INNOVATIVE EDUCATIONAL TECHNOLOGIES IN BLENDING LEARNING. FUTURE IT PROFESSIONALS IN THE TECHNICAL UNIVERSITIES OF UKRAINE

Yurii Tryus[1], Tamara Kachala[2]
Cherkasy State Technological University
460 Shevchenko blvd., 18006, Cherkasy, Ukraine
[1]tryusyv@gmail.com
[2]chdtu-cherkasy@ukr.net

Abstract: *This study analyzes opportunities for using innovative educational technologies when training IT professionals at the technical universities of Ukraine. The paper discusses the main trends in the use of innovative educational technologies and cloud technologies in higher technical education, analyzes cloud services used by leading technical universities in Ukraine in management and learning. Consideration is given particularly to e-learning, mobile, and blending learning, virtualization mechanism to support the students learning in the field of natural, mathematical and engineering sciences. The experience of Cherkasy State Technological University in the use of innovative educational technologies and cloud technologies in management and blending learning is presented.*

Keywords: innovative educational technologies, blended learning, cloud technologies, web-oriented computer system, mobile ICT, mobile environment.

INTRODUCTION

With the civilization development the role of computer science and its methods is constantly increasing. The interrelation of computer science into other sciences is getting more significant. Information technologies today are the powerful instrument in finding solutions to difficult problems, which appear in different spheres of human (commercial) activities. The gradual process of computerization of science and production will continue. In connection with it, there appear major alterations in qualifying requirements of future specialists in any sphere, especially in production, economics, finance and management.

Therefore problem investigations, which appear nowadays in computer training of future IT education in higher schools and finding their solution is an urgent social goal.

Ukraine is an emerging free market, with a gross domestic product that has experienced a rapid growth in recent years. Ukraine now has the potential to be one of the region's leaders in volume of foreign direct investment and portfolio investment. Ukrainian Parliament adopted the law "On the Foundations of the Development of Ukrainian Information Society in 2007-2015". The goal of the law is to promote a growth of information society in Ukraine strengthening the basis of IT sector development.

Today Ukraine is one of the leaders among Central and Eastern European countries in the field of IT outsourcing and a number of IT professionals (Exploring Ukraine. IT Outsourcing Industry). Over the last years, the volume of software development and IT outsourcing services has grown by ten times. However, there are problems that lead to the emergence of professionals' deficiency in the IT job market, employers' dissatisfaction with the level of computer student training in the technical universities of Ukraine.

One way for increasing the quality level in computer science training for future IT specialists today is the use of innovative educational technologies, particularly blended learning.

The article considers the current state of IT education in Ukraine, the problems of higher technical education in Ukraine which train professionals for the IT industry, as well as some solutions to these problems through an extensive use of innovative educational technologies at the technical universities of Ukraine.

1. IT EDUCATION IN UKRAINE

Universities in Ukraine have the potential for the efficient implementation of tasks in innovative economic development: providing qualified personnel and the creation of new knowledge. In Ukraine in 2013-2014 the training of staff is performed by 823 higher educational institutions, including universities, academies and institutes (334) (40%). Over 2.17 million students are enrolled in higher educational institutions, among them 1.824.900 students (84%) are enrolled in universities, academies and institutes (Key indicators of higher education in Ukraine at the beginning of the school year 2013/14).

Ukraine's higher education tops the ranking in Eastern Europe. Ukraine occupies the 25th position out of 48 evaluated countries. Czech Republic, Poland, Slovenia, Russia and Slovakia are placed at the 26th, 27th, 28th, 32nd, and 35th positions respectively. The researchers ascertained the United States of America, Sweden, Canada, Finland and Denmark to be the top five countries in the overall education rating. Eastern European countries (Ukraine, Czech Republic, Poland, and Slovenia) were in a cluster in the middle range of the list. The data was examined according to 20 different criteria to find the best countries at providing higher education. All the criteria were combined into four main groups: resources, output, connectivity and environment.

Ukraine has a long standing reputation as a major technology region, with a well-developed scientific and educational base. With only 1% of all world population, Ukraine accounts for 6% of the world's physicists, mathematicians, computer programmers, and other highly educated professionals.

More than 16,000 IT specialists with a Bachelor's degree and about 14,000 IT specialists with a Master's degree graduate from universities every year.

