Hybrid Cloud-Oriented Educational Environment for Training Future IT Specialists

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Abstract. The article considers the issue of creating and utilizing a hybrid cloud-oriented environment for training future IT specialists in higher educational establishments. It solves the problem of designing and creating such an environment, which will provide effective development of IT students' professional competencies as well as Soft Skills. The proposed model of hybrid cloud-oriented environment of a higher educational institution is verified experimentally. Methods of its usage in the educational process was developed.

Keywords. Hybrid cloud-oriented educational environment, Soft Skills, cloud technologies

KeyTerms. ICT Environment, Information Communication Technology, Teaching Methodology, Teaching Process

1 Introduction

The current situation of the development of higher vocational education is associated with the transition to practical implementation of a new educational paradigm that aims to create an integrated system of lifelong learning, to increase student self education in learning process by means of information and communication technologies (ICT), which form self education competence and such skills as self organization and self education.

The professional level of training IT specialists of higher education establishments meets new demands within dynamic development of an information society. A modern IT developer must not only possess professional knowledge and skills, but also gain the so-called "soft skills" (Soft Skills). The study conducted at Harvard and Stanford universities showed that only 15% of career success is provided by the level of professional skills, while the other 85% is Soft Skills [6]. P. Moss and C. Tilly define skills as abilities and qualities of a person, attitude and behavior but not formal

ICTERI 2016, Kyiv, Ukraine, June 21-24, 2016

or technical knowledge [16]. Modern employers in IT industry expect that a candidate will have dozens of different skills such as the ability to think creatively and to manage time, communication skills, networking, project management, effective teamwork. It is possible to form professional skills and Soft Skills in future IT specialists in a traditional classroom. A great deal of methods and technologies can solve the problem of effective training of future IT developers, including blended learning, flipped classroom, problem learning, project method and so on. These methods usually use ICT, e-learning environment (ELE), web resources.

The aim of higher education in IT is to provide quality fundamental knowledge that can serve as a solid foundation for rapidly building commercial IT variables and technological superstructures. It is sometimes difficult for higher educational establishments around the world and their faculty to keep up with new trends, to track changes in commercial technologies of companies-vendors. Programming languages and IT technologies (C#, Java, JavaScript, Python, HTML5 and others) that are supplied by commercial companies develop fast and often unpredictably. There are two tasks before university IT education that will help to ensure proper training of students of IT specialties; one of them is continuous professional development of teachers and to involve certified training centres into learning process, the second is to create a learning environment through which students will be able to develop their professional skills and soft skills.

This article discusses the issue of ELE for training future IT specialists, in particular the design of ELE based on cloud technologies as well as the issue of the efficiency of its use.

2 The Presentation of the Main Research and Explanation of Scientific Results

Ukrainian scientists Bykov V. Yu., Bohachkov Y.M., Panchenko L.F. and others studied the issue of information and education environment of an educational establishment. In particular, Bykov V.Yu. defines the concept of e-learning environment as a kind of learning environment that is specifically designed as simulation and formulated, educational and cognitive, organizational, technological and information and communication environement, which provides necessary and relevant conditions for the effective achievement of the objectives of e-pedagogycal systems [1, c.169].

Panchenko L.F. [5, c.78] defines information and education environment of a university as an open multidimensional pedagogical reality that includes psychological and pedagogical conditions, modern information and communication technologies and learning techniques and provides interaction, collaboration, personal development of teachers and students while solving educational problems.

E-learning as “the information environment of an educational establishment which is built on the integration of information data on electronic media, information and communication technologies of interaction that include a virtual library of full-text electronic resources, media materials, structured e-learning courses, which are used

on the basis of a new educational system, media for collaboration and learning management system" considers in [7].

G. McCray came to the conclusion that courses which combine online learning with traditional classroom learning enable students to become more active participants of interactions, using different learning styles by providing a variety of content [13].

K. Graham, in his book "The Blended System of Education: Definition, Current Trends and Future Directions", gives mainly idealized definition of "hybrid" or "blended" learning environment that is blended learning is an approach to combine different methods of training and resources, to utilize them and to accept them in an interactively meaningful learning environment. Students must have an easy access to a variety of learning resources to apply knowledge and skills with the support of a teacher in the classroom or outside it [13].

Synchronic hybrid environments are technologies of full learning environments which allow students to interact online and in the classroom with each other as well as with an instructor [22].

