

# Platform of Educational Process Support for the Internet Technology Area

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Teaching internet technology allows the usage of a wide range of approaches and tools. The platform mentioned in this paper seeks to integrate these resources and also offers the possibility of direct testing of subject matter. Its involvement in educational process has been done, and still is, within the subject the Development of Internet Applications. It turned out that the usage of practical and interactive examples to test students' knowledge has positive results. So, the formed software platform is a base tool that brings more interactivity and student involvement during the teaching lessons.

## I. INTRODUCTION

University subjects teaching brings a wide range of options and approaches that are often affected mainly by the type of these subjects, their content, form of teaching tools, etc. The tools and approaches used for some kind of teaching are usually focused on the interpretation of the theory which is often problematically linked with the practical involvement of students already during the initial phase of some topic presentation. Ensuring sufficient interactivity is thus neglected at the expense of theory, supported by the classical concept of interpretation in the form of lectures. Although students have an opportunity to check and verify the information obtained during lectures based on laboratory or practical exercises trainings, they are often confronted with the practical usage of gained knowledge through their employment.

This state then penalizes the students themselves, as well as efficiency and quality of their work for employer. The educational process should give them sufficient knowledge base for practice, which is unavailable for the most of the students. But also offers of ways how to solve common problems during practice should be a part of their education. So, the E-learning approach is often use, because it can include theory, practice, research or can cover sophisticated teaching process based on innovative and effective approaches.

A specific area in terms of education and available tools are technological based subjects. For these subjects or lectures, emphasis placed on practical usage of knowledge is crucial [1]. The perception of relation between theory and practice is one of the major outputs of the educational process. The students should be able not only to identify and describe issues concerned with a given topic, but should be able to apply and use their knowledge in real deployments.

This article discusses the possibilities of promoting the learning process of technical subject focused on web development and Internet applications. The developed educational platform is used as the main tool for

mentioned purposes. The mission of this platform is the above-mentioned support of relation between theory and real-world experiences.

## II. CONCEPT OF TEACHING PLATFORM

The platform to teach Internet technology and web application development goes a step further from this point of view. Its aim is to provide teachers and students new opportunities for interactive teaching and testing the acquired knowledge. It focuses mainly on demonstrating the technology discussed in the examples and exercises that seek to verify the practical knowledge and skills gained from lectures and materials. Everything is placed into a real environment of Internet or Web technologies [2].

The main advantage, compared to traditional/non-interactive way of teaching, is direct usage of a test server even during at the lectures. This opens up new possibilities for presentation of information and results, which are applicable by students during their test. The interactive lessons extended by all important educational components are provided based on this platform. Also the students' feedback of their activities during the lecture is achieved.

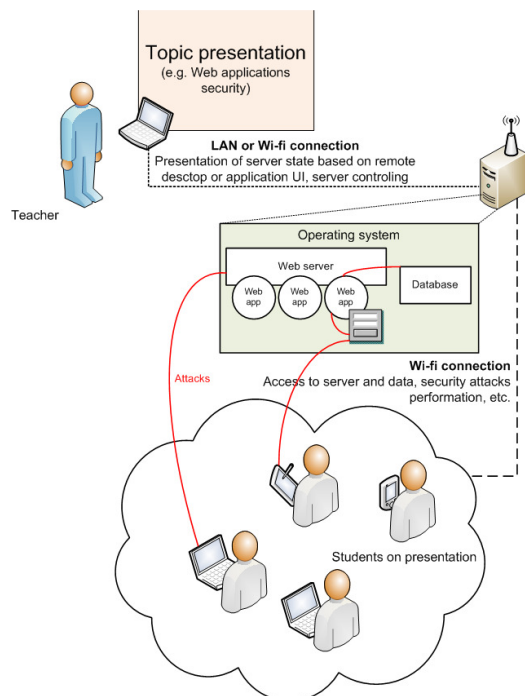


Figure 1. Utilization of our platform directly within the teaching of internet security topic

The Figure 1 illustrates a general concept of mentioned platform even during the topic presentation. The security of web applications is a case study topic at this moment. The hardware devices – server is the basis for the platform operation. It can be accessed by teacher as well as students. These two roles need to have different access rules and interfaces for obtaining interactivity from/to our platform. The administration interface is provided for teacher. Based on this, all the settings via an intuitive user interface can be changed as well as the activity can be monitored. Local Wi-fi network is primary used to connect to the device. Based on this connection the students use the platform to test their knowledge to pass the tasks and perform the examples.

