MODEL OF HYBRID CLOUD-ORIENTED EDUCATIONAL ENVIRONMENT FOR FORMAL AND INFORMAL LEARNING OF IT STUDENTS

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Abstract*. Educational process of IT specialists' training should be based not only on formal education, but also to use various forms and tools of non-formal and informal learning. Main practical professionally oriented skills and abilities are retained only due to students' individual work while doing tasks in programming, algorithmization, designing etc. Development of effective academic resources for formal learning will help students to work individually as well as provide comfortable ways of delivering such materials with the help of Internet guarantees enhancing the quality of studies. The present article describes the most effective tools and technologies of formal and informal learning of IT students, considers the issue of creating and using a hybrid cloud-oriented environment. It solves the problem of designing and creating such an environment which will provide effective development of students' professional competencies as well as Soft Skills.*

Keywords: formal learning, informal learning, hybrid cloud-oriented environment, professional competencies, Soft Skills, IT students'

INTRODUCTION

The professional level of training for IT specialists of higher education establishments meet the new requirements that are bound with the 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). 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 and outside the classroom work. 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. 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 using during formal, non-formal and informal education.

1. THE CONCEPT OF FORMAL, NONFORMAL AND INFORMAL EDUCATION

Formal education anticipates the existence of structural programs that are recognized by a formal system of education, the probability to receive generally defined certificates and documents (Maslova, 2004). That is to say this education is based on the structural academic materials, tasks that are made by a teacher according to curricula and branch academic standards (Glazunova, Voloshyna, 2014).

A big amount of useful information that helps a student's professional development he receives from other sources outside an educational establishment. This form of getting the knowledge is known as non-formal education. Non-formal education is defined an academic activity determined by educational demands, by youth's ambition to gain necessary knowledge and abilities and this education is done beyond educational establishments curricula (Lugovyi, 2008). This education is associated with one's desire to gain knowledge and acquire abilities necessary for one's personal life and for professional work.

Informal education is defined as education that is still not organized (Hart, 2011), which means that such education is based on one's own experience and on the experience of other people. Studies in informal education can be purposeful (for example, watching TV programmes, reading books and magazines, meetings) and unplanned as well (accidental as everyday activity).

Investigating the indicators of quality of formal education, many scientists make conclusions on the need to use modern ICT to provide students with academic resources, educational communication and evaluation training results.

2. DIGITAL RESOURSES FOR FORMAL EDUCATION

Academic resources for formal learning can be made in some electronic academic course, for example based on a CLMS platform - Moodle (Educational portal of NULES of Ukraine, 2017). Moodle Platform is oriented towards the organization of cooperation between a teacher and students with the help of an electronic academic course where different types of academic resources can be placed for students'

individual work. At the beginning of an academic semester students receive access to an electronic academic course and have an opportunity to work with academic resources at any place and at any time suitable for students. Let's study some of such resources which during a pedagogical experiment was conducted with students of Computer sciences; these resources showed the best results, study quality and students' satisfaction.

To apply theoretical and practical training material effectively used video lesson. Video lesson is one of the resources that we recommend in our research. It is a systematic, successive presentation of academic material that does not demand a teacher's personal presence before students, using a wide range of possibilities of working, keeping and transferring audio and video information (Nozdracheva, 2014, Seytvelieva, 2010). The resource of the type "Video lesson" is widely used for studying professionally oriented courses focused at Computer sciences in the form of a screencast of work of some program or practical realization of program coding of scripts with obligatory textual and voice supporting (Figure 1). Video lesson use in individual work enables students to attain the information in individual regime and if needed simultaneously revising what is being demonstrated in the video lesson and the highest effect will be reached using all sources of perception and attaining the information such as visual, audial and kinesthetic.

