

Security of Virtual Campuses – Collaborative Systems

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Abstract: *20 years ago the concept of a virtual campus appeared to be part of an utopic world. The communication needs have greatly increased during the last decades and research in technology has focused on developing new ways to offer access to sources of information. At the end of the first decade of this millennium we can state that a virtual campus is a very common concept for a university nowadays. Almost all the important teaching centers in the world have a prototype of a virtual campus which is able to offer teaching facilities starting with some courses materials that are posted on the university's website and can be accessed by students through the usage of a username and a password (basic security features). More complex virtual campuses have many facilities and allow students to communicate with their teachers to have access to their marks, to give their exams online and to post their essays or papers so that their teachers have access to them.*

Keywords: *virtual campus, collaborative systems, e-learning, security of virtual campuses.*

1. Introduction

A complex virtual campus can have all the features that are necessary in order to follow classes and graduate without being necessary to be present in the geographic campus of the teaching centre. The problem that arises consists in the need to develop a security strategy that is strong enough to protect the highly confidential information which travels through the internet protocols between students, a teachers and administrative stuff.

The elements that need to be protected against virus attacks or spies or occasional accidents that may lead to important data loss or information alteration. Therefore the architect of a virtual campus has to carefully plan periodical back-ups for all the data stored in the database in order to maintain an up-to-date Disaster Recovery Center that can be used to recover information in case of accidents. At the same time complex security methods have to be implemented in order to achieve a safe environment and to prevent theft and illegal actions.

2. Virtual Campuses

A Virtual Campus, figure 1, refers to the online instrument that provides education programs where college work is completed either partially or wholly online. The term is usually associated with the concept of virtual education that describes online education using virtual courses delivered on the Internet. "Virtual" is used here to characterize the fact that the course is not taught in a physical location, but through some alternative methods.

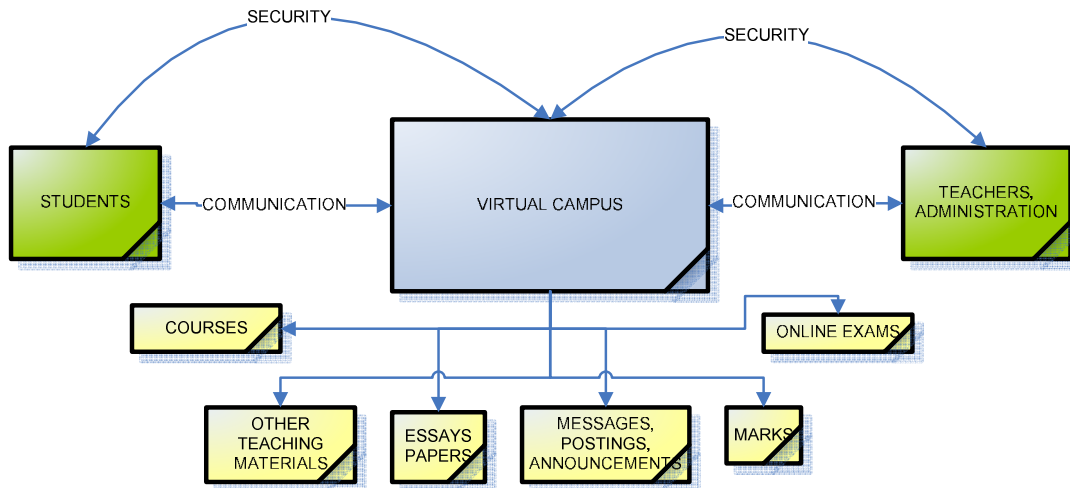


Fig. 1. Virtual campus

The aim of Virtual Universities is to provide access to teaching materials to those who cannot physically attend courses for reasons related to distance or need for flexibility. Students meet rigorous criteria in order to graduate and obtain a diploma. Many virtual institutions are accredited in the same way as traditional universities and operate according to the same academic standards. These universities can grant degrees that will be recognized around the world.

Schools use a variety of tools for conducting classes - typically called Learning Management Systems (LMS) or Learning Content Management Systems (LCMS).

A Learning Management System (LMS) is software for delivering, tracking and managing training/education. LMSs range from systems for managing training/educational records to software for distributing courses over the Internet and offering features for online collaboration.

A Learning Content Management System (LCMS) is software for authoring, editing and indexing e-learning content (courses, reusable content objects). An LCMS may be solely dedicated to producing and publishing content that is hosted on an LMS, or it can host the content itself (remote AICC content hosting model).

