Collaborative Web-Based E-learning Environment for Information Security Curriculum

Wei Hu, Tianzhou Chen, and Qingsong Shi

Abstract—In recent years, the development of e-learning is very rapid. E-learning is an attractive and efficient way for computer education. Student interaction and collaboration also plays an important role in e-learning. In this paper, a collaborative web-based e-learning environment is presented. A wide range of interactive and collaborative methods are integrated into a web-based environment. This e-learning environment is designed for information security curriculum.

Keywords—E-learning, information Security, curriculum, web-based environment.

I. INTRODUCTION

IN recent years, rapid progress in the field of e-learning has promoted the development of e-learning environments [1]. E-learning environments are more convenient and source saving to build compared with the traditional learning environments. E-learning environments can provide flexible and user-oriented learning environments to students. In such learning environments, almost all the resources are provided through the computers and networks and students can learn anytime and anywhere.

After e-learning has been proposed, many educators and researchers have proposed their designs, described their implementation and shared their experiences from different points of view on e-learning environments. [2] and [3] presented the topic on how to use the agent technology to build e-learning environments. [4] and [6] described their instant messenger system designed for e-learning environment to analyze and estimate the quality of learning. [5] focused on how to provide personalization to the learners in e-learning environments. [6] collected the navigational behaviors of the students to recognize the effective performance. K. Olsevicova [7] shared his experiences in the topic maps used in the e-learning environment to provide the conveniences to the uses. [8 -11] also discussed the different fields in e-learning environments.

As the above researches have proposed, there are some

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important differences between e-learning environments and classical education. The different –learning environments should be constructed according to the different using environments. In this paper, the curriculum-specific e-learning environment is presented. This environment is designed for distance information security curriculum. In our design, it tries to solve the problem that typical e-learning environments lack of the face-to-face learning opportunities to the students though they can provide fruitful resources to them. Student interaction and collaboration plays an important role in e-learning. Sufficient interactive and collaborative methods should be provided to the students. So in our curriculum-specific e-learning environment, the prevalent and effective interactive and collaborative methods are integrated to improve the learning effects.

The paper is organized as follows. Section II introduces the related work of this study. In section III, it depicts the framework of the curriculum-specific e-learning environment. Section IV evaluates the results of the proposed design. And finally section V gives the conclusion and possible future work.

II. RELATED WORK

In different types of e-learning environments, an increasing activity of web-based environments has been observed in recent years to provide effective education [12]. G.K. Tegos et al presented a general of the e-learning system and proposed a component-based web-environment [12]. This system was divided into two different parts: computing part, which was used to do the computational process and data access and training part, which was used to provide the e-learning interaction between the students and the computers. S. Garruzzo [13][14] described their multi-agent e-learning platform. The agents in their system can provide adaptive service by exploiting the device agents associated with the e-learning website and the teacher agents. [15] focused on the UI architecture of web-based e-learning environment. In this system, the user's characteristics and their concentration are the main factors when developing the e-learning system. [16 – 18] also discussed on the web-based e-learning systems.

As information security is becoming more and more important, there are also many e-learning systems developed for information security curricula. [19] presented a remote "hands-on" network laboratory with 17 hands-on e-learning

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modules and relative comprehensive open courseware. [20] [21] also described the remote networking labs for information security to improve the learning effects. [22] focused on the utilization of digital radio, Internet Protocol TV (IPTV), and other multimedia technology in e-learning environments for information security curriculum. [23 – 25] also discussed on the construction of e-learning environments for information security curriculum from different points of view.

This paper presents a different design concept from the above researches to construct an e-learning environment. It takes the web-based environment and the features of the curriculum into accounts and designs a collaborative web-based e-learning environment for our information security curriculum.

III. FRAMEWORK OF THE CURRICULUM-SPECIFIC E-LEARNING ENVIRONMENT

Information security curriculum of Zhejiang University has first been opened as a selective curriculum for all the students in the major of computer science from 2001. Then it was introduced into Distance Learning College of Zhejiang University as the compulsory curriculum for the students in majors of computer science, electronic business and information security management and selective curriculum of some other majors after two years. Since this curriculum is opened, it has begun to construct an e-learning environment to the students to provide fruitful resources and improve the teaching effects. Now this platform has been used mainly used for information security curriculum in Distance Learning College of Zhejiang University.
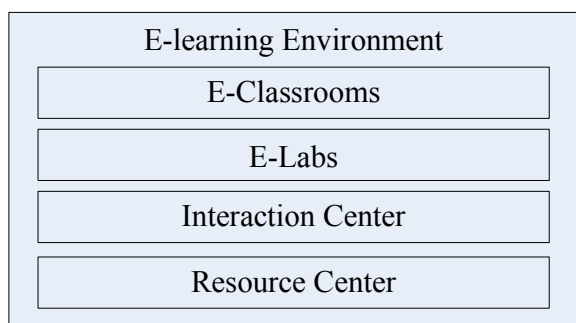

