

E TESTING ONLINE PLATFORM FOR ALBANIAN EDUCATION SYSTEM

**A THESIS SUBMITTED TO
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OF
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BY

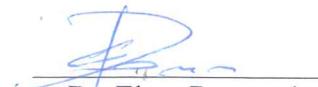
JULI LOLOCI

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FOR
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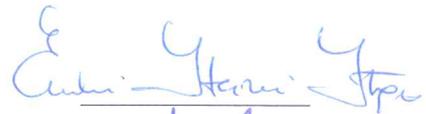
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This is to certify that we have read this thesis entitled “**E Testing Online Platform for Albanian Education System**” and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.


Dr. Elton Domnori
Head of Department
Date: July 08, 2016

Examining Committee Members:

Dr. Endri Stoja (Computer Engineering)
Dr. Albana Halili (Computer Engineering)
Dr. Elton Domnori (Computer Engineering)





I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name: Juli, Loloci

Signature:

ABSTRACT

E TESTING ONLINE PLATFORM FOR ALBANIAN EDUCATION SYSTEM

Loloci, Juli

M.Sc., Department of Computer Engineering

Supervisor: Dr Albana Halili

TYK (Test Your Knowledge) is an online platform which has the sole goal of boosting education and e-learning with innovative ways. Every user will be invited to explore and gain experience in many fields, and will be challenged with exciting goals and achievements. TYK will be the first platform in Albania that will offer online exams. It is in English language and it is an interactive platform suitable for every user. The main goal of this platform is to have a large variety of courses in different fields in order to satisfy different background users that are having difficulties with traditional ways of learning.

Keywords: E Learning, E Testing, Online Platform

ABSTRAKT

PLATFORMA ONLINE E TEST PER SISTEMIN EDUKATIV NE SHQIPERI

Loloci, Juli

Master Shkencor, Departamenti i Inxhinierisë Kompjuterike

Udhëheqësi: Dr. Albana Halili

TYK (Test Your Knowledge-Testo Njohurite e Tua) është një platformë online e cila ka për qëllim të nxis kalimin nga edukimi tradicional në atë online. Në këtë platformë mund të regjistrohen të gjitha grupmoshat e të rinjve dhe të përfitojnë nga shumëllojshmëria e dinamikës që platforma ofron. TYK do të jetë e para platformë online e cila është e konceptuar me teste. Qëllimi kryesor i kësaj platforme është të përmbushi kërkesat e të rinjve në shumë fusha edukimi, për tu përqsasur me metodat e reja që ofron teknologjia.

Fjalët kyçe: Platform Online, Testimi online, Mesimi Online

Dedicated to.....

ACKNOWLEDGEMENTS (optional)

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CHAPTER 1

INTRODUCTION

During the past years technology has grown so fast, and has influenced every single field in medicine, military, industry but also in education. Since the future of each country is depending more and more from the well-educated and intelligent young people, a lot of effort and money is going towards education, by both public and private sectors. In the recent years in Albania, the most important evolutions were the opening of private universities and integration of Bologna System which brought higher quality of education and integrity. But new techniques of learning have developed like e-learning and e-testing. E-learning is a computer based educational tool or system that enables students to learn anywhere and at any time. It is implemented already in Albania in online certificates, in different job trainings but not yet in academic institutes like universities.

1.1. Brief History

In 1924, the first testing machine was invented by Sidney Pressey [1] (psychology professor at Ohio State University). It was a typewriter with a window that showed one question with four answers (Fig.1). The user pressed the key to the answer to move on to the next question. The answers were recorded on a counter to the back.



Fig 1. Pressey Testing Machine

Later on, BF Skinner [2] a professor in Harvard invented the teaching machine based on Pressey model but with some different features. The main difference of Skinner proposal was that the student should prepare his response not just choosing the right answer. In 1960 the first computer-based training program was introduced and it was called PLATO (Programmed Logic for Automated Teaching Operations) (Fig.2). It all started as a project at the University of Illinois at Urbana-Champaign and was eventually commercialized in the 1970s by Control Data Corporation. Later over the years, the system developed into a sophisticated computing infrastructure consisting of smart workstations that could run games, chat rooms, and courseware. It was also used for education and training by many schools and universities, corporations, and by several branches of the U.S. government, including the military [3].



Fig 2. Plato Example

In the same year Suppes and [Richard C. Atkinson](#) (the future president of the [University of California](#)) tried to experiment teaching math to schoolchildren in the Palo Alto area using computers. They used the specialized [IBM 1500](#) Instructional System which was initially prototyped at the Brentwood Elementary School in East Palo Alto California by Suppes and it was also supported in 1964 from the U.S. Department of Education to the Institute for Mathematical Studies in the Social Sciences at Stanford University. The students first used the system in 1966.[4]

The creation of Internet was also an important part of the history and it was ARPANET (Advanced Research Projects Agency Network) that founded the packet switching network and the first network to implement the protocol suite TCP/IP.

In 1980's the first MAC enabled individuals to have computers in their homes making it easier for them to learn about any subjects and develop certain skills.

Then, in the following decade, virtual learning began to rise even more and it was widely used by the majority of the population. People started to use online information

and e learning opportunities for variegated purposes. By the early 90s several schools started delivering online courses, making the most of the internet and bringing education to people who wouldn't previously have been able to attend a college due to geographical or time constraints. This innovation brought new opportunities but also helped the educational system to reduce the costs of distance learning which led to a wider audience. In the 2000's, businesses began using e-learning to train their employees but in the same time people started searching on internet for online courses to improve their skills and expand their knowledges. At home individuals were granted access to programs that offered them the ability to earn online degrees and enrich their lives through expanded knowledge. Below in Table 1 is shown the timeline of computer history.