Another type of resources that will enable individually at one's own speed to gain academic information with the help of visual and audio types of perception. It is a video lecture. The mentioned types of resources such as a video lesson and a video lecture can be included into passive ones as for controlling individually learned material one needs an additional test of reflective papers.
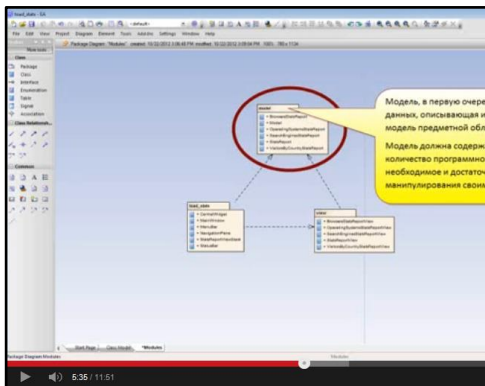
Figure 1. An example of using a resource of the type "Video lesson"

Source: Own work
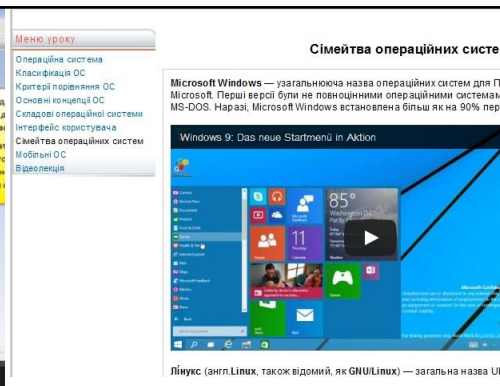
**Figure 2. Example of pages of resource "Lesson"**

Source: Own work

Moodle Platform allows one to make active resources that anticipate a student's activeness while doing some activity. One of such resources is "Lesson" that is a structural continuity of pages where a text, graphics, video, text tasks can be placed.

We can organize individual step-by-step learning academic material, and the opportunity to revise it impacts on the level of mastering this material. An example of such a resource on the subject "Information Technology" for the students' field of study "Computer Science" is shown in Figure 2. The resource type "Lesson" on "Operating Systems" offered students the theoretical material in the form of text with additions in the form of videos and graphics.

Between informative parts of a lesson we can place testing tasks for periodic testing of individually learnt material. Giving a wrong answer, a student can be sent back to the lesson page with enough information to answer the question correctly or moved back to the beginning of the lesson. Thus we receive an effective instrument for students' individual mastering of the learnt material, that helps do a current testing and provide students' work assessment automatically that frees a teacher from checking students' done task.

To determine the degree of satisfaction in each of the study groups with student's field of study "Computer Science" were surveyed. The grading scale was distributed on the following points: 5 points – fully satisfied, 4 points – satisfied overall, 3 points – satisfied, 2 points – partly satisfied, 1 point – generally dissatisfied. The survey results are presented in Figure 3.
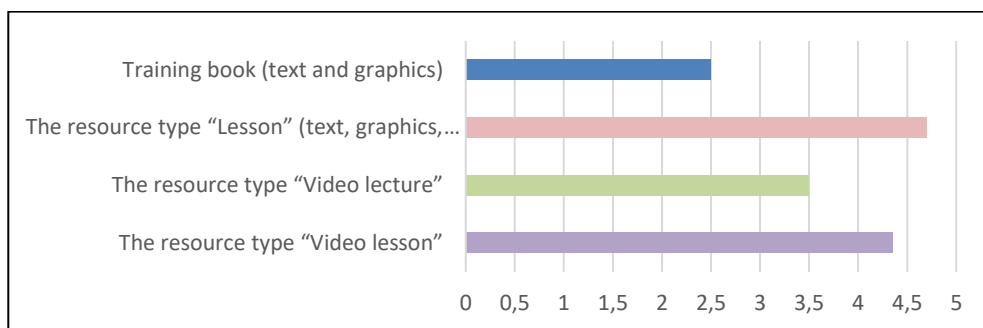
Figure 3. The level of satisfaction with various types of resources for formal learning

Source: Own work

The greatest satisfaction with resources show students who have used the resource type "Lesson". This once again confirms that the most convenient and effective resource for independent work is exactly the resource.

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 their 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 electronic training course. (Glazunova, 2015) studies the

efficiency of such an environment; this research states the efficiency increases by 6%, the consent increases by 12%, individual work increases by 8%, motivation increases by 17%.

The incentive of constant practice plays a significant role during the process of training future IT specialists in programming languages and standard algorithms. Therefore, the automated system ejudge was integrated into EEE 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.

