriculum is a very important professional curriculum, with the features of content update instantly and covering a wide range of knowledge points. We provide rich types of curriculum resources to enable the students to learn in better way for information security curriculum. The resources are open to all the students.

- **Multimedia Courseware:** The curriculum provides 32 credit hours of multimedia courseware, and each chapter provides the corresponding courseware of the difficult knowledge points.
- **Experimental practice:** There is also experimental practice. This curriculum provides videos of the experimental practice.
- **Case discussion:** This curriculum provides text and video of case discussion.
- **Textbook:** Some books are selected as the textbook and the references.
- **Rich types of additional teaching and learning materials:** It is certain that many domestic and foreign universities open their information security related curricula. We provide these materials to help the students deepen their understanding of curriculum contents.
- **Teaching and learning environment.**

C. Teaching Methods

Practical cases will be taught to the students on the network platform. The teachers will try their best to avoid the pure theoretical preaching in our curriculum. The cases in real world will be selected and adapted as the example cases. For example, we will tell the students about the attacks on windows series operating systems and we actually attack the computers which did not install patches in operating system on the network.

Our curriculum will stimulate students' interest in learning and cultivate students' self-learning ability. We arrange some problems for the students to think and discuss. The following cases are the potential problems: why the operating system has to be patched from time to time? What are the differences between the different digital signatures? How to design a secure system to protect the database? We hope the students can have more interests during the thinking and discussion. And when the students confront new problems, they can provide their own solutions according to their own concepts.

We also provide BBS symposium. The teachers will publish some special topics and the students can discuss these topics online. The students can also obtain online guidance from the teachers. At the same time, the teachers and the students can have mutual exchange during the learning process. The students can learn the knowledge by themselves through the network. When they meet some problems which they can not solve, they can resort to the help from the teachers. The teachers can also supervise the teachers when they find that there are some errors from the students.

D. Learning Evaluation

The learning results of the students will be strictly evaluated according to the assignments, BBS discussion, the hands-on labs and the final examinations. They have different proportions in the final access. This evaluation method can avoid the bad study habits of the students. They can not try to pass the examinations through the temporary hard study before the examinations and have to study step by step. This can lead the students to participate actively in collaborative learning and engage in self-learning to achieve good learning results.

IV. DISTANCE LEARNING PLATFORM DESIGN

A. Platform Architecture

We design a distance learning platform for the students as shown in Figure 2. The distance learning platform consists of the web server and the uses terminals which can access web server through VPN service. Zhejiang University has constructed network in different campuses and provided VPN service to the teachers and the students. The students can browse curriculum contents and communicate with each other on this platform. The curriculum contents can be accessed by the students and modified by the teachers. So this platform is very suitable for distance learning.

B. The Characteristics of the Learning Platform

We design the interfaces of this learning platform guided by the principles of human-computer interaction to embody the features of aesthetics, availability and convenience.

1) The human-computer interaction features of the learning platform

- **Network:** This curriculum is constructed based on the Internet. The students can access the Internet to learn the teaching contents. This curriculum also provides the students with various learning resources through Internet, including a variety links of learning resources, courseware, teaching videos, experimental demonstration videos. At the same time, interactive services are also provided, for example, BBS.
- **Multimedia:** This curriculum uses the multimedia technology to provide the students with a variety of visual teaching resources, including teaching videos, experimental demonstration videos, security case videos and other related videos. This curriculum not only provides the students with fruitful text materials, but also provides a variety of multimedia materials.

These multimedia resources will help the students during the learning.

- **Interaction:** We have developed an online interaction platform including Q&A, hands-on labs, practice and test modules for students. These modules provide the students with necessary ways for the feedback, self-training, thinking and improvement. The teachers can also understand the difficulties which the students may encounter during the learning process. At the same time, the curriculum also provides the corresponding curriculum cross-platform BBS for communications between students and teachers.

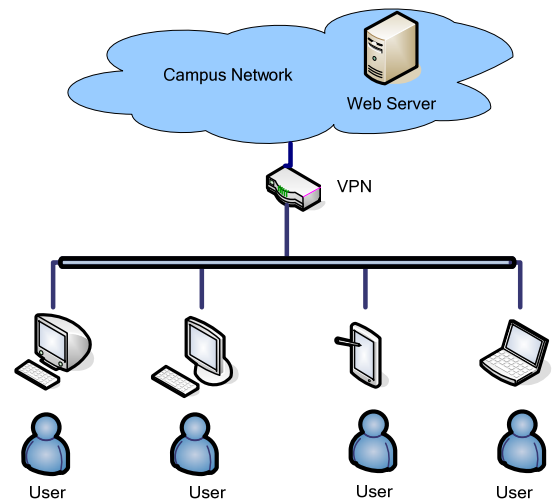


Figure 2. Distance learning platform

- **Open:** This curriculum enhances the students' understanding of information security through the case discussion, study groups, online Q&A and BBS. The students can freely express their views of the curriculum and learning problems on the BBS, and can provide enough feedbacks to the teachers to improve the teaching.
- 2) *The technical characteristics of the learning platform.*
- **Reasonable interface design:** Human-computer interface engineers provide a lot of recommendations for webpage design. And these engineers explore and optimize the capacity of interface information, color matching and information layout. Curriculum designers sort the curriculum contents, and the main contents are shown on the location of eye-catching.
 - **Online service of help, navigation and search:** This curriculum provides a clear navigation to guide the students in the entire learning process. Each knowledge point is provided detailed study guidance. The entire website has the search function to help the students find the required resources.
 - **This learning platform uses "PHP + MYSQL" as the core technology:** PHP scripting language now is a very popular scripting language of the web development. We can provide complete functional modules through

this language and we can also a good security performance. The server system can run under not only the windows based system, but also some other mainstream operating systems. MYSQL database is an open-source database system. The users can use it free of charges, and completely not have to worry about the problem of authorization.