To bridge the gap between classical education and real business and technical process, outsourcing companies have partnered with leading universities to offer additional classes and labs for students. In Table 2 there is a list of top-five universities in Ukraine in terms of training of IT-professionals.

Table 1.

Top-five universities in Ukraine in Terms of Training IT-professionals

Place in rating	University
1	National Technical University of Ukraine "Kyiv Polytechnic Institute", Kyiv
2	Kyiv National Taras Shevchenko University, Kyiv
3	National Technical University "Kharkiv Polytechnic Institute", Kharkiv
4	National University "Lviv Polytechnic", Lviv
4	Kharkiv National University of Radio Electronics, Kharkiv
5	National Aviation University, Kyiv
5	National University "Kyivo-Mohylanska Academy", Kyiv
5	State University of Information and Communication Technologies, Kyiv
5	Oles Gonchar National University in Dnepropetrovsk

Source: Tryus, Cahala, 2013

The most popular IT jobs in Ukraine include:

- web developers (PHP);
- programmers .Net;
- programmers Java;
- QA (Quality Assurance);
- programmers C / C + +;
- developers of mobile applications;
- web designers;
- developers and database administrators;

- specialists in automation systems (ERP, CRM, BI).

The minimum requirements that employers require from technical universities with IT majors include: fundamental basic knowledge of Mathematics and Physics; knowledge and possession of programming languages C/C++/Pascal in the scope of university programs; knowledge of the database theory; English language (reading); basic knowledge of HTML, Java Script; practical experience in the IT industry (6 months and more); an overview of the software development process.

At the same time the representatives of IT companies would like students to have initial experience in the IT industry, pursue independent studies; carry out their IT projects; and nonprofit IT projects; participation in freelance IT projects; visit free training; have many interviews with prospective employers.

The abovementioned information makes it clear that the representatives of IT companies see no prospects for gaining initial experience in IT students at the university where they are studying.

According to the authors one of the reasons for this paradoxical situation is the poor representation of Ukrainian universities in the Web space that results in the low positions of Ukraine's universities in the prestigious world ranking – Ranking Web of Universities (http://www.webometrics.info/en/Europe/Ukraine), especially for peripheral universities (Tryus, Cahala, 2013).

Another reason why employers are not satisfied with the preparation of IT professionals in Universities of Ukraine is that technology in this area is changing rapidly: new special development tools and problem-oriented software is rapidly evolving with the hardware to provide computer technology and networks. In this situation the universities with limited financial resources are not able to respond to these changes to upgrade computers, network equipment, to buy new licensed software, to develop teaching resources and new disciplines for professionally-oriented training needed to teach future IT professionals (Tryus, Cahala, 2013).

What is necessary to be done by universities in Ukraine in order to prepare IT professionals to change the situation in the regional technical universities?

Answer: To use the innovative educational technologies in the training of IT professionals at the technical universities of Ukraine.

The main approaches in the use of innovative educational technologies are considered in the training IT professionals at the technical universities of Ukraine**.**

2. INNOVATIVE EDUCATIONAL TECHNOLOGIES IN TRAINING

Real ways to improve the quality of IT professionals in the technical universities, to enhance the learning, cognitive and research activities of students, to reveal their creative potential, to increase the role of independent and individual work, to increase their competitiveness in the IT labour market are:

1. *Development and implementation in the educational process of the innovative learning technologies*, on the basis of the organic combination of traditional and computer-oriented forms, methods and means of education, including among others: e-learning, technologies of mobile and blended learning; information educational environment and the community; educational services and Web 2.0; cloud computing.

2. *Collaboration of Technical Universities with IT companies*. Creation of the educational and research centers and centers of certification leading IT companies of the world: Microsoft, CISCO, Hewlett Packard, Intel and Oracle.

3. By the *innovative ICT technologies of learning* we mean the new and original technologies (methods, tools, ways) of creation, transmission and storage of teaching materials and other information resources for educational purposes, as well as technology of organization and support of the teaching process (traditional learning, e-learning, mobile and blended learning) using telecommunications and computer networks that deliberately, systematically and consistently are implemented in educational practice (Tryus 2012).

According to the authors, such methods of teaching in technical Universities, that mostly are used in the preparation of IT professionals, include: web-oriented specialized software; mobile ICT learning; mobile learning environment.

