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Development of the Web-Game-Portal focused on Serious Games for Elementary School Pupils

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Abstract

The main purpose of the present paper was to design and develop a web portal that would store intelligent educational games aiming to eliminate cognitive shortcomings in elementary and secondary school pupils. The design of the portal was based on a previously implemented project that was aiming to find out the differences in cognitive levels among elementary and secondary school pupils in five selected subjects. The tests were carried out on a sample of pupils in the border region between Slovakia and the Czech Republic. The evaluation of these tests revealed specific shortcomings in specific cases. On this basis, we decided to create so-called serious games. For the purpose of storing these games it was necessary to create a portal that would contain them.

Keywords:
Web-Game-Portal
Serious Games
Architecture
Elementary Pupils

1 Introduction

The development of web technologies enabled developers to create complex web applications that have a positive impact on the end user. Thus, a standard user may very easily and comfortably access a large amount of information. The direct advantage of modern web portals lies in their ability to improve and enhance everyday human activities.
The word "portal" comes from the Latin word "porta" meaning a door or a gate. Compact Oxford English Dictionary defines "portal" as "a doorway, gate, or other entrance, especially a large and imposing one", also listing its second meaning from the area of computer understanding as "an Internet site providing access or links to other site". We began to encounter the term "web portal" in the beginning of 1990s. The portal www.oreilly.com presents a more extensive definition of the word - according to the Portlet Specification, "a portal is a web application that commonly provides personalization, single sign on, content aggregation from different sources, and hosts the presentation layer of information systems. Aggregation is the act of integrating content from different sources within a web page." [1], [2]

Following the results of the research, our aim was to develop an educational portal that would concentrate educational games in one place so that it helps to eliminate the largest cognitive shortcomings of elementary and secondary school pupils in the selected subjects.

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2 Reasons of creation of the Web-Game-Portal for Serious Games

Improving the quality of education in every country is reflected in the growth of national economy. If leaders of the country preferred the need to build quality of educational system then the support of educational and regional projects is one of the possible solutions to contribute to this goal.
Project leaders were: Ostrava University in Ostrava (principal investigator), Trnava University in Trnava (the main cross-border partner) and Methodology and Evaluation Center in Ostrava. The project was funded 85% from the European Union ERDF (European Regional Development Fund). Fund designated for economic and social development of the European Union (its member states) aimed at reducing disparities between disadvantaged regions to supporting economic growth, increasing competitiveness in the employment.
From September 1, 2008 to August 31, 2011, a research study led by Martin Malčík called "Diagnostics of the state of knowledge and skills of pupils in the Czech-Slovak border region with focus on their development" was conducted. The study focused on examining the knowledge of elementary and secondary school pupils in the border region of the Czech Republic and the Slovak Republic. Project involved more than 200 primary and secondary schools (including grammar), of which 155 schools from the Czech Republic and 45 schools in the Slovak Republic. A total of 6,231 students tested. Testing could only attend school (primary and secondary) in the border region SR (Schools from Trenčín region, Trnava region and Žilina region) and the CR border (Moravian region, Zlín region, South Moravia region). Other schools from other regions were not included in the project. The project was divided into two stages of testing:

- testing input and
- testing output.

After passing the test was carried out comprehensive analysis and evaluation of admission testing of pupils and students of schools involved in the project. Test results were analysed by multivariate statistical test (ANCOVA, MANCOVA) correlations (Pearson). According to the analysis that the project carried out by Paul Prokop. Differences in test results between the SR and CR, as well as differences between the sexes overall results were not significant [3]. In some subjects, however, significant differences were noted. E.g. differences in the results of physics at secondary schools were quite clear – the boys consistently achieve higher average scores than girls.

