E-Learning Security Risks and Countermeasures

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Abstract. E-learning, a novel way in the learning process that involves more interaction between the learners and teachers to some extent, in comparison to the traditional education. Moreover, it depends on the Internet technology and executes via web applications. However, network environment is a honey pot to attract many hackers and it may have some potential security risks such as: malicious attacks, hackers and so on. In addition, network security is one of the security issues of E-learning because it is usually concerns with the instructors, learners, trainers who cannot foresee the risks and know how to prevent the threats and the like. This study mainly focuses on the E-learning security issues and the countermeasures to deal with risks towards e-learning-system.

Keywords: e-learning security, information security, information security risks, countermeasures.

1. Introduction

Learning new knowledge is an urgent need of human-beings. In the past, individuals observed the knowledge in a passive attitude from the instructors. The learners only approached the theory from one direction, so they didn't have any choices. However, with the boosting of Internet technology, it creates a new decade to meet the requirement for human learning's needs. The new and innovative ways of transmitting education everywhere is E-learning [1]. Nowadays, E-learning plays an essential role in replacing the traditional methods in many aspects. People can get knowledge from everywhere at any time from E-system. It is based on Internet environment and executes via websites. Moreover, it can reduce the initial cost for the deployment and it makes easier for managing resources and users. For instance, universities, colleges, or the companies don't need to spend a lot of money for renting equipment from the other universities, building high-technology infrastructure for education such as classrooms, electronic boards, projectors and so on.

E-learning can enhance the training method in various circumstances: long-distance learning, part-time training, academic courses, and the like. In fact, the students or the workers can learn courses, take the exams and send the feedbacks or homework online via the website easily and fast. This new method can bring quality education for many people and it can save money, time and effort for the learners [3]. In addition, it is convenient and inexpensive means to gain the knowledge and information in pursuing the higher education [4]. Although E-learning has a lot of benefits for the users, it faces

some various security concerns. Some cyber security issues related to e-learning system such as corrupted or lost communications, messages, grades, data or work; a compromised the users and the teachers identify; stolen personal information and corrupted social technical systems [5]. The most concern is that instructors and students use the e-system for their education purposes but they don't know the threats behind that system. In short, e-learning not only offers a lot of benefits for the users but also carries some cyber security threats making data vulnerable. Therefore, we need to ensure the security and the safety of the users in e-system

2.   Background

2.1.   E-learning technology

E-learning is used to express a new way of training for the users. It enhances the knowledge for the users not only for schools but also for organizations in comparison to the traditional educational method. E-learning takes place in educational context including continuous education, company training, academic courses and the like [7]. E-system also creates a virtual environment for users and the instructors who use the applications and tools via websites. Regarding the virtual technology, it offers a lot of advantages for the users and the managers such as: centralized data storage, benefits for teachers and students and easy monitoring [11]. First of all, all documents, materials (eBooks, videos, texts, images, etc.) are located in a website in order to make easier for the users to connect directly and use them rapidly. For example, the users can use some of the multi-media devices like laptops, computers or mobile. With the high speed of internet connection, the users can connect to websites and take the resources of the online courses fast and simply. Second, the virtual environment also brings a lot of advantages for the students and the teachers. In fact, the students can download the materials to learn the courses from anywhere at any time. Moreover, students can upload their homework and submit to their teachers. Teachers can upload online tests, assignments, create a course, receive feedback, and send comments to their students quickly. Third, all resources of e-learning are stored in one place in a website; therefore, the administrator can control all kinds of data from different sources instead of monitoring them.

2.2.   Benefits

E-learning is widely held as one of the best ways to facilitate learning process of the learners. Its benefits to the teacher and students are listed below.

According to [4], E-learning creates the big opportunity for various types of information such as: text, sound, videos, pictures, etc. that are stored over a long periods of time and available for long distances. Compared to traditional teaching method, where students need to keep a lot of materials during a course and it is hard for them to revise before the examinations.

Every individual can take into consideration e-system at different levels [15, 16]. For example, in a traditional class, the instructor gives a lecture to the students but they take in and process all the information presented during the lecture at varying levels. But, the new technology (E-learning) makes the students more active in choosing the part of the lesson. Some students can select some parts of the course while the others can start to review the whole course.

Online learning offers the learner-determined location that students can take the course everywhere [14]. Because with the new technology, the courses are stored on the web applications and accessible 24 hours per week. They can use their multi-devices as laptops, computers, smart phones and so on in order to access the course everywhere. They don't need to go to school at a specific day in a week. In addition, they can read, download online materials, learn the courses and update the knowledge nimbly.

E-learning environment helps the institutes, schools or the organizations in reducing the initial cost for deployment applications and training people. They don't need to pay a lot of money for the storage memory of data [9]. In fact, in the past, without the technology of e-system, company's human resource division took many times in a year to train new recruited employees and this procedure took a lot of time and money.

Furthermore, e-system is the best solution in order to compensate for the inadequate resources like books, classrooms, academic teaching staffs, the IT technician as well as coordinators [12, 16]. Indeed, it can solve the major issue in the situation which the high qualified teachers can't deal with a huge number of students and the materials are sometimes unavailable. Regarding to this technology, these restrictions don't exist anymore.