### III. EDUCATIONAL PLATFORM FOR WEB APPLICATION DEVELOPMENT

The basic idea of the general concept of educational platform is based on direct interactivity between teacher and students. The area of Internet technology and Web development offers rich possibilities for implementing the relations between theory and practice. In essence, the theory plays more supportive role in this area, mainly for supporting the standardization of approaches and results. But just the application of knowledge, approaches and technologies in a practical deployment is a fundamental element for teaching of this area.

#### A. Educational platform integration to the teaching process

This chapter tries to describe basic process how the concept of our platform should be used during the lectures. The server (laptop, special portable device, etc.) with installed platform software needs to be started to use the platform in the classroom. This device will be act as a test server during the lesson. Its job is to offer platform interface and capture and evaluation of all user requirements and related responses. Also the presentation of results and monitored values is its role. The students can connect to this server via local established wireless network that is operated only for those specific purposes. The teacher can select the topic and its materials using the administration interface. This selection opens the lesson for students and also configures the server as needed. Everything takes place only within an easy user interface and therefore it is no need for a deeper impact into the application or platform itself. The platform may also include materials required for a given topic presentation



Figure 2. Zotac ZBOX HD-ID11 as an example of suitable server (source: www.zotac.com)

and lectures which is prepared by teacher. The overall concept of the platform integration and usage was shown above in Figure 1.

It is possible to see all the functionality and relations of the concept. Also the ways to communicate with the server is depicted. Specifically, the scheme covers issue of web application security, which is used as a case study example to illustrate the ability of our platform. It is also important, that we use “special” kind of hardware equipment which is prepared and installed only for the purposes of the platform. In our case, we just use simple Atom mini PC, which fulfill all requirements as portability, MS Windows compatible hardware, sufficient performance, etc. The fact, that this type of hardware is