3. DIGITAL RESOURCES FOR NONFORMAL AND INFORMAL EDUCATION

Besides the revealed methods of organization of formal element of individual work, in a modern information society there are widely used instruments for providing nonformal education, one of which is a social net. A social net is structure that is based on people's relations or mutual interests. As an Internet service, a social net can be regarded as a platform helping people make connections and group themselves according to their interests. Tasks of this site are to provide the consumers with all possible ways for interaction such as video, chats, pictures, music, blogs etc.

**Figure 4. A blog picture of a programmer on a social page "Facebook"**
Source: https://www.facebook.com/
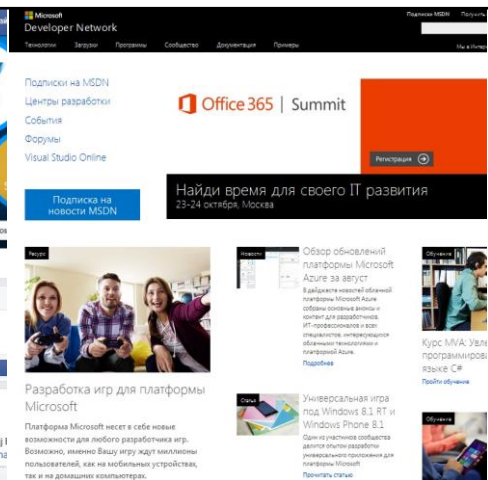
Figure 5. A professionally oriented web-site
Source: https://www.microsoft.com/

Using social nets, IT specialists can get new knowledge individually as they have a free access to professionally-oriented information, that is revealed in magazines, books, video, blogs etc. to make a quick exchange of information between the participants of groups who are users of social nets and have mutual professional

interests, discuss questions that touch the sphere informative technologies. One of the examples of groups that are united to discuss professionally interesting questions in the sphere of IT technologies is a programmer blog (a social net "Facebook") and it is given in Figure 4.

Blog is the most effective instrument of non-formal education that enables to conduct Internet register of events, online diary in the form of notes that are constantly added, containing a text, pictures or multimedia. Future specialists can not only familiarize themselves with professional programmers' experience but can ask questions, share their achievements, take part in discussions and projects etc. besides social nets there are special professionally focused sites in the sphere of IT, containing a big amount of users' instructions, code examples, links for downloading programs, debatable forums, blogs etc. For example, resource DeveloperWorks reveals themes from open industrial technologies (Java, Linux, SOA, PHP etc.) to products IBM (Figure 5), resource Microsoft MSDN thematically focused at Microsoft goods, though it is characterized with less filling (Microsoft.com).
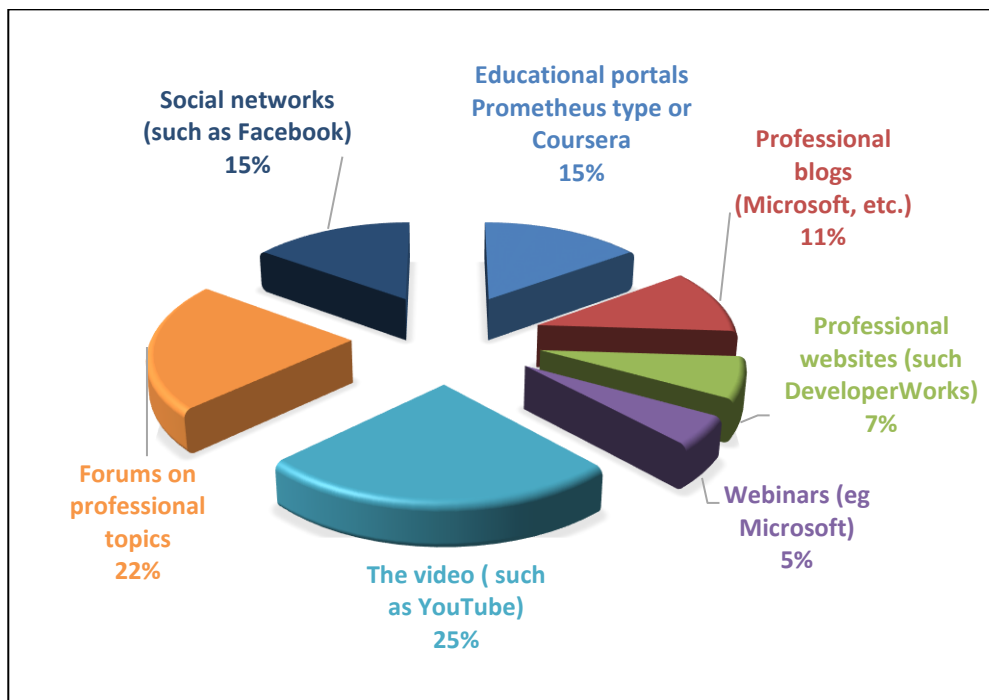
Figure 6. Social services used by students for professional growth