Foreign researchers Sneha D. and Naharaya J. define virtual learning environment as a system to transfer educational materials to students through Web. These systems contain every student's profile, means of communication, assessment of tasks and cooperation. It may be available inside and outside the campus 24 hours a day, seven days a week [20].

Tools of virtual learning environment (VLE) support e-learning by giving access to training materials, links, online tools (e.g., electronic notice boards and chat rooms), administration and evaluation tools [9].

The Committee of common information systems defines VLE as a set of components, which enable teachers and students to participate in online interactions of various types, including online training. VLE changes the way students study specific subjects [9].

The most popular, convenient and efficient technology of such an environment is the technology of cloud computing. National Institute of Standards and Technology (NIST) defines cloud computing as follows "Cloud computing is a model to provide a convenient "on demand" access to Internet so that information resources e.g., networks, servers, storage, applications and services were easily accessible with minimal effort to manage and to interact with the supplier" [17].

There are two main types of cloud infrastructures. That is internal and external. In an internal cloud, servers and software are used inside the system in order to form a scalable infrastructure that meets the requirements of cloud computing. In an external cloud environments, providers offer services at the request of an educational establishment. IT support, services and experience will be included in the package, which must work only in providing applications and services.

Services for educational cloud computing represent a growing number of relevant services available online, and is the most innovative and fastest growing element of technology and education. It also promises to provide several services, which will be very useful for students, faculty and staff [18].

The role of cloud computing in higher education should not be underestimated, as higher educational establishments can benefit in getting direct access to a wide range of different academic resources, research programs and manuals [8].

Kiran Yadav suggests the following benefits of cloud computing for educational establishments and students [122]:

1. The personal approach to learning. Cloud computing allows a student to have more options in learning. Using an Internet connected device, students can have access to a wide range of resources and software that meet their interests and learning styles.

2. Reduced costs. Cloud services can help educational establishment to reduce costs and accelerate new technologies to meet the changing needs of education. Students can use free office applications, install and maintain these programs upgraded on their computers but at the same time it provides some commercial applications.

3. Availability. Availability of services is the most important and desirable point for the user who uses educational cloud technologies. You can log in and access the necessary information from any place.

4. The absence of additional infrastructure will increase the number of research centers available for students and will create a global learning environment. There is no need in spending time to think about classrooms and laboratories.

Cloud computing environment provides the necessary foundation to integrate platforms and technologies. It integrates teaching and research resources, which have places, using existing conditions as much as possible to meet the demands of teaching and learning [21].

The term “academic cloud” becomes more and more popular which [7] defines as information and communication technology of education which is built in the principles of cloud technologies and aims at providing education services at educational establishments. “Academic cloud” of a university is a cloud-oriented environment of an educational establishment which combines technical, software and technological, information resources and services and which functions on the basis of technologies of cloud computing and provides academic process of a university by means of a local network of an educational establishment and Internet.

Higher educational establishments mostly use hybrid cloud environments to organize learning process by integrating internal and external cloud. Thus, hybrid cloud-oriented educational environment of a higher educational establishment is the system that combines academic cloud of an educational establishment and external academic clouds based on integration of resources into the educational environment of an educational establishment.

At National University of Life and Environmental Sciences of Ukraine a hybrid cloud-oriented environment was designed to train IT major bachelors. This environment combines internal and external platforms (Fig. 1).

EEE of the university provides IT students with:

– Electronic learning course (ELC) for every subject;
– Electronic books;
– Software to do practical and laboratory activities by means of a virtual desktop;
– Environment to improve practical skills in programming (automatic system ejudge).

The main element of this environment is e-learning course (ELC) based on CLMS system platform Moodle, which places different types of learning resources [4, 15]. To teach IT specialists using a virtual learning environment it is necessary to upload

academic videos, video tutorials, video lectures and other video resources (http://video.nubip.edu.ua). To provide students with academic and research activities, the university has institutional knowledge repository that contains full-text electronic academic and research resources. It is available at elibrary.nubip.edu.ua and can be used by students for self-study. Students have access to a virtual desktop via appropriate links for laboratory or individual work. With virtual desktop DaaS users are able to access necessary applications. All resources, which support every subject, are integrated into an ELC. Efficiency of such an environment studies in [7]; this research states the efficiency increases by 6%, the consent - by 12%, individual work - by 8%, motivation - by 17%.