Table 1. Timeline of Computer History

1924	The First “Testing Machine”	Ohio State University professor Sidney Pressey invented the “Automatic Teacher”, the first device in electronic learning.
1954	The First “Teaching Machine”	The professor of Harvard BF Skinner creates the “Teaching Machine” for use in schools.
1960	Computer Based Training	PLATO-Programmed Logic for Automated Teaching Operations-was the first computer-based training (CBT) program. It offered drills and the ability to skip questions. The cost 12000\$
1966	C.A.I. in Schools	Stanford University psychology professor Patrick Suppes and Richard C. Atkinson began using computer-aided instruction (CAI) to teach math and reading to young children in Palo Alto elementary schools.
1969	Arpanet Heralds Internet	US Department of Defense commissioned ARPANET to create the Internet
1970	Computer Mouse & G.U.I	Computer mouse and GUI are invented, helping to define “Modern Computing.” Computer-based training (CBT) begins at the New Jersey Institute of Technology
1980s	PC Begin with the First Mac	Personal computer era begins with Macintosh. Online communities begin sharing information, slowly towards elearning.
1990s	The First “Digital Native”	The first “digital natives” are born. Email takes off. It’s the down of a new era in learning. Virtual learning environments begin, and “elearning” becomes a widely recognized term.
2000s	Businesses Adopt eLearning	Businesses begin rolling out elearning courses as a central way to train workers. Authoring tools are more accessible than ever, and a wide range of online learning opportunities are available.
2010+	Social Online Learning	A new era of elearning inspired by social media builds momentum. Youtube, Twitter, Skype, Facebook. Opportunities to connect, share information, and learn from each other are found everywhere.

1.2. What is eLearning

E-learning is a computer based educational tool or system that enables students to learn anywhere and at any time. In most cases, it refers to a course, program or degree delivered completely online.¹

E learning can be described in many terms like online learning, distance education, internet learning, online courses and many others. It can be defined especially as a course taken via the internet by users in different places. The information is not delivered via DVD or USB in this case, but the users usually can download the materials or the notes of the teacher from a specific website.

E learning is an interactive way of learning because users can communicate with teachers, professors or other students in the course at any time. It is also an easier way of teaching because the teacher can record the lecture only once and upload it to the specific website or platform.

1.3. Benefits of eLearning

eLearning techniques are still being analyzed because the ability to soak up information is different in different individuals; some learn with strong memorization, repetition or writing and some learn visually; some prefer to learn by themselves, whilst others need someone to guide them all along the way; some are extroverts and feel comfortable talking in front of people, whilst others are introverts and are afraid to communicate openly inside the classroom. But eLearning responds to those needs using different tools

¹ http://www.elearningnc.gov/about_elearning/what_is_elearning/

and also there are other benefits that affect not only the students but lecturers also. Some of the outstanding advantages are listed below:

- **Reduced cost** is the most important benefit in adopting eLearning. This factor includes eliminating the costs associated with the instructor's salaries, classroom or building rentals, and student travel, dwelling place, and meals. The reduction of time spent away from the job by employees may be the most positive offshoot.
- **Learning times reduced** an average of 40 to 60 percent².
- **Consistent delivery** of the materials is possible with unsynchronized, self-paced eLearning.
- **Expert knowledge** is communicated, but more importantly captured, with good eLearning and knowledge management systems.
- **Proof of completion and certification** can be automated by the system.
- **Eco Friendly** Paper free usage because all the materials and testings are online.
- **On-demand availability** it is much easier for students to complete trainings and courses conveniently at off-hours or from home.
- **Self-pacing** for slow or quick learners reduces stress and increases satisfaction.
- **Interactivity** engages users towards the course because online courses are less stressful than traditional learning.

² Brandon Hall (*Web-based Training Cookbook*, 1997, p. 108)

1.4. E Testing

Testing is the most essential part of the learning process because students must be evaluated for their knowledge. Recently with the development of technology, even testing techniques have evolved by going online. The topic of online testing has been in focus of many studies and researchers which made possible the implementation of these methods in many universities, especially in online courses. In order to implement the online testing, first we need to know what we will achieve by this method and its benefits. Below there are listed the advantages and disadvantages of using such methods:

- ***Better learning system:*** If a student is having difficulties about understanding a part of the course, he can have immediate access to supplementary, unlimited and mostly free material online.
- ***Objective assessment:*** Since the right answers are automatically generated in the program, there won't be debates about the grades and the results.
- ***Immediate results:*** after submitting the exam, students can have the results right after the test and check for the correct answers. This also brings to another aspect:
- ***Reduction of Evaluating Time:*** the evaluating part is done automatically after submission.
- ***Accessible for students with disabilities:*** Students with disabilities have some assistive programs built into their computers, therefore it is easier for them to access online tests rather than hand written tests.

There are also some disadvantages that can be improved but they still exist, for example computer hardware or software. These may be subject to freezing and crashing; in the test setting, time can be wasted when computers have to be restarted or changed. The computer screen for longer tests, it may be more tiring to work than on paper. The questions in e testing can be only with multiple choices, in order to have immediate

results, but there are some academic fields that require their exams to have cognitive thinking of the student and in this case they can't use e test. Table 2 as shown below provides the summary for all the advantages and disadvantages of e Testing method.

Table 2. Advantages and disadvantages of E Testing³

Advantages of E Testing	Disadvantages of E Testing
Better learning system	Hardware problems
Objective assessment	Software problems
Immediate results	Difficultes regarding cheating
Reduction of evaluating time	It requires time for the teacher to upload the questions in the system
Improved accessibility for students with disabilities	Fewer types of questions
Reduced paper usage	Testing software may be expensive

³ Hovland, E. (2005, March-April). Online testing – a look into the near future. Media Methods, 13, Retrieved from www.media-methods.com

CHAPTER 2

SOME APPLICATIONS OF E TESTING

2.1. Some Applications of E Testing

There are a lot of applications regarding eLearning and online assessments but we will focus more on three main programs which are MyWebExam, Quizstar and Code School.

MyWebExam

It is an online paid platform to create professional-looking online courses and tests about any topic (Fig.3). The 3 main tasks of this platform are:

- Create online tests and quizzes
- Create eLearning courses
- Track progress and measure results

MyWebExam[5] is used in different fields like:

1. Trainings for employees.
2. Studying in distance
3. Evaluation of employees.

This platform can support images, audio and video for a better learning method. These files can be uploaded by computer libraries but also by online platforms like Youtube and they are stored in the database of the platform. Businesses can upload their logo for their trainings. Tests can be made with multiple questions or check box questions.

Benefits:

- The platform is very easy to use, and guides each user step by step.
- Since it is a web based it is very easy to update and can be accessed by any browser.
- It is not expensive.
- It supports different languages and time zones.