Source: Own work

To familiarize users with new informative technologies leading educational centres in the sphere of IT conduct webinars, for example in the educational system Microsoft in the academic centre CyberBionic Systematics etc.

Webinar is an interactive seminar or a training session using a computer, Internet and means of communication, broadcasting video, audio, documents sharing voice and text chat – all this helps a teacher conduct a class on the high level of interaction with the audience.

To identify the most frequently used tools for informal education in independent work of students of IT specialties a questionnaire was developed and under were surveyed students in the area of training courses 1-4 "Computer Science" for educational and informational portal NULES of Ukraine.

Figure 6 shows that social services are used for professional development of students.

4. ACADEMIC RESOURCES OF IT COMPANIES

Such global companies – producers of IT products as Cisco, IBM, Intel, Microsoft open wide opportunities for universities. Companies of such level create their own academic clouds that include online courses, cloud services to access the practical use of the latest developments and tools for organization of training in their own technologies (Goncharenko, Tyutyunnik, 2014, Suhonyak, Kovalchuk, Danilchenko, 2002, Tsirulnik, Zagorsky, Metelitsa, 2014, Martsenko, 2014).

In terms of cooperation with Universities IT companies offers full support of technologies being developed for distribution among users. Most developed technologies are accompanied by online course or Microsoft Virtual Academy or Imagine Academy, IBM academy of Technology, Cisco Academy, Intel Academy.

Microsoft offers a cloud platform for studying technologies such as O365, Azure and the ability to go through the MOS certification lines, MCE, MTA. In addition, Microsoft provides many other resources to support its own technologies that envisage for every developed IT product the creation of platform for access to this product, online courses for studying the features of the product and the opportunity of professional certification for this IT product (Microsoft.com, 2017).

Microsoft is one of a few companies that offer free academic resources and services for training. With the help of these resources it is possible to gain new knowledge and skills required also for career promotions. In particular, Microsoft provides an opportunity to study such technologies as databases, programming, virtualization, duplication, server technology for training students in the IT profession.

To explore each technology Microsoft offers training resources in the form of online courses, software and cloud environment that provide practical use of software such as virtual machines – Azure Virtual Machines.

At the same time, Microsoft educational policy is to attract as many teachers of secondary, vocational and higher education institutions as it can to study modern educational technologies based on the use of ICT in education.

Microsoft resources such as: Imagine Academy, Virtual Academy, Channel9, Educator Community, Developer Network include online courses, informative educational materials for different types of users from beginners to professional software developers.

Services O365, Azure, Imagine, CodePlex and others serve as modern tools of working with the latest versions of software, software development, as well as tools of co-work with documents, communications, creation of an educational e-environment.

Within the study of various disciplines and practical training, a teacher makes the curriculum in the Imagine Academy which consists of a set of online courses. Students take these online courses during laboratory and independent works planned for the relevant discipline. The Academy Administrator creates curricula for groups of students, based on the lecturer's formal request, makes reports.