Let's consider these innovative learning technologies in detail (Tryus, Gerasimenko 2012, Tryus 2012, Slovak, Semerikov, Tryus 2011, Rashevskaya 2013, Tryus, Cahala 2013, Tryus, Yatsko 2013).

2.1 Blended learning as an innovative educational technology in higher education

The fast development of information technologies makes changes in almost all spheres of human activities, and education takes one of the first places among them to introduce innovations on the basis of information communicative technologies.

The notion of online training is attached fast in students' minds today. The internet becomes largely an educational space, which provides modern students with better opportunities of getting to informational database and of teamwork. New educational approaches like distance learning, electronic learning, mobile learning, online learning and blended learning are developing fast. But specialists suggest exactly blended learning is one of the most perspective innovative trend in higher education.

In the research work (Tryus, Gerasimenko 2012) the concept of blended learning process is analyzed in details. Therefore we will give here only some basic principles, of which the use of the blended learning approach in authors' professional activity consists.

Blended learning is aimed first of all at learning and professional requirements of every participant of the learning process while in the traditional learning system a

general knowledge level is expected from all students present in class. A lesson has got an only usual scheme, individual qualifications are mostly not taken into account whereas the blended learning system provides everyone with the opportunity to choose the rate of mastering as well as priorities in learning by themselves. Blended learning is useful for those students, who due to different circumstances cannot be present during the lectures in their higher education course (because of health problems, family matters, occasional employment or permanent work, especially in the case of senior, graduate students) and for those, whose profession demands regular business trips and missions, that cause means durable absence from the town, where the higher school is.

In the principles of blended learning the learning process includes job-retraining and qualification raising of specialists and studying to get a post-graduate degree. So graduates, who have got a bachelor's degree, can get a master's degree in the field they work, without discontinuing work. Learning programs like these are widely used in German and British universities. In several European countries universities offer some modules which are taught simultaneously in traditional way for present in class students and for distant ones so they won't feel left alone. Blended learning gives opportunities to students to go on learning at universities in European countries.

In contemporary educational literature sources you may find different explanations to the concept of blended learning (Collis 2001, Heinze 2013).

According to one of them, *«blended learning is a purposive process of getting knowledge, experience and skills. It is learning methods for education and personality development, obtaining creative abilities by complex and systematic application of the traditional and innovative pedagogical technologies and informative-communicative learning technologies to complement one another with the aim to get the better quality of education»* (Tryus, Gerasimenko 2012).

We will use it in the context of our study.

As it is mentioned above, the tendency in organization of the educational process in higher school develops toward blended learning process, which combines traditional as well as computerized methods, forms and means in its organization.

As a rule, blended learning consists of following stages (Tryus, Gerasimenko 2012):

- individual students' work on the theoretical material using distance, electronic and mobile technologies;
- learning practical skills in the form of traditional class lessons using innovative pedagogical technologies;
- discussing difficulties on the internet in an online or off-line mode using distance, electronic and mobile technologies;

- monitoring and executing control as well as scoring students' educational achievements using computerized test programs, especially doing a computer test;
- execution of a final test in discipline (examination test) and presentation of student's qualification project in a traditional full-time form.

Blended learning model is a type of using informational educational resources in traditional learning with applying of the elements of asynchronous and simultaneous distant and mobile learning. Blended learning in higher school is recommended as a part of traditional learning in class lessons. The aim of blended learning is to combine the advantages of traditional and distant learning and to reduce their defects.

The main problem in the introduction of blended learning in higher school is the low rate of self-management and self-control of learning students. If they are too low, the learning material won't be learned well enough and will influence the education quality. Therefore purposive work on the development of the student's self-educated skills and getting knowledge, making them communicative and cooperative in teamwork are not less important aims in the learning process and forming their informative and communicative competences.

For the realization of blended learning process technology in higher school computerized learning systems are mostly used. One of the most widespread systems of this type is Moodle (Modular Object Oriented Distance Learning Environment) (Website learning management system Moodle, Smirnova-Trybulska 2007).

Here we observe an example of electronic learning in higher school, in which one of the authors participated.

2.2 Web-oriented specialized software

Due to an extensive use of the Internet and its resources in higher education institutions, including technology Web 2.0 in the educational process, freely distributed software for electronic, blended and mobile teaching, web-oriented specialized software, there is an actual problem of creating a web-oriented methodical complexes of natural and mathematical courses. One of the ways to solve this problem is to use the web-oriented versions of mathematical software (*Matlab Web Server*, *webMathematica*, *wxMaxima*) and their integration with each other and with other software.