Fig. 1 Framework of e-learning environment

A. System Framework

Teachers and students are distributed in different physical areas in our information security curriculum. The students will get almost all the resources and learn from the network. There will be few chances for the teachers and the students to interact with each other face-to-face. Thus when the e-learning environment is designed, the most important things are: 1) how to provide the curriculum relative resources to the students; and 2) how to solve the interaction problem between the teachers and the students. So a collaborative web-based e-learning environment has been designed for this curriculum. The framework is shown in Fig. 1.

The framework has four parts: e-classrooms, e-labs,

interaction center and resource center. In the following sub-sections, these parts will be described.

B. e-Classroom

The teachers will give lectures to the students through the e-classrooms as shown in Fig. 2. Each teacher can use one e-classroom when he is teaching. And at that time, this e-classroom is exclusive. These lectures will be live broadcast in real time. The students can enter the e-classrooms and listen to the teachers. And they will be divided into different groups automatically when they enter the e-classrooms according to their majors and grades.

The e-classrooms are designed to the students who have enough time to listen to the live lectures. And sometimes, the videos will also be played in these e-classrooms.
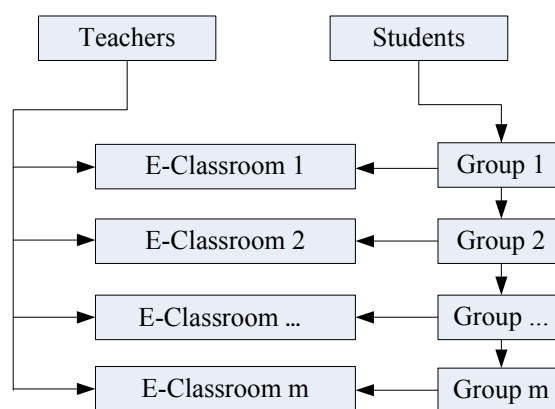

Fig. 2 The e-classrooms

C. e-Labs

Practice is very important in information security curriculum. Two types of practice have been designed: compulsory practice and selective practice. All the practice can be done in our e-learning environment through the e-labs as shown in Fig. 3.
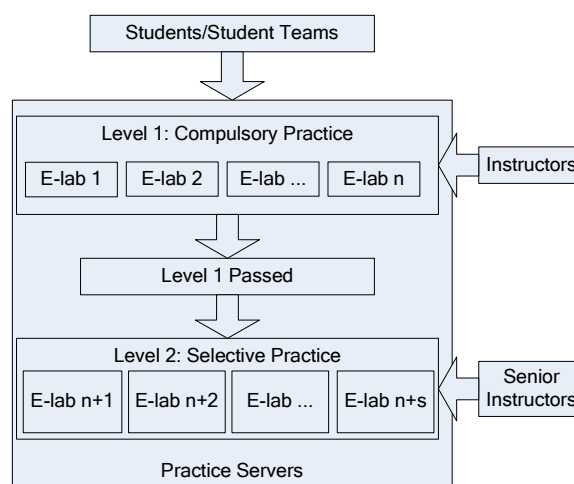

Fig. 3 The e-labs

Students will complete the practice individually or they will be divided into different teams to complete more complex

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practice jointly. Students or student teams can enter the e-labs to do their practice. In level 1 e-labs, the choice practice is some basic experiments which derive from the basic information security theory. And the students who have completed all the level 1 practice can enter the level 2 e-labs. In both levels, there will be instructors to help them if necessary.

D. Interaction Center

The feedback from the students is very important when the teachers cannot teach them face-to-face. Different students have different interaction features. Interaction center can provide fruitful interaction methods.