The evaluation system in the university involves the accumulation system of scores for various activities. Therefore, mastering these online courses within the discipline is assessed with a certain number of points and is obligatory for students. It is also possible for students themselves to choose courses in the academy and study without any additional motivation from the teacher (Figure 7, Figure 8).
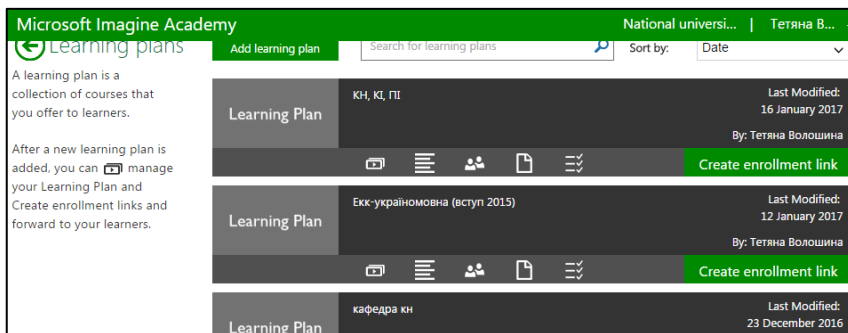
Figure 7. Curricula of faculty groups in Microsoft Imagine Academy

Source:
https://imagineacademy.microsoft.com/administration?whr=urn:fed eration:MicrosoftOnline

Figure 8. A page of an on-line course «Get Productive with Microsoft Excel 2016»

Source: https://imagineacademy.microsoft.com/? whr=urn:federation:MicrosoftOnline&courseId=17062

Courses of the 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 (Figure 9).
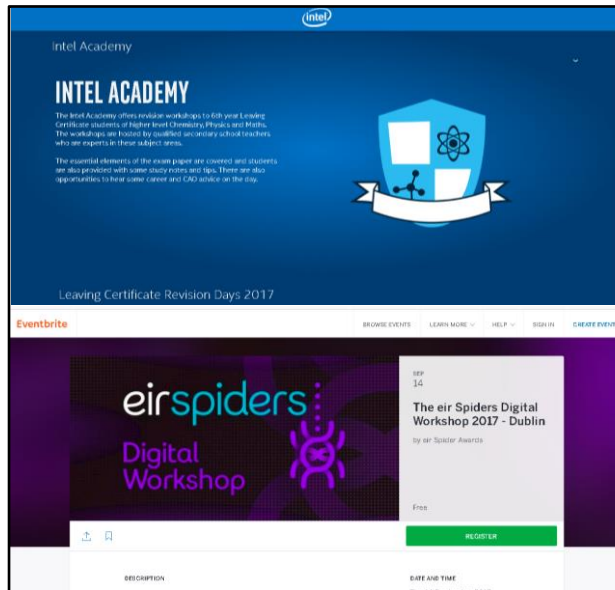

Figure 9. Course «IT Essentials: PC Hardware and Software»

Source: https://www.netacad.com

Figure 10. Course «Introduction to Programming with Python»
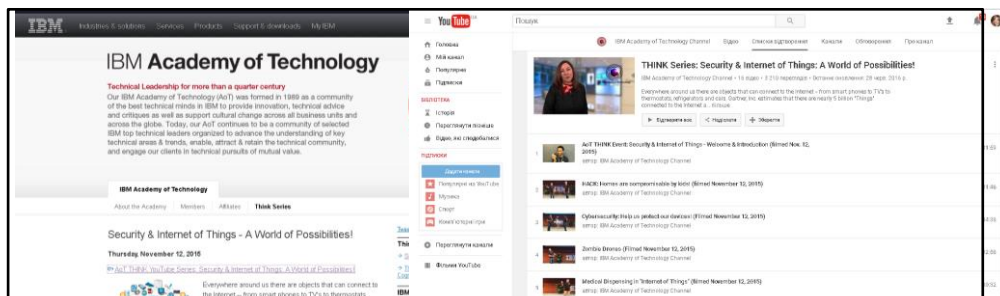
Source: https://mva.microsoft.com/

Intel Academy (Figure 11) offers both free and paid resources and activities for learning technologies.

Figure 11. Intel Academy

Source: https://www.intel.ie/content/www/ie/en/education/ie-intel-academy.html

IBM's Academy of Technology (Figure 12) opens up access to a large number of IT courses hosted on YouTube Channel (Figure 13).