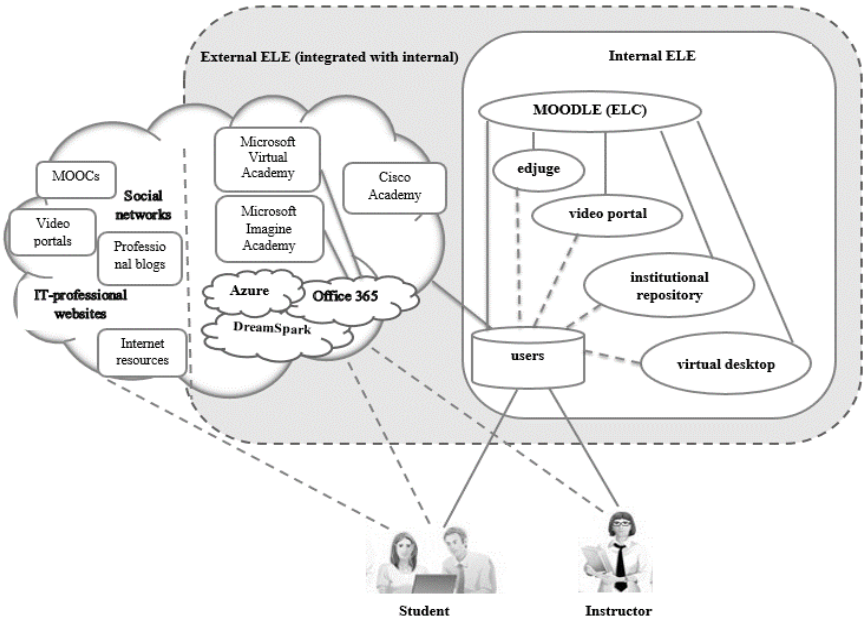


Fig. 1. The Model of hybrid cloud-oriented environment of a higher educational institution

The incentive of constant practice plays a significant role during the process of training future IT specialists in programming languages and standard algorithms. Therefore, automated system ejudge was integrated into ELE of the university which enables students to get a significant amount of programming tasks as individual work and thus provides automated assessment of their progress.

A systematic use of external academic clouds such as Microsoft, Cisco, IBM is significant to form professional skills and Soft Skills in a future IT specialist. The NULES of Ukraine has a license contract with Microsoft Enrollment for Education Solutions. Students and faculty have access to cloud service Microsoft Office 365 which gives access to different software and services on the platform Microsoft Office, business class email, function for communication and management. Besides, students are advised to use a virtual academy Microsoft Virtual Academy (MVA), educational portal, where there is available interactive academic course in

programming (Fig. 4), complements development, Windows Server 2012, Windows 8, visualization and complements developments for HTML5, Windows i Windows Phone, Microsoft Office365, SQL Server, AzureSystem Center and Microsoft Imagine Academy. To provide students with learning software we have access to Microsoft DreamSpark, that enables students to get a free access to tools of projecting and developing software. Platform Microsoft (Windows) Azure enables students and faculty to develop, doing software in storing data which are primarily placed in distributed data servers.

3 Results of Experimental Research

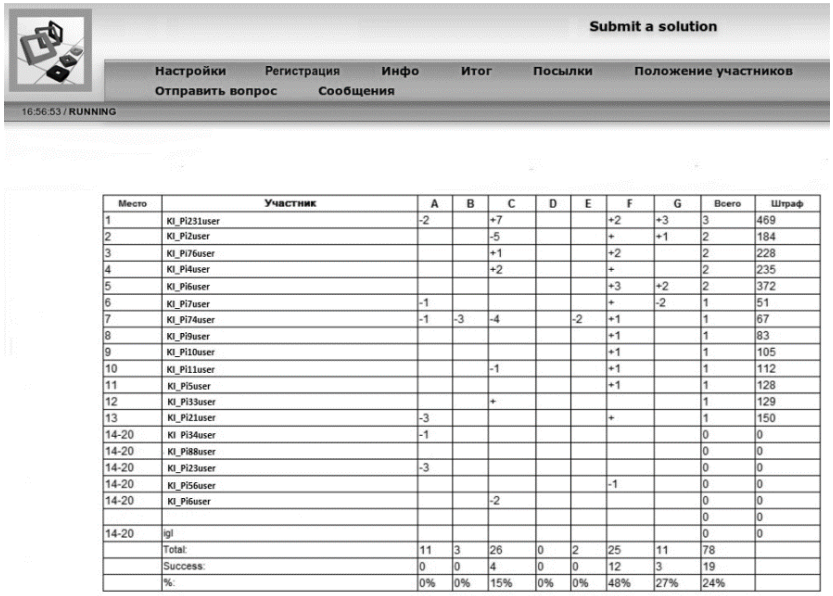
Students of such specialties as “Computer sciences”, “Programming Engineering” participated in this pedagogical experiment. The pedagogical experiment predicted that students of a control group were offered electronic course to study programming, each theme of this electronic course was presented as a resource “Lesson” which is a structured succession of pages. It is possible to place texts, graphics, video, tests etc there. Students were also offered a resource “Video lesson” which as [11] states is the most effective type of resources for students who study IT. This resource was in the form of screen cast of a certain program or practical implementation of software code of scripts with obligatory texting and audio, which is built according to a certain script. The use of this resource enables students to take academic material individually and, if necessary, to revise the performance that is demonstrated in Video Lesson. All this resulted in achieving maximum effect by using all sources of perception and assimilation of information: visual, auditory and kinetic [14].