Fig 3. MyWebExam webpage

QuizStar

QuizStar is another web based platform that offers the possibility to create online quizzes and organize results (Fig.4). Quizzes are made with multiple answers, True or False and short descriptions. It is offered in many languages. It can be accessed by any computer with network. The results can be visible after any quiz.

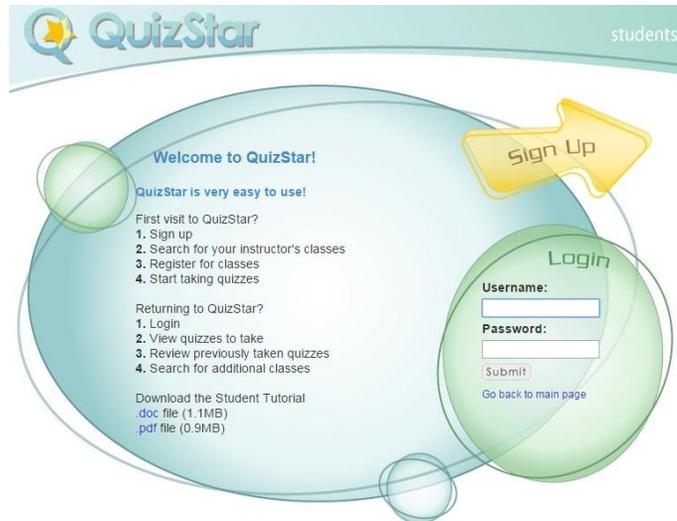


Fig 4. QuizStar webpage

Code School

Another platform is Code school [6] which teaches web technologies in the comfort of the browser selected with video lessons, coding challenges and screencasts (Fig.5). It covers different courses like JavaScript, iOS, HTML/CSS, Ruby, and Git. Each course is built around a creative theme and storyline so that the users feel like they are playing a game. This platform offers a new learning technique by combining gaming mechanics with video instruction with the aim to make learning educational and memorable.

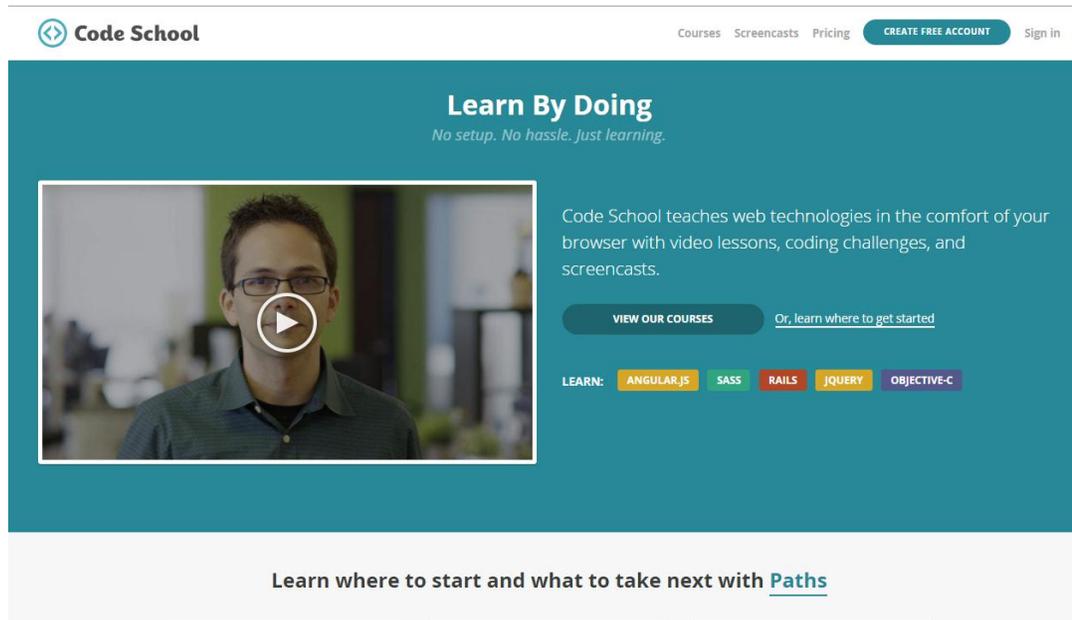


Fig 5. CodeSchool webpage

2.2. E Testing in Albania

Online testing in Albania is already used in some sectors, like the license driving test and in some English online tests like Toefl or SAT. These online tests are made in different institutions, where you can enter by having the ID card and there are supervisors who manage the tests, so there is no cheating and frauds.

2.3. Main Technologies for e Testing

HTML5 / CSS3

The latest versions of front-end development used world-wide to structure and modify appearances of the content. HTML 5 was officially standardized by the World Web Consortium in October 2014.[7]

On the other hand, Cascading Style Sheet 3 (CSS3) is the most commonly used styling language used to format the web content. The CSSWG are always bringing innovative and simple ways to style user interfaces, adapting with most common techniques developers use.

Javascript / JQuery

Javascript is a powerful scripting language used to build lightweight application with enhanced user experience.[8] It is also the core language used to build many other libraries, like JQuery, AngularJs, BackboneJs, etc.

JQuery is another library of Javascript commonly used to build animations in a web page which is very easy and flexible to use.

**Both the above mentioned languages are functional languages (not object oriented)*

Wordpress

Wordpress is an online, open source website creation tool written in PHP (Fig.6). WordPress can be downloaded for self-hosted installations from WordPress.org or it can also be used as a hosted service via WordPress.com, also it is an open source which means the source code of the software is available for anyone to study, modify and play with.