In the beginnings, the virtual study involved multimedia text based support, such as PowerPoint, PDF or HTML. Currently, technology advancements have led to the appearance of the following implementations of virtual campuses:

- Animated courses: The usage of multimedia applications increases the quality of the teaching process by inserting animated elements in the text. Therefore, teaching materials are brought to life and they are explained much better;
- Virtual Classroom – it is a community that allows remote members to take part to different learning sessions without being physically present in the same location. The only instrument they need in order to access the learning materials that the university offers they need a personal computer and an internet connection;
- Video-based courses and audio-based courses are considered to be the peak of the virtual study technologies as they enable students to experience video and audio lectures that simulate a real environment and are very expressive.

Initially, distance learning has been implemented as learning through correspondence, courses broadcasted by television or learning materials recorded in an audio or video format. The principle of distance learning is to offer the possibility of learning to people located in geographical areas that do not have access to teachers or learning institutions. The first institution that has introduced this teaching system has been The School of Continuing

Education, a programme that was part of the New York University. It has been applied starting with 1922 by organizing virtual classes through the help of systems such as Windows, Netware, ISDN and Indeo.

The e-learning concept has started as an environment made of processes that travel through a permanent development and collaborative processes, that are focused on increasing performance and individual or organizational knowledge.

According to IDC, e-learning allows “*synchronous or asynchronous learning which is led through the help of internet, intranet, extranet or other technologies based on internet. E-learning comprises different sending methodologies that have a personalized content, virtual classes, simulations, forums and focused discussions*”.

The e-learning application is the heart of the e-learning system. It contains one or more phases of the educational process and it consists of the planification of courses, the development of their content and the students' evaluation.

The components of the e-learning applications are the on-line testing, the project evaluation and distance learning.

One of the latest trends in e-learning is the spread of screen casting which is a technology that allows users to record themselves while performing a certain task or giving examples and to broadcast their video material through a web browser. The advantage of this tool is that it provides students with the opportunity to follow the video at their own pace and to better understand as they have a practical example which explains more than a textbook.

3. Collaborative systems

A collaborative system is an application that communicates with people and offers solutions in order to improve the quality of a certain service. Its aim is to bring together the strengths of people and softwares and to increase the performance and the speed of answer. In a century in which people talk about the power of knowledge and scientists have developed theories about organizations based on knowledge and management based on knowledge, it is essential to develop collaborative systems in different areas. One of the major domains in which collaborative systems have been successfully applied is education. That is why there is a strong relationship between a virtual campus and a collaborative system.

4. How to transform virtual campuses into collaborative systems

The virtual campus is collaborative structure in which interact five target groups:

- *students*, that take part in trainings, testing, essay and paper posting, documentation, online meetings, forums communication, banking transactions for study fees payment;
- *teachers* who complete multimedia teaching materials for virtual campus training, evaluates papers submitted online by students, update databases proper evaluations;
- *people outside* the virtual campus, which informs about the performance on campus, interact conveying information allowing the selection of students;
- *organizations* which demand for workforce specialists, requiring new training courses;
- *campus management*, who defines development strategies, moderate discussions on forums, study the labor market, select teachers for the courses who will take place, establishes specific program costs.

The main link between virtual campuses and collaborative systems is the idea that the platform of a virtual campus allows students to follow simultaneous learning programmes. Each student receives a username and a password that are meant to uniquely identify him

during the communication process. Consequently the confidentiality and integrity of the password associated with each user is very important. For example, a university can organize different programmes of bachelor degrees. A student can subscribe to one of them and the username and password he receives at the beginning of the program give access to the courses and teaching materials related to his topic. He will be able to give certain exams that are accessible depending on the year of study and on the bachelor program. All the information that helps organize the communication between the virtual university and its students, professors or administrative staff is held in securized database that store encrypted information.

During several decades, virtual campuses have improved their collaboration power, as they developed new functionalities. The main reason consists in the dynamics of the architectural design that is organized on three levels: the realization level, the representation level and the interface level. The realization level concerns all the techniques and algorithms used in order to build a virtual platform. This is the level where all the aspects related to databases, security, encryption algorithms, stocation methods are discussed. The representation level focuses on manners of organizing information, functionalities and domains on the virtual platform. The methods are chosen according to the easiness of access they bring all together. Finally, the interface level concerns all the communication links between users. The virtual platform is used to post messages, to communicate online, etc.

According to [10], the platform is organized in five spaces:

- *navigation and self-management*, to allow each user and particularly each learner to adopt methods appropriated to his/her specific learning style;
- *consultation*, to explore, collect and process the relevant information;
- *production*, to enable the learner to introduce new data in the active context of the consolidation of learning, and to present the results in original documents;
- *collaboration*, to gather the learners through computer conferencing, to support collaborative work and anchor the socio-cognitive dimension of learning;
- *assistance*, by the way of online help and counseling, to accompany the student in his/her study project.