1) Non-instant interaction methods. Non-instant interaction methods mean that the teachers will not respond the students immediately. The main non-instant interaction methods are shown as the follows:

- Assignment subsystem. The teachers will give assignments on the interaction center through the assignment subsystem to the students. And the students will complete them and upload their achievements.
- Online Forum. An online forum is integrated into our e-learning environment. This forum is divided into different sections. The students can post their questions, learning experiences in these sections, answer the other's question or they can also discuss on some special topics. These will help them to improve their study.
- Email subsystem. An email subsystem is provided. If the students have any questions, they can send them to the teachers through emails.

2) Instant methods. The students can communicate with the teachers directly and instantly through the networks. The main instant interaction methods are shown as the follows:

- Instant message tools. There are many different instant message tools provided by different companies. Some of them are popular and convenient. Two such tools are selected: MSN (Microsoft Service Network Messenger) [26] and QQ [27]. The students can communicate with the teachers instantly through the two tools.
- Online Q&A. The online Q&A will be held in e-classrooms from time to time. Teachers will answer the questions from the students instantly through the network.
- Online discussions. These online discussions will also be held in e-classrooms from time to time. During the discussion, the protagonists are students, which is different from online Q&A. Teachers will also be in the e-classrooms. They will provide their advices if necessary.

E. Resource Center

An e-learning environment should provide enough resources to the students. In our design, four different types resources are provided to the students as shown in Fig. 4.

The curriculum guidance will provide the systemic framework to the student. The detail information includes the curriculum syllabus, the arrangements of teaching contents, the architecture of knowledge points, difficult points, learning tips and learning guidance. Curriculum Guidance will help the students to master the architecture of this curriculum. The students can test themselves through the online test system. They will find the shortcoming of their learning. Online case library provides some selected cases from the real world to the students. And at last, the tools, slides, courseware, reference books and papers, and some other resources will be opened to the students to download.
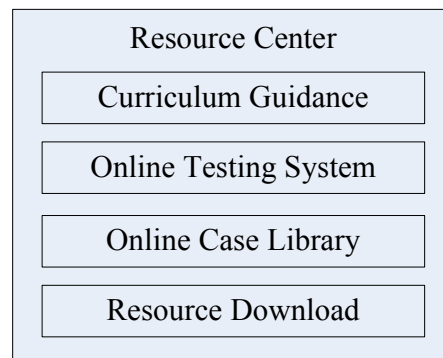

Fig. 4 Resource center

IV. RESULTS

The collaborative web-based e-learning environment has also been investigated from ten different aspects as listed here:

1) Whether the contents of the curriculum are rich, and updated in time.
2) Whether the learning resources are rich as well as in various forms.
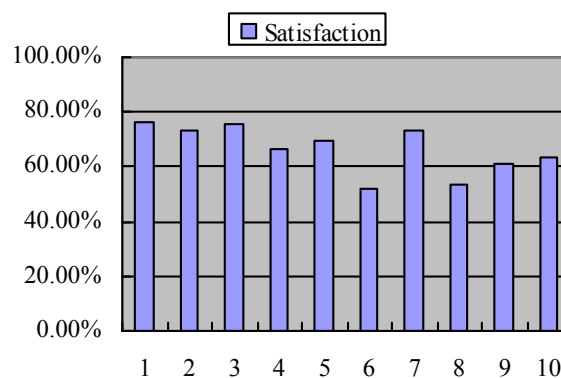3) Whether the express of lectures is clear and focuses on outstanding difficulties.

Fig. 5 Evaluation results

4) Whether the curriculum materials can meet the teaching requirements and have good quality.
5) Whether the curriculum environment emphases on students learning ability.
6) Whether it can provide enough self-evaluation ways to the students.
7) Whether it can provide enough interactive teaching and

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learning methods.

8) Whether it can provide various forms of learning support services according to the characteristics of the curriculum.

9) Whether it pays attention to the combination of theory and practice.

10) The overall evaluation.

The students evaluate our design through the network. The results are shown in Fig. 5. The results show that most students are satisfied with the web-based e-learning environment.

V. CONCLUSIONS AND FUTURE WORK

Many researches have explored on how to construct the e-learning environments. As they have showed, e-learning environments are different from the classical education. In this paper, the design is presented from a different point of view. It has constructed a curriculum-specific e-learning environment. It focuses on not only how to teach the students but also how to prompt the interaction between the teachers and the students according to the features of the curriculum. The student interaction and collaboration has also played an important role in this e-learning environment. So it provides sufficient interactive and collaborative methods to the students.

Although this design has been successful in practice, it can be improved further to provide better service to the curriculum. How to enhance the functions of this platform will be our main work in the future.

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