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!url::attack=yes::
!url::attack=yes::
ip::192.168.1.1-192.168.1.2::
ip::192.168.1.6::
session::fine=true::
session::fine2=true::
post::sme=yes::
!post::soxme=yeser::
```

Figure 3. Příklad kofiguračního souboru

not equipped by LCD display is mostly advantage because of price and portability. The access to the server environment and software of platform can be established by remote desktop access from any standard laptop within range. The example of this suitable piece of hardware can be Zotac ZBOX HD-ID11 see Figure 2.

#### B. The platform architecture

The administration interface is a one of the basic parts of the platform. It is available only for teacher. Thanks to this administration, the teacher can change the contents of each lesson, choose the current lesson materials, tasks and examples, see and check the tests results, has a full control over the tests operation and restore the whole platform to its original state (prepare it for next lesson) Particular lectures are stored as an application modules. These modules are divided into several functional units which communicate between each other and which are linked to platform core.

The first part of architecture is a set of *configuration files*. These configurations include the variables needed to connect the module to the application itself, the interface addresses and port numbers for the teacher and students access. In addition, they also defined the location of each part of the module. For simplicity and usability with the widest area of technology the configuration files are written in the form of a standard text document. The form of their content is based on own syntax and grammar that is chosen to allow simple definition of test case requirements. An example configuration file is shown in Figure 3. In this case, the sense of this configuration file example can be unclear, but it is necessary to bear in mind that the close relation between the configuration and a given lesson is covered within this setting.

Another important part of each module is associated with *teaching materials*. This is the content of lectures and exercises. They are not being exclusively focused on textual materials, but also the animations and another multimedia data can formed the content. Of course, the

scripts and application codes illustrates the topic in practice are stored there.

Next part is an interface module for each user especially students. Mostly it is formed by *simple applications* running inside a Web browser. The interface for each module can have its own graphic design easily changeable using styles. Teachers use the administration interface of whole platform primary. It may be used internally for them, or they can present it to the students to gain a better understanding of the ongoing testing or real-time usage of educational platform. Teacher can also use and present a testing part of lesson (interface for students) and illustrate examples and procedures to be undertaken by students. There should be a couple of examples based on mentioned interface that is ready to offer the interactive form of test of knowledge gained from lectures and materials on those technologies.

The last optional part of each module consists of a *directory containing the default state* of the databases and other data used in testing. These allow semi-automated recovery of the starting conditions of the tasks for quick and efficient repeating of lessons.

The reason why the modules are divided in this way is that each lecture can be easily and effectively updated. Internet technology and its environment are rapidly changing and our platform should be able to react to that without a huge intervention of the programmer. Obsolete technologies are being replaced and current technology problems and their solutions need to be presented to the students.

### C. Technical solution of the events capturing on the server side

From the technical point of view, the very important functionality of the platform is to capture and analyze communication between server/platform and students [3]. The utilization, feedback and evaluation can be performed thanks to this. The platform itself is responsible for that feature.



Figure 5. Scheme of the server structure

The platform, via a special application written in .NET technologies, is able to monitor the requests that users send to the web server (in this case we use Apache as a web server). The basic scheme of platform structure during the testing is depicted in Figure 4. The application is also able to track information on the facilities which are currently communicating; it is able to detect the IP address, MAC address, browser type packet, the destination and source port of the packet [5]. It is also necessary to be able to put Apache modules to its original state and lead through the logs of all events. Finally, this application can read the data directly from the Apache

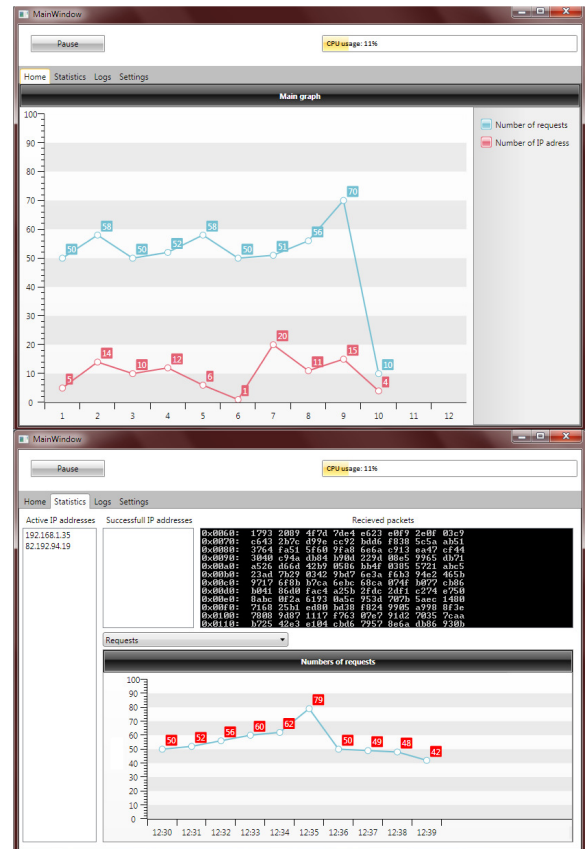


Figure 4. Administration application screenshots. The chart of server utilization and communication snipping is depicted.

application. All of these things what the application is able to do, can be displayed as charts, statistics or data tables. An example of server utilization chart is presented on Figure 5.

How it is mentioned above, the ability to capture communication and server state is crucial for our approach. This can be performed by a several ways on the server side:

- Incoming packet sniffing – it is based on some special components WinPcap and WinDump. These components offer functionality to read a data directly from the network adapter, parse it and filter this data based on some conditions.
- Information reading directly from the Apache application – it is based on Apache extended mode which generate special XML file with real-time operational information.