2.3.   Drawbacks

Using e-learning also has some weaknesses. They include internet technology dependency, materials incapability in different OS [17] and teacher qualification's challenges [12]. First of all, e-system runs on internet environment through website applications; hence, it depends on the speed of internet connection. The individuals are required to have a high bandwidth Internet connection which allows students to download the materials from the course and upload their homework in time. Besides, they need to have at least the basic technical skills to use e-system. Some lecturers designed some materials, lessons which operate only on specific operating system such as Windows, Ubuntu or Mac OS. For example, some lesson materials with some special functions on windows system won't have full function when it runs on Macintosh OS [17]. The new technology requires a lot of time to train the instructors how to use it in their work. Moreover, it also needs the well-qualified teaching staffs in order to compose their curricula and update new knowledge on their lessons.

With the developing of ICT, people can take advantages of using it in many aspects. However, every new technology also brings with it some potential cyber security issues. E-learning system is not an exception, not only provides a lot of benefits but also has some potential threats and risks from the Internet. In this study, there are some security consideration of E-learning system:

1) According to [3], there are a numerous potential threats and security problems that deal with the E-learning system such as: malicious attacks, hackers and

online social network site threats. Malicious attacks is related to the program that can monitor all your online activities and capture all personal information like Spywares, Trojans, adware and so on. Moreover, they can damage your laptop seriously as virus threats. For example: a logic bomb can change or delete all data – "time bomb" of Tim TIloyd in 1996 (nearly 2 million dollar of OMEGA company's sabotage).Hackers who can victimize the other people by using malicious code to steal, change or destroy the information. Attackers can use the hidden code inside the advertisements and put them to the online social network (Facebook, Twitter …).

2) The security concerns for the E-learning system can be defined in different ways such as authentication, availability, integrity and confidentiality [6].**Authentication**: the attackers steal the user's authentication or the information are eavesdropped in the insecure communication. **Availability**: the intruders use DoS or DDoS technology to attack the victims. **Integrity:** unauthorized users alter or modify the content of the information by executing malicious codes. **Confidentiality**: insecure storage, information leakage.

3.   Research methodology

For this study, online survey was used to investigate students' opinions about using/ applying e-learning in their own learning. The online survey has been initiated and circulated (via Facebook groups) among students in Vietnam. The online quantitative survey consists of 24 questions on required fields. Because of the quantity of elements our database cannot be considered representative of the population as whole students.

Sample. 97 Vietnamese students filled out the online questionnaire (69 males and 28 females), expressing their opinions of e-learning system under investigation.

Hypothesis. Based on the collective results, the author has 3 hypothesises.

H1: E-learning system is very essential not only for full-time students but also for part-time and distance students in their training program.

H2: Web materials are valuable sources for all training students.

H3: Video materials are very necessary for all students during their training program.

Method. Using Chi-Square test by SPSS to evaluate the correlation of the variables' hypothesises in **H1, H2, H3** in respectively.

4.   Research results

The survey data has been analysed using SPSS 20 program. In addition to descriptive statistics, a cross table was run in order to explore the relationship/correlation between the variables. Since the paper is presented with the preliminary results of an ongoing

research, all relationships described below are seen as indicative, rather than evidential statements.

Table 1. Students' opinion about E-education system (source: own data)

Training status		E-education system				
	Count	Absolutely not necessary	Rather not necessary	Rather necessary	Absolutely necessary	Total
Full-time	Count	2	1	26	46	75
	%within Training status	2,7%	1,3%	34,7%	61,3%	100,0%
	Std. residual	,4	-,9	,5	-,2	
Part-time	Count	0	2	2	10	14
	%within Training status	0,0%	14,3%	14,3%	71,4%	100,0%
	Std. residual	-,5	2,4	-1,1	,4	
Distance learning	Count	0	0	2	5	7
	%within Training status	0,0%	0,0%	28,6%	71,4%	100,0
	Std. residual	-,4	-,5	-,1	,3	
Total	Count	2	3	30	61	96
	%within Training status	2,1%	3,1%	31,3%	63,5%	100,0%

Table 1.1: Chi-Square test for **H1**

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.978[a]	6	.175
Likelihood Ratio	7.525	6	.275
Linear-by-Linear Association	.341	1	.559
N of Valid Cases	96		

a. 9 cells (75.0%) have expected count less than 5. The minimum expected count is .15.

Students' opinions about the role of e-learning. According to the students' views of their academic years, e-learning is very necessary for them. **61,3%** full-time students believed that E-learning is necessary and **71,4%** part-time students shared similar views. However, there is no statistical relationship/ or relation between the examined variables (Pearson Chi-Square = 0,175, Table 1.1) [2].

Students' views of the value of learning materials. The author found that there was a statistical correlation between training status and the evaluation of the value of web-based learning materials (Pearson Chi-Square = 0.002, Table 2.1). Among the full-time students, **60%** students thought web materials were at least quite valuable for them during their study. It can be said that web materials are quite valuable for students regardless of their training status.