3 Development of the Web-Game-Portal

On the basis of the above, our aim was to design and program the web portal that allows storing serious games for elementary and secondary school pupils for the purpose of fixating the learning content from the given area for which the game has been designed. The portal will contain games that may serve as an additional form of education.
In view of the characteristics of the proposed portal, its basic features include:

- **Security** – is a priority when developing a portal designed for users. They have to feel sufficiently secured against possible attacks when visiting the portal without being unnecessarily limited.
- **Responsiveness** – the user interface of the portal behaves "appropriately" on every device regardless of the screen size so that it is be able to offer its users carefree room for education.
- **Speed** – responses of the portal should be always very quick regardless of its visitor load. The portal speed can't restrict users' work.

3.1 The philosophy of the design of the Web-Game-Portal

When creating the design of the Web-Game-Portal, we followed the results of the analysis of selected Slovak and foreign portals. One of the largest shortcomings that we were trying to avoid was mostly the absence of web portal support for mobile devices. We based our web portal on HTML 5 technology with the emphasis on having a simple and stylish modern user interface in order for the portal to be:

- **responsive** - by means of which we enhanced the attractiveness of the portal for a wide group of mobile device users.
- **open** - in order for the web portal to be able to store as many serious games as possible, it was necessary to create sufficient room and enable developers to upload their own games to the portal.

Using the portal doesn't require registration. However, registered users may rate and comment on applications. Applications uploaded by developers will be manually controlled by administrators before they appear on the portal. The decision to allow anyone to register and upload their own applications brings a lot of problems from the security viewpoint. It is very important that users feel secure on our portal, that's why we decided to require only a minimum amount of personal data from users such as email address, age, year of study. Furthermore, we will monitor IP addresses and requests for login attempts:

- **simple in terms of appearance** and
- **quick in terms of access to applications.**

3.2 The structure of the educational portal

Before we designed web portal, we realized comparison research on characteristics of educational web portals that would help us in the development of Web-Game-Portal designed by us. We chose the criteria to analyse the selected web portals as: the number of visitors of the web portal and its topicality. We use Alexa website analysis tool for obtained the popularity of selected portals as traffic, page views per user, session length, frequency of visits old and new users. These data are evaluated also in comparison with the site, which the company Alexa in the database. [5]
Alexa company was founded in 1996 and offers high and deep analytical previews. They also provide analysis of web portal based on attendance. The second criterion was the number of materials to the site, we found that there are many portals, but which contain only the minimum educational applications.[5]
There are many techniques and media, as well as services that support e-learning. World Wide Web is undoubtedly one of them. It is used as the communication tool, which "frees the pupils" while it connects them to each other, creating learning communities. [6]
Our aim was to design the simplest possible portal structure. After loading the portal, we immediately reach the main page with the menu and navigation through individual portal sections on the left. Most of the remaining space is taken by games which are split into columns. From the main page, it is possible to load a page with a more detailed description of the game by clicking on its image or start the game by pressing the PLAY key.
An administrator has a privilege of editing applications. The editing option will appear on the application with a page for modifying it. Moreover, administrators will be given a separate option on the main navigation to see which applications are awaiting authorization.
The structure of the portal is very simple. We try not to embed the portal into itself unnecessarily so that it is not too complex and so that it does not have a complicated navigation. The access to games is almost immediate from each section of the portal.

4 Web portal implementation

In the following chapter, we will describe the transformation of the design of a theoretical model of a web portal into its real form. We will start with characterizing the creation of the basic framework and then we will further elaborate on creating the database and on important PHP and JavaScript functions. However, due to the extensive nature of our portal we will describe only the most important processes, functions and the way they are created.

4.1 Creation of the main page

The basic pillar of the creation of our web portal was the creation of the main page. To this end, we used HTML 5 and CSS technologies. As the content of our site will be dynamic, we only need to create a framework into which we will dynamically insert content from our database. After that, we needed to make sure that our site will be usable for mobile devices. We decided that the most effective way of achieving optimal responsiveness will be to use CSS framework Bootstrap. It is rather easy to implement this framework.
When creating the web portal menu, we used the feature of PHP language and created the menu in a single PHP page that we call using the command include. This way, we make sure that the menu always stays the same and we do not have to change navigation on every page individually when editing it. The menu design

includes: logo, search, individual categories of classification of games, profile setting options and, depending on the user rights, options of uploading or editing applications.