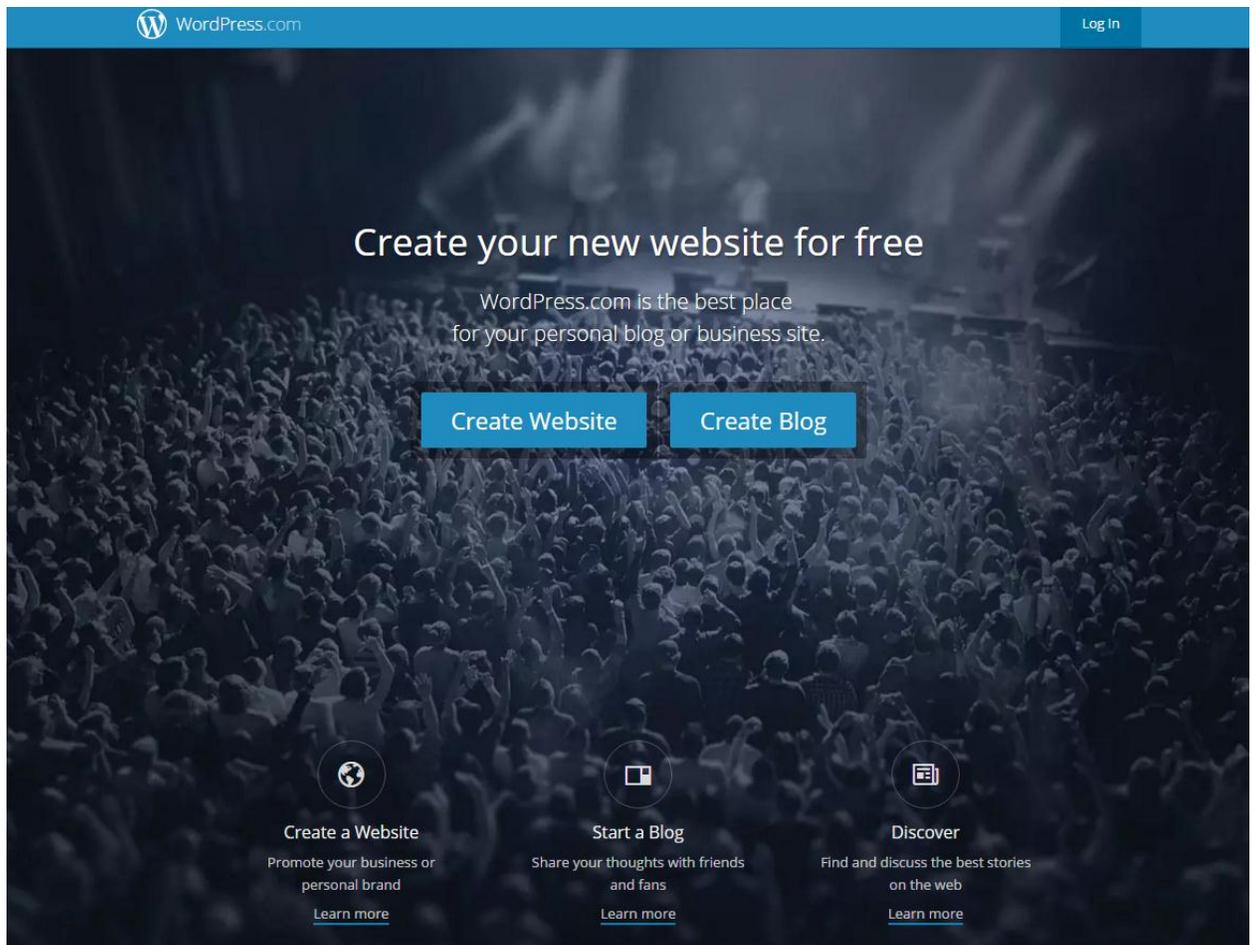


Fig 6. Wordpress webpage

How Wordpress works: First Wordpress needs to be installed in the computer (from cpanel provided by the hosting company or by any FTP Client Software) and then the user log in in the administrator panel. The platform has a dashboard where the website is build. After planning how the website should look than the user searches for a theme that provides his needs and customizes it with the desired background, front image, font sizes colors ect. For any extra feature (despite from the code that it can be edited in the css stylesheet) Wordpress uses plugins, which are bits of software that can be uploaded to extend and expand the functionality of the website.[9]

CHAPTER 3

SOFTWARE CONCEPT AND DESIGN

Analysis and design is a determining factor for the development and future work on a project. A well analyzed and designed project may shorten the coding time and release date. In order to achieve this goal there are some requirements to consider. In our case, we should keep in mind that the application is composed of two parts: website and CMS. Successfully linking these two parts, means having carefully analyzed all requirements and planed the database, which will be described in more details in the following sections.

3.1. Functional Requirements

This platform will offer online education where users (students) will be able to test their knowledge. Professors with different specializations will give online lectures by uploading the materials on the platform. Students will have the possibility to register online to take exams and evaluate them. They will login with their user name and password and after that, they can enroll in the courses presented in the platform.

Usability Requirements

TYK is a web-based platform that can be viewed by different devices. It is designed for educational purposes and is user friendly with a nice and simple interface. Users will be asked to register and login to navigate through the environment of the web platform. On the other hand, the administrator is the only one that knows the link to accessing the content management system. Entering the link on the address bar, a login page will be

displayed. If the correct credentials will be entered and a second-level verification will be passed successfully, then the administrator will be able to edit the content.

Performance Requirements

The user must have a computer, laptop or (any other device), internet connection and a browser to open the platform.

The browser used should be up to date. The problematic browsers are IE7 or older, Mozilla 24 or older, older Chrome

Internet speed should be at least 512 kbps

Supportability Requirements

The Web Platform is very user friendly and easy to navigate. When updates are done, they are nicely added, fitting the structure. Sometimes the structure is programmed to dynamically adapt with the changes in the case of the navigation menu bar.

Security Requirements

Administrator will be able to enter his credentials and access the management panel and he can add all kinds of users and reset their password. The fields are secured not allowing special characters that can be used to write malware scripts, sql injection. Also the password is encrypted in case of attempt of hacking by hashing them. Also, the administrators only will be let known about the link of the login page and will have to pass a second level verification.

Interface Requirements

Users will be able to navigate through the web platform with the help of the navigation menu bar and the interface. As far as they know, they have full access to the web platform. On the other hand, the administrators will be provided with a very user friendly structure and easy to use management panel.

3.2. Non Functional Requirements

Hardware Requirements

A device with network driver installed would be enough.

Software Requirements

TYK is available through all installed browsers.

Security Requirements

Every user' sensitive information is stored encrypted as hash code.

Compliance Requirements

TYK should be compliant and adapts quickly to the device used. This is done by using device-responsive design, which will adapt with device resolution.

3.3. Use case Diagram

The actors that take part in the platform are as follows:

1. Administrator
 - Can edit the test prepared from the teacher
 - Adds Users
 - Add tests
 - Delete Users

2. Teacher

- Creates the tests
- Can edit the tests
- Follows the student performance

3. Student

- Register
- Takes exams
- Get results
- Access on the results from the exams taken

Taking in consideration the role of the teacher for the questions, tests, materials and evaluation of the students, we can give him the role of an administrator.