Table 2. Preciousness of web materials for studying (source: own data)

Training status		How valuable of web materials for studying are				Total
		Not at all	Not very	Quite	Very	
Full time	Count	0	9	39	21	69
	%within Training status	0,0%	13,0%	56,5%	30,4%	100,0%
Part-time	Count	2	0	3	5	10
	%within Training status	20,0%	0,0%	30,0%	50,0%	100,%
Distance learning	Count	0	1	1	3	5
	%within Training status	0,0%	20,0%	20,0%	60,0%	100,0%
Total	Count	2	10	43	29	84
	%within Training status	2,4%	11,9%	51,2%	34,5%	100,0%

Table 2.1: Chi-Square test for H2

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	20.519[a]	6	.002
Likelihood Ratio	15.562	6	.016
Linear-by-Linear Association	.151	1	.697
N of Valid Cases	84		

a. 8 cells (66.7%) have expected count less than 5. The minimum expected count is .12.

We have found statistical correlation between training status and the value of video lectures' preciousness (Pearson Chi-Square = 0,009, Table 3.1). Among the full-time students, **88, 2%** of students thought that web materials are at least quite valuable for them during their study. According to our results, it can be said that video lectures are quite valuable for students regardless of their training status.

Table 3. Preciousness of video materials for studying (source: own data)

Training status		How valuable of video materials for studying are				Total
		Not at all	Not very	Quite	Very	
Full time	Count	0	8	30	30	68
	%within Training status	0,0%	11,8%	44,1%	44,1%	100,0%
Part-time	Count	2	0	3	5	10
	%within Training status	20,0%	0,0%	30,0%	50,0%	100,%
Distance learning	Count	0	0	2	3	5
	%within Training status	0,0%	0,0%	40,0%	60,0%	100,0%
Total	Count	2	8	35	38	83
	%within Training status	2,4%	9,6%	42,2%	45,8%	100,0%

Table 3.1: Chi-Square test for H3

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	17.083ᵃ	6	.009
Likelihood Ratio	12.392	6	.054
Linear-by-Linear Association	.038	1	.845
N of Valid Cases	83		

a. 9 cells (75.0%) have expected count less than 5. The minimum expected count is .12.

Based on the collected data (Table 1), it can be said that e-education environment is very essential not only for full time but also for part-time education program for Vietnamese students at higher education level. Furthermore, according to student's conscious on video and web materials, it can be indicated that these materials are quite valuable for students regardless of their training status (Table 2, Table 3). However, all lecturers and students aren't aware of E-learning's security issues and don't know-how to protect their data on E-system.

5.   Countermeasures in E-learning

Here after are listed some technologies that ensure the security of e-learning.

Malicious attack. Computer viruses, malware, Trojan are malicious program which change or damage the operating system without the user's permission. We can use spam filters to prevent spams, Trojans and viruses from harmful email attachments, because some malwares and Trojans usually are attached from emails when students or professors download the materials in E-system. Moreover, we use the secure protocol (HTTPS) to surf thru E-learning websites and applications in order to protect the privacy and data on the system.

Availability attack. There are two types of availability attack: flooding attack and blocking attack such as DoS (Denial of Service), Network infrastructure attacks [13]. We extremely recommend using IDS (instruction detection system) or firewall to detect these attacks. Moreover, regular backup is one of the best solutions to keep the data safe and counter these potential attacks.

Authentication attack. This attack means that hackers use stolen passwords or keys in order to gain access into the system. One of the measures to against this attack is that using biometric based security mechanism because it is very difficult to steal or duplicate passwords easily. Besides, applying HTTPS (secure socket layer) in web browser should be used.

Integrity attack. Damaging or modifying the content of data on the system is integrity attack. Hackers use some malicious codes or programs injection to alter the information of data on E-system. Therefore, we can use some security algorithm such as: hash and digital signature algorithm to prevent the information of data from this kind of attack effectively [13].

Confidentiality attack. Session eavesdropping and session traffic analysis are one of this attack's types [8]. This attack tries to display private and secret data for the unauthorized users. In order to counter this kind of attack, we use strong cryptography mechanism. For example: we encrypt secret information in storage instead of putting data on plain text so that hackers can access these important data. Furthermore, authorization should be considered seriously. We separate the user's right clearly per each requirement on accessing data.

6.   Conclusion

E-learning is a powerful way which helps facilitate students and lecturers in an educational environment. Nowadays, many universities and colleges implement e-system in their own programs to satisfy the needs of the learners. In this research, we recognized that Vietnamese students extremely need e-learning in their courses at higher education level not only full-time course but also for part-time ones. Moreover, this research indicates the effectiveness of e-learning for the users, especially web materials. In the other hand, in this study, we mainly focus on some potential security issues in e-learning environment and countermeasures to deal with these attacks. We believe that using cryptography algorithms (encryption and decryption) is one of the options for securing data storage and retrieval data. Data should be in encrypted form before storing on e-system and every authorized individuals will be received decryption key to access data. The researchers strongly believe that e-learning will become more popular in the future and cryptography is the best way in order to make the users feel comfortable and secure.

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