Figure 12. IBM's Academy of Technology

Source: http://www-03.ibm.com/ibm/academy/index.html

Figure 13. YouTube Channel

Source: https://www.youtube.com/channel/UC2GPxz3UaLBDktz5tp2qAMQ

Such academic resources of IT companies can be used both for formal and non-formal education. On the one hand, the courses are embedded in the curriculum and

then become part of formal education. On the other hand, students, having access to the academies, have the opportunity to independently choose the following courses and study outside the curriculum.

5. MODEL OF A HYBRID CLOUD-ORIENTED ENVIRONMENT

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 environment, 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 (Richard M. Felder, Rebecca Brent, 2004).

The term "academic cloud" becomes more and more popular which is defined 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. The "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 (Glazunova, 2015).

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 on the basis of integration of resources into the educational environment of an educational establishment (Glazunova, O., Kasatkin, D., Kuzminska, O., Mokriyev, M., Blozva, A., Voloshyna, T., Sayapina, T., 2016).

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 and uses for formal and informal education (Figure 14).

EEE of the university provides IT students with:

− Electronic academic course in 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).

Components of the hybrid model of ELE	Internal ELE	Relation	External ELE
Architecture	"Academic" cloud of the university, Server infrastructure, campus network, Internet Channel, IT Infrastructure of Universities	Integration (one user database)	Academic Clouds: Microsoft CISCO IBM Google
Technological	Electronic training courses Video materials, full-text educational materials	Content	Microsoft Imagine Academy, Cisco Academy, Microsoft Virtual Academy, MOOCs
	Methods: problem-searching, interactive, project activity, coaching		
	Virtual desktop, training portal	Tools	Professional websites, blogs, forums, Video portal (youtube channel)
	Forms: classroom, non-auditorium, individual, group		
	Regulations on the e-learning environment Regulations on eLearning The procedure for managing the information and	Management	Regulations on the training laboratory of Microsoft Imagine Academy Regulations on the Cisco Training Laboratory

	educational environment		The procedure for managing the resources and services of Microsoft at NUBiP Ukraine
Informational-competent	STUDENT: Competence: professional, integral, informational and communication, self-education, foreign-language communicative, communicative, intercultural		
	TEACHER: • competence in the possession of ICT and the use of technology in teaching activities, organization of independent work, teamwork of students • advanced training in the use of ICT in the learning process, the use of cloud services Microsoft in the learning process • Microsoft Certified Microsoft Certification Educator (MCE), Microsoft Technology Associate (MTA)		
Communica-tive	Mixed communication, face to face	Forms of communication	Teamwork, online communication

Figure 14. The Model of hybrid cloud-oriented environment for training future IT specialists

Source: Own work

The main element of this environment is an e-course based on the Moodle CLMS platform, which contains different types of learning resources. 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).

The incentive of constant practice plays a significant role during the process of training future IT specialists in programming languages and standard algorithms. Therefore, the automated system judge was integrated into EEE of the university which enables students to get a significant number 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. For example, students are advised to use a virtual academy Microsoft Virtual Academy (MVA), educational portal, where there is available an interactive academic course in programming (Figure 10), complements development, Windows Server 2012, Windows 10, visualization, complements developments for HTML5, Windows i Windows Phone, Microsoft Office365, SQL Server, Azure System 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.

Hybrid cloud oriented environment for students of IT specialties, which combined possibilities of electronic learning environment of the university (internals) and external services of Microsoft, Cisco, IBM where the university gained its part of "academic" cloud (externalities) made it possible to develop Soft Skills together with developing professional skills (Glazunova, Voloshyna, 2016). Table 1 presents the results of the experiment on the use of the developed hybrid cloud model for students of computer science during the study of the discipline "Information Technologies". The total number of students participating in the experiment: in control groups - 75 students, in experimental groups - 78 students. The results of student academic progress measured by tests of performance and control tasks in 100-point system. The average value of students' achievement in this discipline based on the results of the entrance testing was 63.3 points in the control groups and 64.5 in the experimental ones. The hypothesis about the equality of general averages was checked against the t-criterion of Student. The experimental value criterion T missed a critical region (0.25 <1.96), so the null hypothesis was accepted. After the completion of the experiment, the average value of success in the experimental groups significantly increased (to 77.5 points), which significantly differs from the value in the control groups. The hypothesis of equality of general averages (verified by the T-criterion) was rejected. The hypothesis of the equality of variances (Fisher's criterion) was adopted.