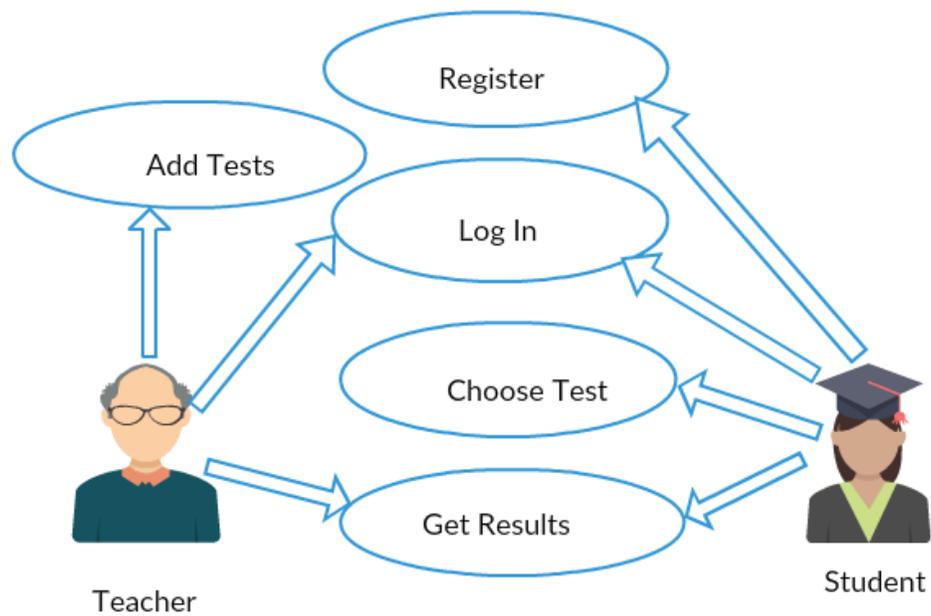


Fig.7 Use Case Diagram

3.4. Database Diagram

The database diagram for the testing part is shown in Fig 8. First the user chooses the quizzes from the list of courses listed in the website. Each quiz has different questions and all the answers. At the end of the test, the user gets immediate results.

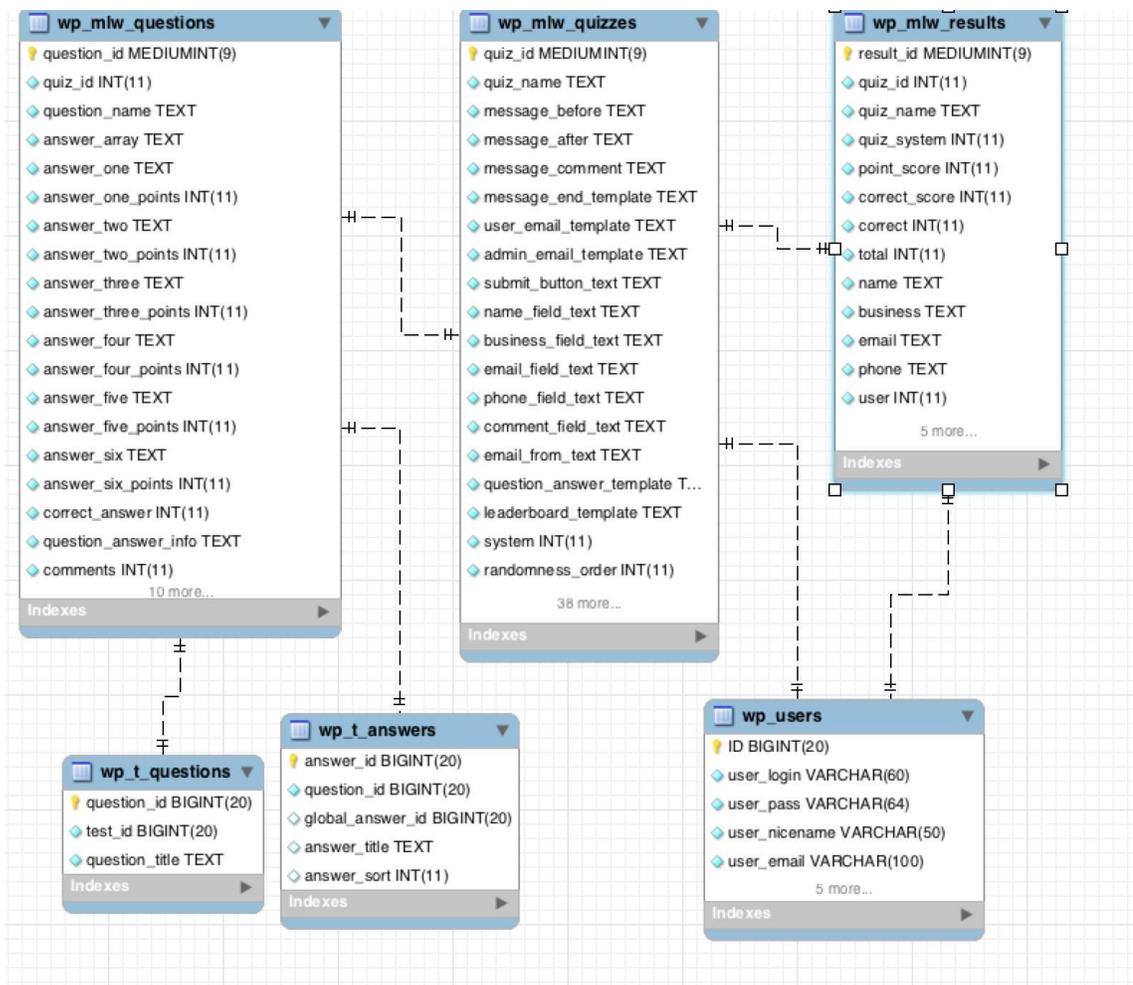


Fig.8 Database ER Diagram

3.5. Physical Architecture

Since the platform is web based, the architecture used is client server (Fig.9). Client-server architecture (client/server) is a network architecture in which each computer on the network is either a client or a server. [10] Usually clients and servers communicate over a computer network on separate hardware, but both client and server may reside in the same system. A server host runs one or more server programs which share their resources with clients. A client does not share any of its resources, but requests a server's content or service function. Clients therefore initiate communication sessions with servers which await incoming requests.