The example of such integration is *SAGE* (Software for Algebra and Geometry Experimentation) (www.sagemath.org). It is the open source system for performing symbolic, algebraic and numerical calculations and graphical constructions in which interface is written in a powerful programming language Python, and that integrates with both commercial SCM (Maple, Mathematica, Matlab), and open source SCM (Skilab, Maxima, Octave, etc.). In addition, SAGE can integrate with e-learning

systems (e.g., Moodle), which is very important for creating the web-oriented educational and scientific information environments and web-oriented methodical systems of teaching of mathematical subjects.

The innovative web-oriented ICT for teaching natural and mathematical courses include the system *Wolfram|Alpha* – a computational knowledge engine (CKE). Wolfram|Alpha (www.wolframalpha.com) is based on the processing of a natural language (currently – English), to a vast library of algorithms and NKS (New Kind of Science) – the approach to finding answers to queries. Wolfram | Alpha does not return a list of links, based on the results of the query and calculates the answer based on its own knowledge base, which contains information about mathematics, computer science, physics, astronomy, chemistry, biology, medicine, history, geography, politics, music, cinematography, and information about famous people and websites.

2.3 Mobile ICT learning

Among the existing ICT and teaching methods the most favorable to the realization of higher mathematics under the blended model are mobile information and communication technologies.

Mobile information and communication technology learning are considered as a set of mobile hardware and software, and system methods and forms of use of such principles in the teaching process in order to get, storage, processing and playback of audio, video, text, graphics and multimedia data in operative communication with global and local resources (Slovak, Semerikov, Tryus 2011).

The introduction of mobile ICT into the methodical systems of teaching mathematical and computer sciences at the university changes all its components, but to the greatest extent it changes the technological subsystem of methodical teaching (principles, methods of teaching forms). The leading teaching methods of mathematical disciplines are mobile means of general and special purpose: hardware (mobile phones, smart phones, e-books, notebooks and net books, PCs, tablets, etc.) and software (mobile system to support learning, mobile educational software, feedback communication system, mobile systems of computer algebra and dynamic geometry).

As mobile mathematical software of learning of higher mathematics the new system *MathPiper*, which integrates computer algebra system *Yacas* and dynamic geometry system *GeoGebra*.

2.4 Mobile environments

Today, an opportunity of teaching anywhere and at anytime is a general trend of intensification of life in the information society. Such opportunity is provided mostly using the so-called mobile teaching – the new method of teaching, which is based on the intensive use of modern principles and mobile technologies (Slovak, Semerikov, Tryus 2011).

Mobile learning is a new educational paradigm and on its base a new teaching environment is being created, where students can access teaching materials at anytime and anywhere, making the teaching process more appealing, democratic and it promotes students to self-teaching and training throughout life.

Mobile environment (ME) can be defined as an open modular mobile network information-computing software that provides users (teachers, students) with mobile access to information resources and educational purposes, creating conditions for the effective organization of the educational process and the integration of classroom and extracurricular work. The main components of ME are computational kernel, information and methodological support (lecture demonstrations, presentations, and other educational materials in electronic form, accessible, dynamic mathematical models, educational expert systems) and network server.

Technical universities in Ukraine have some experience in creating mobile mathematical environments (MME) used in teaching students of higher mathematics and other mathematical disciplines. The main criteria for selecting Mathematical software for the computational kernel MME are: scalability (the system should permit the user to supplement it to solve new classes of problems); availability of various interfaces and support for web-services (for mobile access); cross-platform (mobility software); the ability to create applications with standard controls (lecture demonstrations, dynamic models, simulators, educational expert systems); the ability to integrate with a variety of software (based on open APIs); support for Wiki; the possibility of localization and free distribution. In particular, the SAGE that satisfies almost all of the following requirements can be used in the way of the computational kernel MME.

3. THE MAIN TRENDS IN CLOUD COMPUTING APPLICATION IN UKRAINE'S TECHNICAL UNIVERSITIES

In the document The NIST Definition of Cloud Computing the National Institute of Standards and Technologies (NIST) it is pointed out that Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics (On-demand self-service, Broad network access, Resource pooling, Rapid elasticity, Measured service), three service models (SaaS - Software as a Service, PaaS - Platform as a Service), IaaS - Infrastructure as a Service), and four deployment models (Private cloud, Public cloud, Hybrid cloud, Community cloud).