5. Quality metrics for virtual campuses

In order to measure the quality of a virtual campus, some quality metrics are defined:

1. *The eligibility of the virtual campus*

A virtual campus is considered to be eligible if it undergoes the following criteria:

- it achieves the established goals;
- it is accepted by the user;
- it uses modern technologies;
- the hardware resources are between reasonable limits;
- the results are according to expectations;
- users can receive help whenever they have questions related to the usage of the platform;
- it is user-friendly and it can be integrated with the existing technologies.

Several metrics can be computed:

$E = AO / SO$, where:

AO = Achieved Objectives,

SO = Scheduled Objectives;

$E = \text{UAF} / \text{URF}$, where:

UAF = User Accepted Functionalities,

URF = User Required Functionalities.

The eligibility coefficient takes values between 0 and 1. The eligibility of a virtual campus increases as the value of the eligibility coefficient approaches 1.

2. *The efficiency*

The software product is considered to be efficient if:

- The time of response is short
- The processes' rate of success is high
- The ratio between performance and cost is high
- The ratio between errors and results is low
- It achieves the established goals

The efficiency indicators are:

$E_f = \text{RT} / \text{ERT}$, where:

RT = the Response Time of the virtual campus,

ERT = the Expected Response Time of the virtual campus

The efficiency metrics takes values between 0 and 1. The efficiency of the software product is higher if the computed coefficient approaches 1.

3. *Accessibility*

The accessibility of a virtual campus consists in the easiness with which the final beneficiary uses the campus. A current problem in the European Union area refers to the identification of social problems related to the integration of different population categories that have certain disabilities. These people have certain difficulties in using their senses or their members and it is important to create spaces that give them equal chances to access learning resources.

The virtual campus will offer a high degree of accessibility, if:

- It implements assistance methods for blind people (text-to-speech synthesizers);
- The colors used in the design facilitate the access of people suffering from daltonism;
- The ability to process vocal commands.

$A = \text{AF} / \text{TF}$, where:

FA = accessible functionalities,

TF = Total functionalities.

The accessibility coefficient also has a positive value that is less than or equal to 1. The accessibility is proportional with this coefficient.

4. *Security*

The virtual campus is protected against potential attacks by implementing a user authentication process and by encrypting confidential information. Depending on the

importance of the information and on the risk degree to which the system is exposed, several security modules can be implemented, such as tracking user activity, the usage of authentication based on digital signature, mechanisms of anti brute force attack, etc.

CS = Protected Functionalities / Total Functionalities, where:

PF = Protected Functionalities through specific security elements;

TF = Total Functionalities.

The security coefficient has the same behavior as all the metrics presented above.

6. The security of virtual campuses

The security of e-learning applications studies the ways and the means of implementing data integrity and protection policies that are specific to organizations that use them.

The main aspects that concern information security are the physical integrity of data and their confidentiality.

When it comes to integrity, the hardware and software elements and the communication mechanisms have to cooperate in order to maintain and correctly process the data and move the data to their final destination without unexpected alterations.

The systems and the network have to be protected against contamination. The confidentiality represents the ability to ensure the fact that the necessary degree of security is implemented at each level of data processing. In order to achieve this data encryption is used during information storage and message exchange. The systems also need to protect the network and to strictly control the access, data classification and to train the staff according to the procedures.

The physical integrity is affected through the modification and information alteration. The attacks are represented by all the actions that aim to obtain confidential information and to destroy it. The main types of attacks are:

- the interruption: a communication process is interrupted or a hardware component is destroyed
- the modification: the process through which an unauthorized person uses means of inserting, modifying or deleting information from files or tables in the database
- the interception: an unauthorized entity has access to the network and read confidential information
- the insertion of false data: a user connects to the database and inserts new records. For example an unauthorized user connects to the database of a virtual campus and inserts new records representing false students or new marks.

There are two types of attacks: active attacks and passive attacks. The former are those cases in which the hacker discovers the content of the messages or analyzes the traffic in order to determine the identity and the location of the message sender. The latter are determined by the interaction of the unauthorized person with the application through the methods of:

- service refusal (some messages are refused while the network is used at its full capacity with false messages. Therefore the communication speed is lowered and the information processing is delayed);
- resending information (the interception of information in the network and resending them with the aim of obtaining certain privileges);

- message alteration (an unauthorized entity determine the content of a message and has the possibility to modify the message and to resend it to the destination)

7. Modern tools for virtual campuses security

The main preoccupation of the modern virtual campus should be to find a more effective tool or algorithm that improves the quality of the security process. There are many actors that are interested to harm different components of the virtual campus. Some countries have created government regulations that require maintaining high standards for security and data protection when it comes to a virtual campus.