- Information reading from log files – Apache server, as well as another internet servers, creates log files included a huge amount of data about requests, responses, errors, etc. It is also an interesting source for users' behavior and communication analysis [6].

### IV. CASE STUDY – PLATFORM USAGE FOR WEB APPLICATIONS SECURITY TOPIC

The current most common web security problems were included in the pilot version of the project. This selection of problems was motivated by the real situation of the Web applications area. The aim is to provide not only

information, but also practical examples to test problems discussed in terms of security of web applications and subsequent attacks on them. It is not necessary to introduce the topic the depth, but it is focused on the right directing the students within this subject. The following text describes a standard process of teaching based on our platform [2].

Teacher turns on the laptop (for presentation) and the device that acts a server role. Runs the platform on the server side and chooses lecture and materials. This starts the configuration process within the server environment. This process consists of system variables setting, ports configuration, starting of the listening of incoming requests and, optionally, deployment a database structure designed for testing. After this initial step, students can begin to connect to a running application interface – standard web page within web browser, see Figure 6.

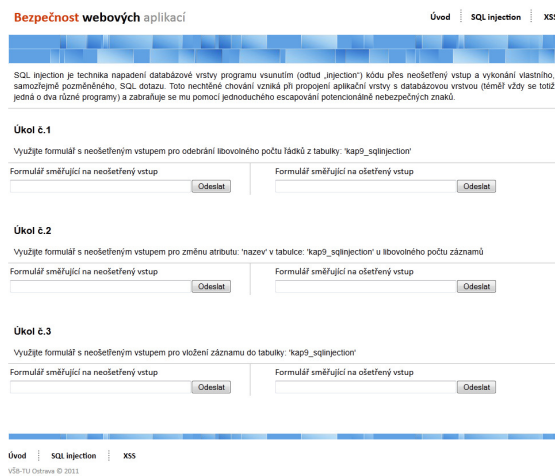


Figure 6. Screenshot of user interface (web pages) for students and their tasks (only in Czech version now).

Teacher can use the administration interface and start the presentation of a given topic.

The first topic is the SQL injection attack. After basic theory introduction the students can try to perform this attack within the closed and secured environment of educational platform. Students select the topic within their interface and get to the screen with the first set of tasks. The first exercise is a challenge to use untreated form input to write a query that will remove the record from the test table. During the students' testing the teacher is able to check the attempts of students in real-time thanks to administrative interface. Also the administrative interface offers information on Web server workload, current data in the database and its state and a list of queries that students are sending to the database server. At the moment when a successful attack is executed, the server can automatically interrupt the connection of all users and the information on attack can be presented. Now, the teacher can illustrate the successful attack and analyze it, as well as discuss the unsuccessful attack of other students.

Subsequently, the recovery of database to the initial state is performed. Other tasks to test knowledge of SQL injection can be based on adding and editing records in the database, deleting the entire database, create a copy of each, etc. The basis for these types of tasks is a form with untreated input. The knowledge and practice how to

realize attack are perfect background to explain the approaches to secure the forms.

The second set of tasks is aimed at Cross site scripting (XSS attacks). The first task is to use an unprotected form input element to save attacker own malicious code that causes the firing of JavaScript method on the target page. This code is stored to the database and it can be generated as a part of regular web page content for another users. This can be dangerous with respect to power of JavaScript. To determine the successful attack the platform uses a regular expression applied to query that checks whether the input contains all necessary elements to induce the desired method. These elements are defined within the configuration of this task. As in the previous case, after successfully testing there is a time for illustration or discussion. Also, the database returns to its original state.

Of course this is just one of the scenarios constructed on our educational platform. The above examples show that the students will be able to test their knowledge and skills directly on the real server environment without any risky behavior within real operational environment. The result is that the students can learn how to secure the scripts and forms by interactive way.

## V. CONCLUSION AND FUTURE WORK

The educational platform for Internet technology is a new interactive way to bring the topics closer to the students and let them to test it based on examples that are ready for them [4]. The innovative approach of this solution is to deploy the application not on the level of the conventional practice, but especially in the context of interpretation lectures. This offers the teacher a simple tool, which contains everything needed to teach this dynamically developing area.

The current state of this project is in a pilot phase with massive development necessity. However, the general concept and prototype of the platform is already formed and it is ready for next extended implementation. The goal of our effort is to deploy this platform to the teaching of mostly all topics included within the Web applications development syllabus. This should be also the experimental operation of our platform in the real educational world. During this initial operation we would like to identify possible shortcomings and subsequently we want to share our platform both with professionals and students. Our aim is to provide innovative and effective tool for increasing the interactivity of the technologically based lessons. Also, the platform would be a basis for the students to start developing Web applications and to avoid common mistakes. It is good way how to put their practical skills to upper level already during the study process.

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