In work (Tony Shan 2009) are considered a taxonomy to classify a variety of XaaS (Anything as a Service) offerings, which extends the traditional SaaS, IaaS, and PaaS areas (Figure 1).

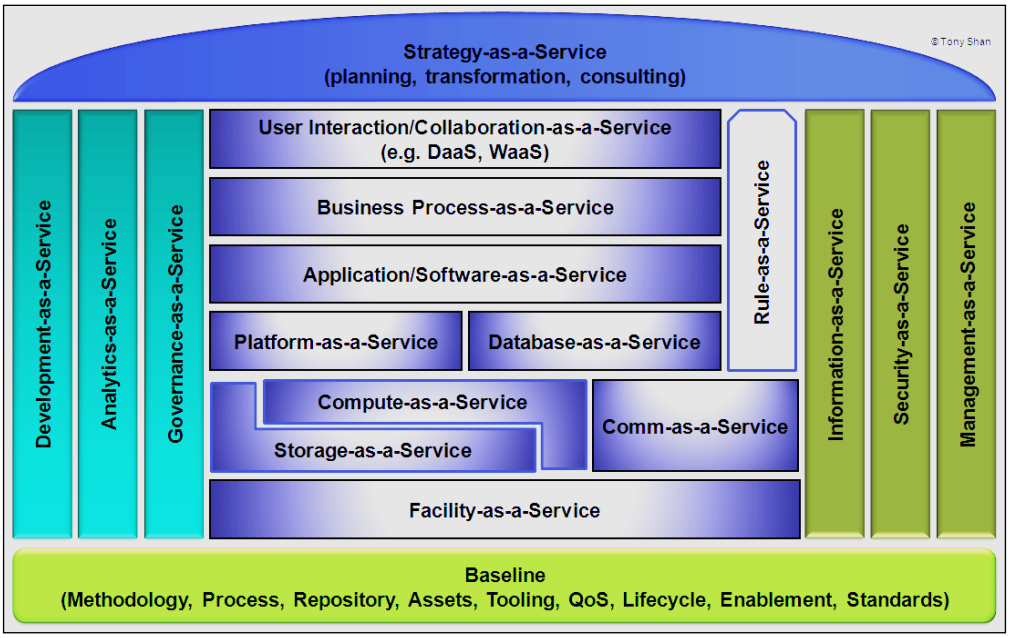

Figure 1. Cloud Taxonomy and Ontology

Source: Tony Shan, 2009

The cloud computing distinguishes from the previous models (distributed computing, grid computing) first of all with the principle of computing power, rent of necessary software, hardware or the provision of the entire infrastructure as a service on Internet. Table 2 provides an overview of cloud providers whose services Ukraine's universities use the most (Seidametova 2012).

Table 2.

Cloud Providers (Vendors) Overview

#	Provider (vendor)	Cloud service Model	#	Provider (vendor)	Cloud service Model
1	Google Apps Engine	SaaS	6	Oracle	PaaS/SaaS
2	Microsoft Azure Services Platform	IaaS / PaaS	7	IBM	IaaS / SaaS
3	Amazon Web Services	IaaS / PaaS	8	Cisco	IaaS
4	VMware	IaaS	9	GoGrid	IaaS
5	Rackspace	IaaS / PaaS	10	Salesforce	IaaS/PaaS/SaaS

Source: Seidametova, 2012

Application of cloud computing in university education gives the opportunity for higher education organizations to use computing resources and software applications on Internet as a service, allows intensifying and improving the learning.

Today there is no alternative for collaborating on text documents, electronic worksheets, presentations, data stores, files and synchronization. Table 3 provides a list of vendors of cloud offices and services, which are to some extent used by universities of Ukraine.

Table 3.

Vendors of cloud offices and services

Vendor	IBM Docs	Google Docs	Office Online (previously Office Web Apps)	Zoho Docs
Sait	greenhouse.lotus.com	docs.google.com	office.microsoft.com/ru-ru/web-apps onedrive.live.com	www.zoho.com/docs

Source: Seidametova, 2012

Examples of the most popular modern services in Ukraine based on cloud computing for education are the Live@edu, Microsoft's (https://login.live.com) and Google Apps Education Edition (http://www.google.com/enterprise/apps/education).