Table 1.

The results of the experiment using the system of training of future IT specialists

| Indicator	Control group			Experimental group		
	high	medium	low	high	medium	low
Academic progress (average), maximum – 100 points		64,8			77,5	
Individual work, %	17	35	48	29	47	24
Motivation, %	15	55	30	34	58	8

Source: Own work

According to the results of the experiment, individual work increases significantly when students solve problems, fulfil other tasks. The development of self-education competencies was determined by three levels: low, medium, high, and measured using the expert method. The level of autonomy in solving problems in the classroom, during individual and group work, was determined by the teachers on the basis of observations. The number of students who demonstrated high and middle level in the control and experimental groups differ by 24% (Figure 15).
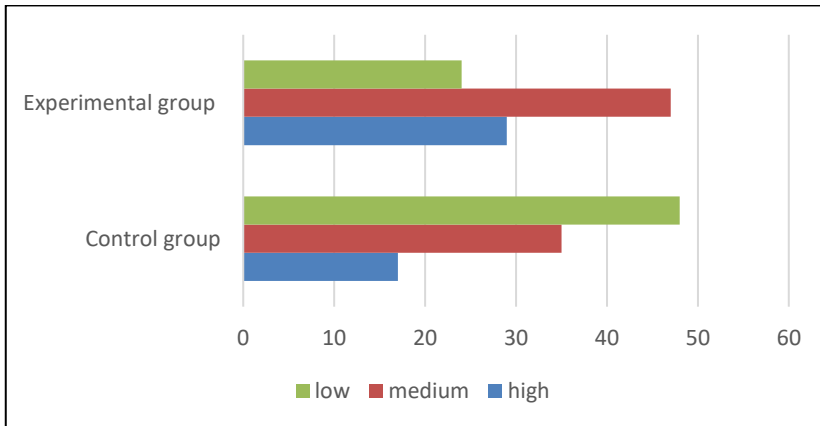
Figure 15. Results of the experiment relating to the level of development of the students' self-educational competence
Source: Own work

The level of motivation of the students was measured using questionnaires. According to the students' responses there were identified groups with high, medium and low motivation to learn (Figure 16). Students of the experimental groups are more motivated and ready to solve non-standard tasks.
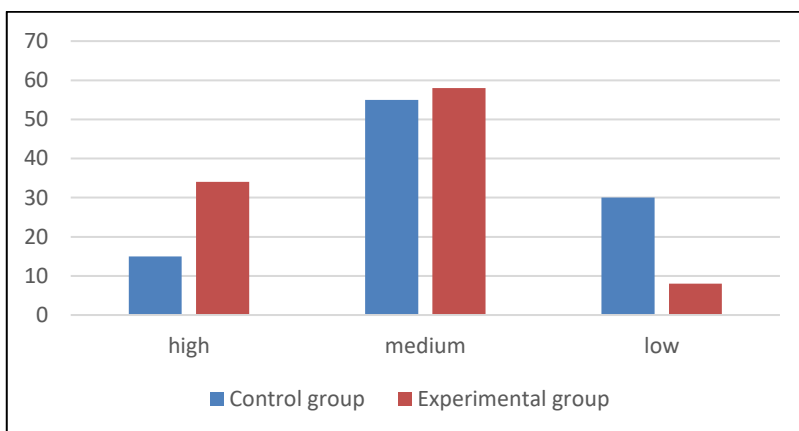
Figure 16. Results of the experiment relating to the level of the students' motivation
Source: Own work

6. CONCLUSIONS

Designing and utilizing a hybrid cloud oriented environment that integrates the components of a 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, Cisco, IBM clouds and external cloud services enabling students to actively develop professional and soft skills. Combining the resources and services of the internal and external e-learning environment with innovative teaching methods and technologies - design methodology, flipped classroom, blended learning makes it possible to increase the level of self-education competence of students and their motivation to obtain the appropriate level of education. A significant amount of resources offered in the framework of formal education, encourages students to systematic independent work, finding new resources for development, professional communities for communication.

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