The rest of the page is the background (which will display the content itself). If we are not in the sections for uploading games, editing profile settings or at the specific description of a unique game, this part will largely consist of games themselves. Therefore, we used the feature of the bootstrap framework and created a grid. We divided the section of the page horizontally in thirds that will display applications with their image, description, link to play and rating in the form of stars. Bootstrap allows up to 12 columns across the page. Special classes are created which divide the content according to our needs. Also, classes are divided based on whether a mobile or desktop device accesses it. We put games into the following class .
The grid system is very effective, in particular with the responsive approach to the issue. The screen size does not matter to us, as we split the section into parts, which represent a percentage, so everything will only appear larger on a larger screen, but the proportions will remain unchanged.

4.2 Portal testing

For the development of our portal, we used the program WAMP which enabled us to easily access the local server and perform simple operations with PHP scripts and MySQL database. However, we needed real conditions for testing our portal for the first time. We rented a web hosting space and uploaded our portal to a server. We created a database and were ready to start with our observations as to how our portal behaves in real conditions.

No problems occurred when uploading the portal and moving the database and the portal appeared to be fully functioning at first sight. We tested the registration of a new user, login, uploaded a test game and observed dynamic loading of games. This was, however, very slow in real server conditions in comparison to our local conditions. Loading a few sample games took a few seconds, which could mean a couple of minutes when loading a large amount of games.

For testing the security, we have prepared penetration tests in cooperation with a commercial company. However, we want to use them to their full potential, so we are preparing and testing the portal on our own at the moment. Once the portal is ready, we will use the results of the tests to eliminate hidden shortcomings of our portal.

Fig. 3: The structure of the Web-Game-Portal

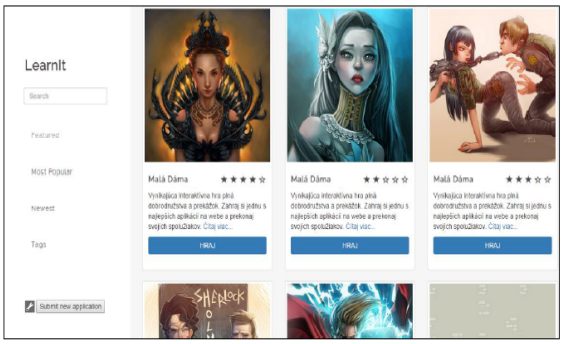

Fig. 4: Design of the Web-Game-Portal - implemented template

5 Conclusion

The purpose of our contribution was the design and implementation of a portal storing educational games. Games will be available for free download or online and will enable pupils-users to eliminate their cognitive shortcomings in the specific subject area in a non-formal educational way. By analysing the Slovak and foreign educational portals, we found out about the functionality and shortcomings of individual portals, which we

used when creating our design and during the implementation process.

In terms of design, we defined responsiveness as one of the key features of our portal. We achieved it thanks to modern web technologies and a quality framework that we used. Thanks to the fact that our portal is responsive, it can be fully used on mobile devices. As for the security, our approach had to be very cautious and it will be the subject of further development of the portal that will be constantly exposed to thorough testing. In the near future, we plan to cooperate with an external company specializing in penetration tests that may help us reveal possible shortcomings of our portal. Our portal is at the stage of development and its complete functionality and optimization will require a certain amount of time.

Besides it would be great if the grid or cloud systems can be used to dynamically allocate resources during the web portal in order to minimize total maintenance costs. [7]

Very important will be obtain some results about impact of communication among pupils and teachers during use of the game. It will be important to find out what kind of role or activities will have a teacher. [8, 9, 10, 11, 12, 13, 14]

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