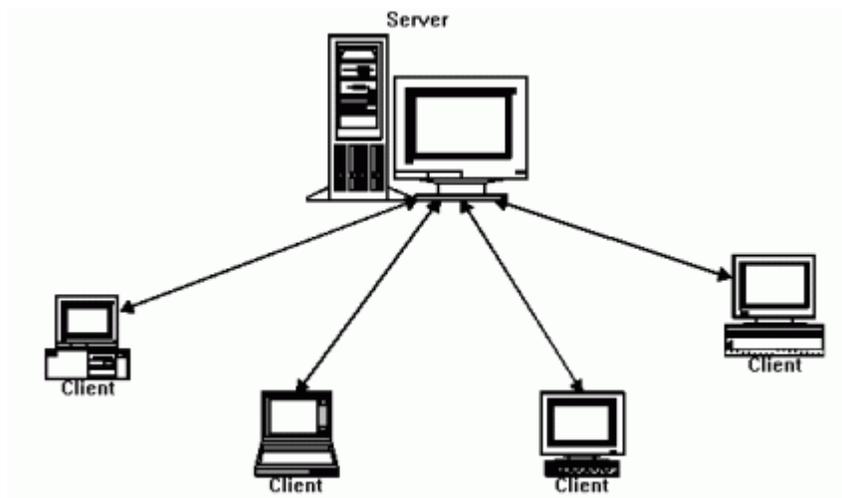


Fig.9 Client server architecture⁴

⁴ <http://www.wildbunny.co.uk/blog/2012/10/09/how-to-make-a-multi-player-game-part-1/>

3.6. Logical Architecture

The platform is divided in two parts, the administrator and the public part. It was chosen this architecture because it offers a high performance and secure system since the parts are divided. Changes can be made in both parts in the same time without affecting each other.

The platform is easily accessible from any computer so there was no need for hardware connection between the systems. The users must only have a computer and an internet connection to access the platform.

CHAPTER 4

PLATFORM DESIGN AND SOFTWARE TESTING

4.1 PLATFORM DESIGN

The platform was designed to be an easy and interactive website for every user (Fig.10). It is also mobile friendly, since now smartphones are designed with high performance and resolution. It has the member's area so users can register and log in, and also some description about the website.

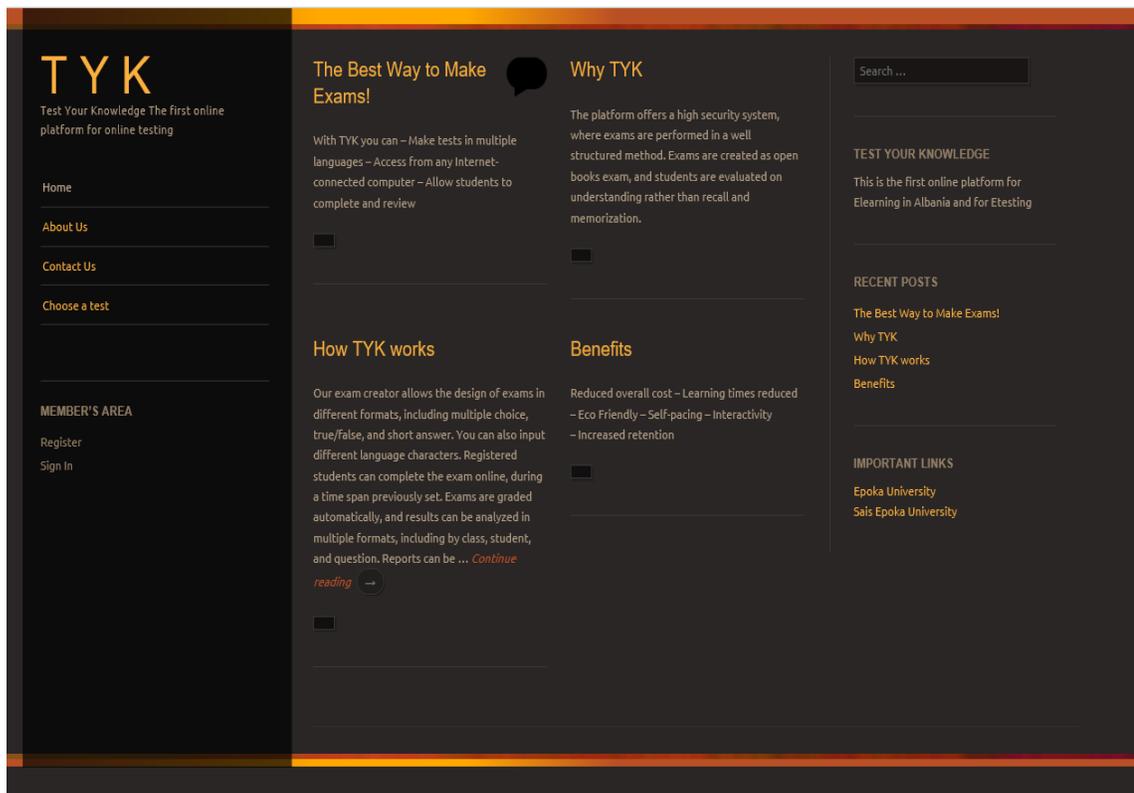


Fig.10 T.Y.K. website

The page Choose a test is easily noticeable but only users that are registered can have access on that page (Fig.11).