One tool that has been designed to reduce the expense associated with security and compliance is Windows Vista that provides multiple layers of protection. The aim is to protect the virtual university from external attacks, internal threats, and unauthorized access to specific information.

The operating systems also offers back-up and recovery methods. In order to achieve these goals Windows Vista uses Microsoft's Security Development Lifecycle that emphasizes security by defining a repeatable engineering process that every developer must follow and then verifying the efficacy that process before release.

Windows Vista ensures data confidentiality by supporting data encryption at the disk, directory, or file level, with features such as:

Windows BitLocker Drive Encryption: is a feature that addresses the information located on lost or stolen computers. The solution is to encrypt the whole system volume and in this way the information is better protected.

Encrypting File System: EFS is used for folder encryption and user-level. Due to the possibility of storing EFS keys on smart cards, the administrator has opportunity to manage the EFS on a network and to grant or refuse the user access, according to his user profile, to different information resources available in the network.

Control over storage device use: Windows Vista includes the possibility to restrict the connection of USB keys to the universities computers, in order to protect the sensitive information that may be stored on the network.

8. Conclusions

The main objective of an e-learning application is to provide users with information without requiring the physical presence of the students and teachers in the same place and at the same time.

This type of applications mainly have three types of users: teachers, students and administrative staff. These classes of users are clearly delimited through the access level to the application's resources. Teachers create courses materials by using multimedia elements and give tasks to different students. He can also play the role of the evaluator that has the objective to create and post different type of exams and to give marks to students after an on-line evaluation. The student can access all the resources posted on a course's section and can learn at his own pace. He has to complete his tasks and to post them and at the end of the course he is evaluated after answering at a series of questions in a certain time interval. The administrative part of the virtual platform is in charge with creating and managing user profiles that have different rights according to their status.

It is very important to have a user-friendly virtual campus because end-users can have very poor IT knowledge. At the same time the virtual campus structure has to respect all the

security parameters imposed by the level chosen by the administrator (low, medium or high security) and by the default standards for entry data. The security level is directly related to the data confidentiality degree and to the educational performance of the virtual campus at a national and international level. Therefore, in the process of creating a virtual learning platform, the designer has to take into consideration all the protection mechanisms and all the methods of electronically testing the user's identity.

It has to be mentioned that an increase in the security level usually leads to a decrease in the user-friendly characteristic of the virtual campus as it is more difficult for the end-user to access and use the functionalities of the e-learning platform.

To resume, the advantages of a virtual campus are:

1. **Improved performance:** A 12-year meta-analysis of research by the U.S. Department of Education found that higher education students in online learning generally performed better than those in face-to-face courses.
2. **Increased access:** the number of people that have access to education and teaching materials has definitely increased.
3. **Flexible timetable for learners:** students are not obliged to go to school according to a certain timetable. They can organize their studies according to their needs.

References

- [1] I. Ivan and C. Toma, *Informatics Security Handbook*, Informatics Security Master Handbook, Editura ASE, 2006, pg. 414.
- [2] V. V. Patriciu, I. Bica, M. E. Pietroseanu and I. Priescu, *Semnături electronice și securitate informatică*, Publishing House ALL, Bucharest, 2001.
- [3] V. V. Patriciu, *Criptografia și securitatea rețelelor de calculatoare cu aplicații în C și Pascal*, Publishing House Tehnica, Bucharest, 1994.
- [4] B. Schneier, *Applied Cryptography 2nd Edition: protocols, algorithms, and source code in C*, John Wiley & Sons, Inc. Publishing House, New York, 1996.
- [5] J. Mendling, G. Neumann, A. Pinterits, B. Simon and F. Wild, *Indirect Revenue Models for E-Learning at Universities – The Case of Learn@WU - Vienna University of Economics and Business Administration (WU Wien)*, Department of Information Systems, Vienna 2004, pg.12.
- [6] Institute for Interactive Technologies, “E-Learning Concepts and Techniques,” *Bloomsburg University of Pennsylvania*, USA, 2006, pg. 198.
- [7] J. Zhang, “E-Seminar,” *Department of Computer Science*, Brown University, 2000.
- [8] K. El-Khatib, L. Korba, Y. Xu and G. Yee, “Privacy and Security in E-Learning,” *Institute for Information Technology*, National Research Council Canada, 2003, pg. 16.
- [9] Web Application Security Consortium, *Threat Classification*, 2004, pg. 24.
- [10] C. Ciurea, “A Metrics Approach for Collaborative Systems,” *Informatica Economică*, Vol. 13, No. 2, 2009, pp. 41-50.

[11] <http://209.85.229.132/search?q=cache:iMbAWiQEVzgJ:www.microsoft.com/education/VistaSecurity.msp+virtual+campus+security&cd=10&hl=ro&ct=clnk&gl=ro>

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