The experimental group 1 studied using both electronic academic course and ejudge. Students had access to their own tasks and individually solved problems; results then were sent to be assessed. The assessment was automatically done by the system on predefined criteria. It should be noted that students had several attempts to download tasks, but each next attempt reduced a number of points. Also, the tournament had a fixed time to do tasks. The student could view their progress after doing every task, namely whether it was successfully done, the number of solutions, the number of tests. In the case when the task was successfully done a student could see the number of test that they failed. As a result, automated system ejudge evaluated a student’s work according to criteria such as the number of fully done tasks; the number of tasks with one mistake; the number of tasks with two or three mistakes; the number of errors that exceeded the runtime which indicated that students selected the wrong algorithm (Fig. 2).

Experimental group 2 had additional access to Microsoft Office 365, did a distance course in programming at a Microsoft Virtual Academy, Cisco and had a wide range of professional blogs, communities of IT specialists in social networks, open electronic resources to study programming, different Internet resources.

Courses of network academy Cisco gave students an opportunity to learn functioning of hardware and software components, structure of networks, security problems and methods of solving them, obtain skills to collect and set up a computer, to install operating systems, software, and to identify and correct errors connected

with hardware and software (Fig. 3).



Место	Участник	A	B	C	D	E	F	G	Всего	Штраф
1	KI_Pi231user	-2		+7			+2	+3	3	469
2	KI_Pi2user			-5			+	+1	2	184
3	KI_Pi76user			+1			+2		2	228
4	KI_Pi4user			+2			+		2	235
5	KI_Pi6user						+3	+2	2	372
6	KI_Pi7user	-1					+	-2	1	51
7	KI_Pi74user	-1	-3	-4		-2	+1		1	67
8	KI_Pi9user						+1		1	83
9	KI_Pi10user						+1		1	105
10	KI_Pi11user			-1			+1		1	112
11	KI_Pi5user						+1		1	128
12	KI_Pi33user			+					1	129
13	KI_Pi21user	-3					+		1	150
14-20	KI_Pi34user	-1							0	0
14-20	KI_Pi88user								0	0
14-20	KI_Pi23user	-3							0	0
14-20	KI_Pi56user						-1		0	0
14-20	KI_Pi6user			-2					0	0
									0	0
14-20	igl								0	0
	Total:	11	3	26	0	2	25	11	78	
	Success:	0	0	4	0	0	12	3	19	
	%:	0%	0%	15%	0%	0%	48%	27%	24%	

Fig. 2. The Page of Tasks results

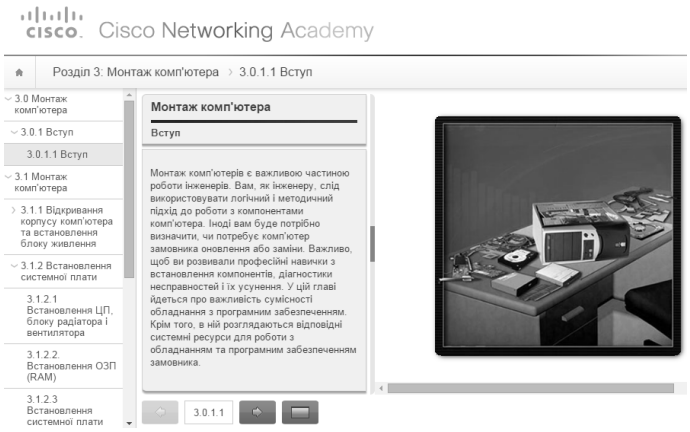


Fig. 3. Course «IT Essentials: PC Hardware and Software»