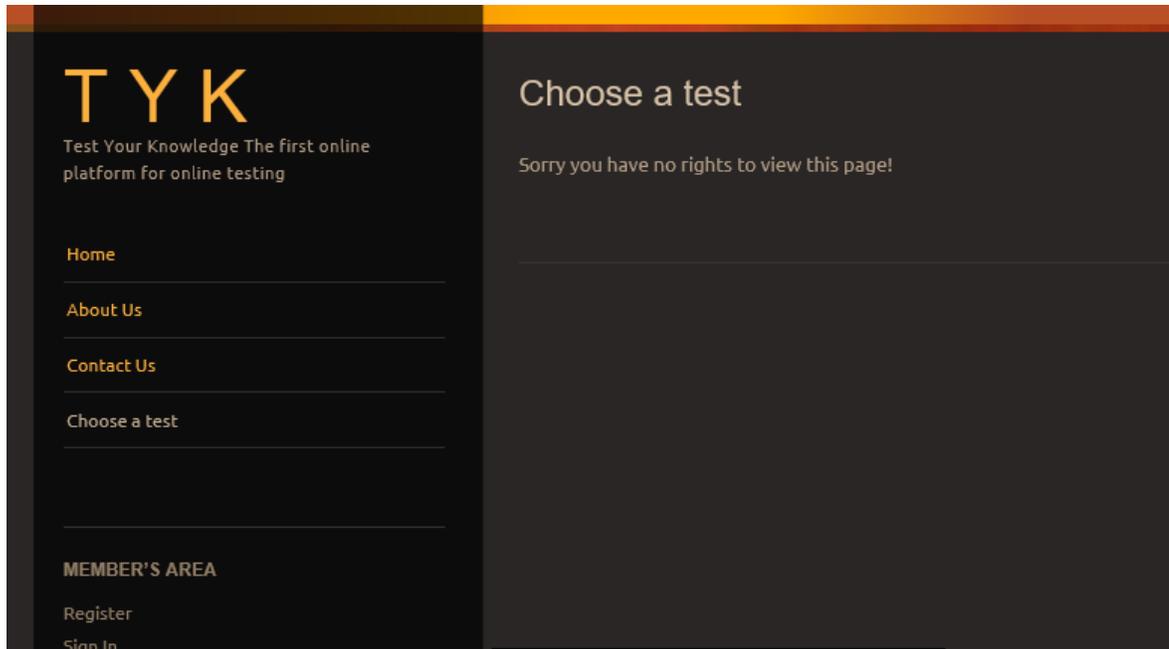


Fig 11. Website specifics

After Sign In users are directly addressed to the tests page and there they will find all the courses with specific tests (Fig.12).

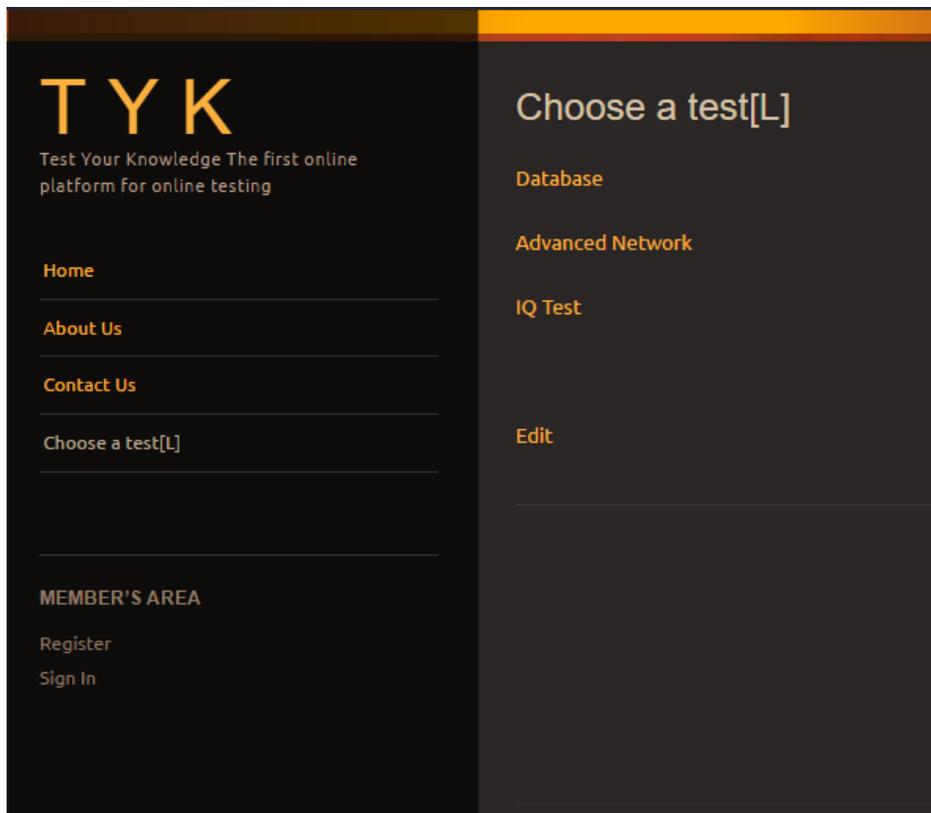


Fig 12. List of tests available

Students can choose from the course name the test, and they will be directed to another page with the test. After filling the required fields like name, surname and email, the user can continue with the test (Fig.13).