- Meeting the CELTS criteria: Our distance learning platform and network curriculum can meet the CELTS criteria, which is the standard designed and published by the Ministry of Education of China. The distance learning platform we developed has passed the standard CELTS certification, and is in line with the 11 released standards of CELTS. And this curriculum is organized as chapter-section-unit architecture. The development of knowledge points follows CELTS-3 criteria.

V. TEACHING EFFECTS

We have conducted a comprehensive survey for the satisfaction degree of the students on the learning platform when they finish the curriculum. A total of 3827 students have participated in the investigation. In the investigation, about 27.0% is “very satisfied”, 57.8% is “general satisfaction” and the overall satisfaction rate is 84.8%.

The main reasons of the achievements consist of two aspects. First, the curriculum design and the online platform can meet the requirements from the students. The curriculum provides different resources to support the students’ study including online resources, teaching videos, learning guidance etc. The teachers can help the students solve the problems emerged during the learning. The students are interesting in the curriculum. Second, the sufficient mutual exchange between the teachers and the students make the teaching of the teachers and the learning of the students is able to complement each other.

VI. CONCLUSIONS AND FUTURE WORK

With the wide utilization of information technology and the emergence of the information era, information itself has become an important strategic resource. Information security plays a very important role under such environment. There has been increasingly wide demand for information security education for the protection of information. Distance learning, which is the application of computer technology and network technology, provides an efficient solution to this problem. In this paper, we share our experiences in designing an information security curriculum based on the networking technology. We have developed an online distance learning platform for this curriculum. The survey in the students shows that the teaching effects are satisfied.

Information security will always be important. And the related technologies will also be in continuous development. In the future, we will continue in constructing our curriculum and improving the online platform including teaching contents

update, teaching method reform, and the other important factors in teaching.

REFERENCES

- [1] Dekker, M. (1997). CERT. Retrieved September 23, 2008, from CERT Coordination Center Reports Web site: http://www.cert.org/encyc_article/tocencyc.html.
- [2] S. A. Shaikh, “Information security education in the UK: a proposed course in secure e-commerce systems”, Proceedings of the 1st annual conference on Information security curriculum development, 2004, Kennesaw, Georgia, pp. 53-58.
- [3] Bradley Bogolea, Kay Wijekumar, “Information Security Curriculum Creation: A Case Study”, InfoSecCD Conference’04, October 8, 2004, Kennesaw, GA, USA.
- [4] Eli J. Weissman, “An evaluation of online learning environments (OLE) on the adult at-risk population”, Journal of Computing Sciences in Colleges, 2003, Volume 18 , Issue 3, pp. 142-154.
- [5] K. Miller, M. Pegah, “Virtualization: virtually at the desktop”, Proceedings of the 35th annual ACM SIGUCCS conference on User services, 2007, Orlando, Florida, USA, pp. 255-260.
- [6] S. Rigby, M. Dark, “Designing a flexible, multipurpose remote lab for the IT curriculum”, Proceedings of the 7th conference on Information technology education, 2006, Minneapolis, Minnesota, USA, pp. 161-164.
- [7] R. V. DeGrasse, “Remote computing in higher education: prospects for the future”, ACM SIGCSE Bulletin, 1972, Volume 4, Issue 1, pp. 39-41.
- [8] N. Moraveji, T. Kim, J. Ge et al, “Mischief: supporting remote teaching in developing regions”, Proceeding of the twenty-sixth annual SIGCHI conference on Human factors in computing systems, 2008, Florence, Italy, pp. 353-362.
- [9] W. D. Armitage, A. Gaspar, M. Rideout, “Remotely accessible sandboxed environment with application to a laboratory course in networking”, proceedings of the 8th ACM SIGITE conference on Information technology education, 2007, Destin, Florida, USA, pp. 83-90.
- [10] P. S. Wang, N. Kajler, Y. Zhou, X. Zou, “WME: towards a web for mathematics education”, Proceedings of the 2003 international symposium on Symbolic and algebraic computation, 2003, Philadelphia, PA, USA, pp. 258-265.
- [11] Mario Guimaraes, Meg Murray, “Overview of Intrusion Detection and Intrusion Prevention”, InfoSecCD, 2008, September 26-27, 2008, Kennesaw, GA, USA.
- [12] Venkat Pothamsetty, “Where Security Education is Lacking”, Information Security Curriculum Development (InfoSecCD) Conference ’05, September 23-24, 2005, Kennesaw, GA, USA.
- [13] H. Erik, S. D. Wolthusen, “Full-spectrum information security education: integrating B.Sc., M.Sc., and Ph.D. programs”, Proceedings of the 3rd annual conference on Information security curriculum development, 2006, Kennesaw, Georgia, pp. 5-12.
- [14] M. Dark, N. Harter, L. Morales, M. A. Garcia, “An information security ethics education model”, Journal of Computing Sciences in Colleges, 2008, Volume 23, Issue 6, pp. 82-88.
- [15] R. B. Vaughn, D. A. Dampier, M. B. Warkentin, “Building an information security education program”, Proceedings of the 1st annual conference on Information security curriculum development, 2004, Kennesaw, Georgia, pp. 41-45.
- [16] S. Goel, D. Pon, P. Bloniarz et al, “Innovative model for information assurance curriculum: A teaching hospital”, Journal on Educational Resources in Computing (JERIC), 2006, Volume 6, Issue 3, Article No. 2.
- [17] Michael E. Whitman, Herbert J. Mattord, “Designing and Teaching Information Security Curriculum”, InfoSecCD Conference’04, October 8, 2004, Kennesaw, GA, USA.