Fig. 4. Course «Introduction to Programming with Python»

Using social networks, IT specialists are able to obtain new knowledge individually because they have open access to professionally-oriented information that is covered in magazines, newspapers, books, videos, blogs, etc., to fast share information with peers who are users of social networks and have common professional interests; to discuss issues on information technology. In addition to social networking sites, there are special professionally orientated in IT sites which contain a large number of manuals, code samples, links to download software, discussion forums, blogs, etc.

The outcomes of progress in "Algorithmic and Programming" of control and experimental groups were measured by means of tests; individual work and motivation was measured by means of observation and surveys. The results of the experiment are presented in Table 1. According to the results of the experiment, individual work increases significantly when students solve problems, fulfil other tasks. Students of experimental groups are more motivated and ready to solve non-standard tasks.

Table 1. The results of the experiment using the system of training of future IT specialists

Indicator	**Control group**	**Experimental group 1**	**Experimental Group 2**
Academic progress (average), maximum – 100	64,8	77,5	79,6
Individual work (high, intermediate, low), %	17; 35; 48	29; 47; 24	48; 35; 17
Motivation (high, intermediate, low), %	15; 55; 30	34; 58; 8	44; 48; 8

So, this hybrid cloud oriented environment for students of IT specialties, which combined possibilities of electronic learning environment of the university (internal) and external services of Microsoft and Cisco, where the university gained its part of "academic" cloud (externalities) made it possible to develop Soft Skills together with

developing professional skills, namely personal effectiveness (group 1) and communication skills (group 2) according to the classification by Dluhonovych N.A. [2]. Managerial and strategic skills were also developed in groups 1 and 2. If we add to this classification critical thinking skills and information management skills (Group 5), which Indian researcher V. Saravanan [19] highlights, we will receive Soft Skills which are presented in table 2.

Table 2. Classification of Soft Skills

Personal progress (group 1)	**Communicative skills (group 2)**	**Managerial skills (group 3)**	**Strategic skills (group 4)**	**Skills to manage the information (group 5)**
Ability to set and to achieve the set goals	Ability to team work	Ability to organize a group	Strategic planning	Critical thinking
Time management	Ability to communicate effectively	Ability to form a team	To make strategic solutions	Ability to analyze the information
Resistance to stress	Inter social communication	Ability to form a system of communication in a team	Ability to take risks	Ability to synthesize data
Responsibility	Ability to solve conflict problems	Ability to motivate team members	Ability to delegate responsibility	Ability to evaluate information
Creativity	Ability to held talks	Development of leadership skills		Ability to make decisions
Analytical thinking	Ability to persuade	Formal and non formal leadership		Lifelong learning skills
Ability to present	Ability to make group decisions			

The task to identify a number of indicators of students' personal progress, communicative and managerial skills was set as well as the task to identify the ability of managing the information according to the classification of Soft Skills in Table 2. In particular, in order to determine whether the student is able to manage their time, the groups were given tasks to accurate state the type, beginning time and finish time of the work. In order to identify formal and informal leaders in the group, their abilities to form a group a sociometric technique developed by J. Moreno was used [3]. Students were offered to answer some questions of a socio metric card; the number of options was limited. According to these results the index of grouping was identified which revealed internal emotional atmosphere of a group. Students of

Experimental groups 1 and 2 demonstrated qualities to turn the idea into the ability faster than Control Group. It shows more developed features of personal progress, communication, ability to influence the surrounding people, the ability to foresee the outcome, to manage the process.

Conclusions

The conducted research resulted in designing and utilizing a hybrid cloud oriented environment that integrates the components of university academic cloud such as e-learning courses, electronic tools and electronic manuals, video resources, virtual desktop and environment for automated assessment of tasks in programming; with academic components of Microsoft and Cisco clouds and external cloud services. The efficiency of such hybrid clouds while teaching IT students programming was tested by means of the pedagogical experiment which showed as effective progress (in average by 14%), so the development of Soft Skills necessary for career success of future IT specialists.

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