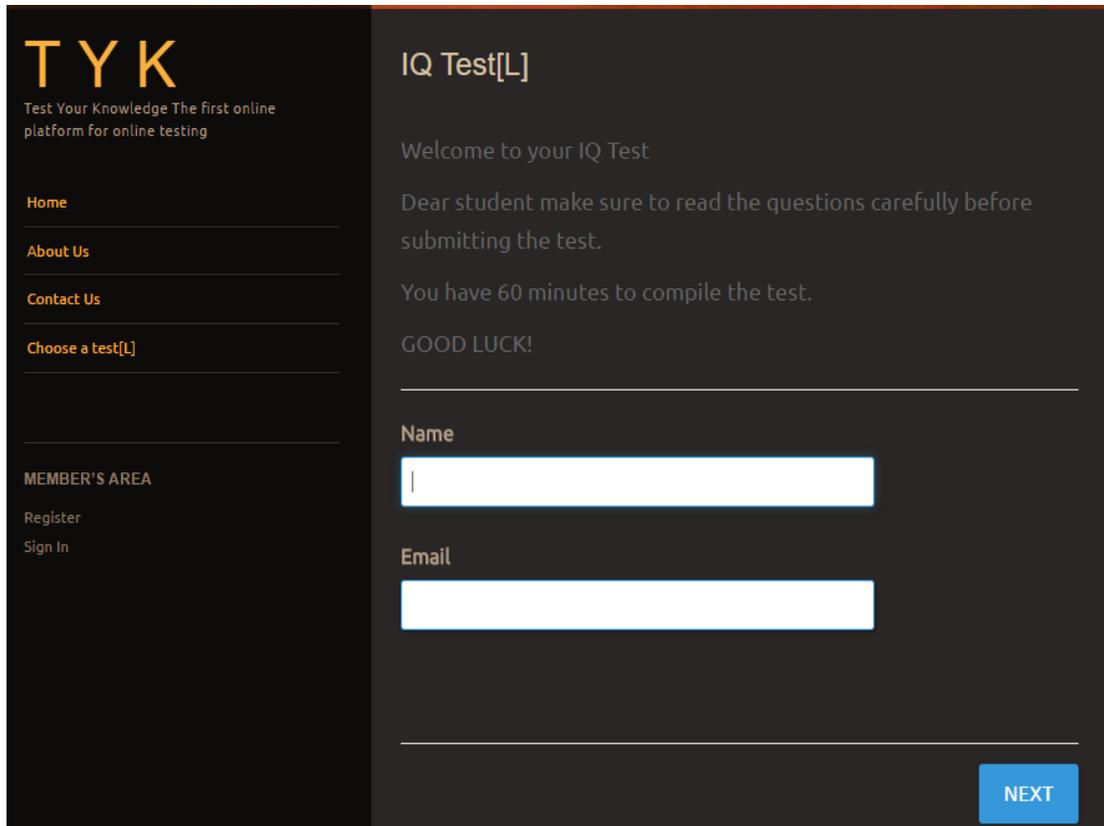


Fig 13. Users Taking the Test

When the user finishes the test, he can submit and he can get immediate results with the correct answers.

4.2 SOFTWARE TESTING AND RESULTS

To test the software, we created a sample test with some random IQ questions and we invited some users to register and take the test. The test was completed by 13 subscribers and they had 60 minutes to compile it. At the end of the test there were revealed to the users the points taken and how many correct answers were given. Below we demonstrate a chart with the results (fig.14.) and the performance of the users. The wrong answers can be easily accessed by the administrator and they can be demonstrated upon request by the user.

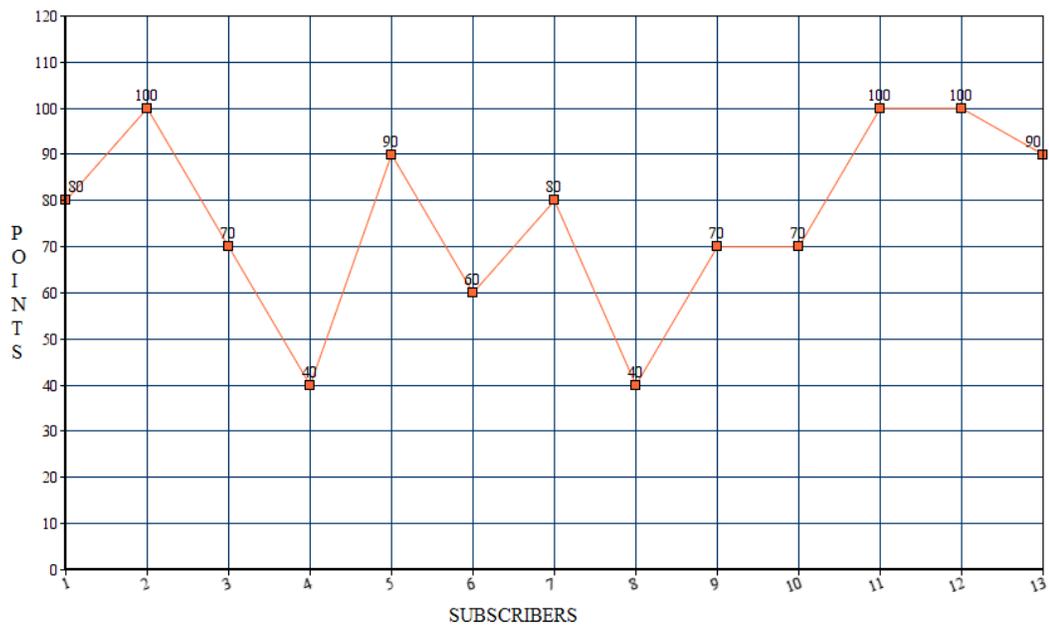


Fig 14. Chart showing the performance of the students

CONCLUSION

E Learning technique can be a real challenge for Albania, since lecturers are used to a certain way of teaching. The exams in Albania are formulated as memorize question exams. Introducing e Testing system in universities, the evaluation methodology also changes, because lecturers have to remake the exams in such manor that the student have to study periodically and to study for logical questions rather than memorize.

This study was made especially because with the evolution of technology a lot of processes are simplified by exploiting technology, for example e testing and e learning technologies are made by having only one computer and an Internet connection at home. Statistically every family has at least one computer in their homes. We have many benefits from this methodology, we use less paper (eco-friendly environment), we save electric power that is used in education institutions, and also we save time since the results of tests are made automatically after testing and they are saved in the database.

The purpose of this study is to introduce these new and innovative methods in educational system in Albania. The aim of this platform is to help the education institutes to facilitate the teaching process, thus it requires a lot of work, different kind of testing of the software and a well structured database system.

FUTURE WORK

Our future work will include making the platform suitable for any kind of exam for every field of study. The exam can either be with multiple choices or with theoretical and essays questions.

REFERENCES

- [1] Pressey, S.L. (1926). A simple apparatus which gives tests and scores - and teaches. *School and Society*, 23(586), 373-376
- [2] Skinner, **B.F.** (1954). The science of learning and the art of teaching. *Harvard Educational Review*, 24(2), 86-97
- [3] By Kirk L. Kroeker *Communications of the ACM*, Vol. 53 No. 8, Pages 19-20
- [4] Suppes Patrick, "Computer-assisted Instruction at Stanford, Technical Report No.174, May19, 1971, Psychology and Education series, Institute for Mathematical Studies in the Social Sciences, Stanford University
- [5] "MyWebExam official website" <http://www.mywebexam.com/en/index.html>
- [6] "Codeschool official website", <https://www.codeschool.com/>
- [7] "World Web Consortium official website", <http://www.w3.org/TR/html5/>
- [8] "CSS3 working group official blog", <http://www.css3.info/>
- [9] First Steps with wordpress [https://codex.wordpress.org/First Steps With WordPress](https://codex.wordpress.org/First_Steps_With_WordPress)
- [10] "[Distributed Application Architecture](#)" (PDF). *Sun Microsystem*. Retrieved 2009-06-16.