A list of cloud services Windows Live from Microsoft includes: *Windows Live Mail, Windows Live SkyDrive, Windows Live Messenger, Windows Live for Mobile, Windows Live Alerts, Office Online (previously Office Web Apps)*.

Office Online is an online office suite offered by Microsoft which allows users to create and edit files using lightweight, web browser based versions of Microsoft Office applications: Word, Excel, PowerPoint, and OneNote. The offering also includes Outlook.com, People, Calendar and OneDrive, all of which are accessible from a unified app switcher.

Google develops and provides a range of applications and services which are accessible from any page in a browser (Mozilla Firefox, Google Chrome, Opera, Internet Explorer etc.) when connected to the Internet. In our opinion, the most frequently used Google Apps for Ukrainian academia are the following: *Google Calendar, Google Docs, Gmail, Google Knol, Google Maps, Google Sites, Google Translate, YouTube*.

In the above mentioned list of services Google Apps plays a special role. It is a service provided by Google to use its domain name to work with Google services. Domain name registration is possible through a registrator authorized by Google. Google Apps has free basic and professional packages. Google Apps Education Edition is developed for educational purposes and is a free package for educational

organizations including all the opportunities of professional package (http://www.google.com/intx/uk/enterprise/apps/ education/products.html).

This gives a university the opportunity to use cloud services described below:

- cost saving for student mail server managing and keeping; as there is no need for keeping a high disk space server, protecting against spam and viruses, thereby reducing the expenditures for support staff;
- increasing data and information resources accessibility; creating of mailing group for notifying on the conferences, changes in the schedule, graduates mixes, administrative events;
- competitive advantage offering maximum of the possible services to students; educational organizations create a competitive advantage over others that limit the student by basic services;
- supporting community graduates and establishing relations with them with minimal efforts and money.

The usage of cloud solutions enable universities to deploy mobile resources such as e-learning systems, digital libraries, and expand resources for research, web portals, information systems, OLE system, provide hosting services.

Applications that a university uses are integrated into the infrastructure of the cloud provider. The University must pay attention to the standardization and automation of deployment and service updating in provider infrastructure; take account of billing procedures.

Thus, for the cloud technologies deployment and usage in universities it is necessary to consider the peculiarities of the cloud architecture and specific categories of users, and also rebuild management infrastructure and university procedures of operational management according to cloud technologies.

Flexibility and dynamism of the cloud infrastructure enables universities to combine reasonably the usage of peaks and slumps of workplace load and minimize operating costs.

Let’s consider some examples of cloud technologies possibly used at Ukrainian technical universities.

3.1. e-learning & blending learning

The modern projects of e-learning and blending learning are using the virtualization process and such concepts as «Elastic infrastructure», «Partitioning of Shared Resources», and «Pooling Compute Resources».

Currently there are a number of specialized solutions for e-learning and blending learning, for example, *Moodle*, *Blackboard*, *Google OpenClass*, *Canvas*, *Piazza*, *eFront*, *ILIAS*, *Claroline*, *Sakai*, *OpenSIS* and other. Some of them are services that are as an Student Information System (SIS) (like solution with open-codes

OpenSIS), other are system of LMS (LCMS) (Moodle, Canvas, ILIAS, Claroline, Piazza), and others integrate components of both systems (OpenClass). In Ukraine, the most common is the LCMS Moodle (moodle.org).

The example of the new generation online learning systems is the joint product of companies Pearson and Google called OpenClass (http://www.joinopenclass.com). OpenClass combines elements of LMS and social networks. The users can run this product from Google Apps. The beta version of OpenClass is implemented. Many universities test this beta version, including the universities of Ukraine, for example Crimean Engineering and Pedagogical University (Seidametova 2012).

On the one hand, e-learning system is an effective educational technology which allows to replace some traditional learning programs, reduce learning costs, and intensify the learning. On the other hand, online learning creates a lot of its own problems.

So, there is a new problem of higher education*: the most successful universities will be able to attract millions of students from all over the world; weak universities will lose students and they can't withstand the online projects of strongest universities*.

3.2. Teachers and students training at open courses of world leading universities

The most popular and successful online learning projects using the advantages of cloud computing is massive open courses (*Massive online-Open Course* – MOOC) offered by projects *Coursera* (https://www.coursera.org), *MIT OpenCourseWare* (http://ocw.mit.edu/index.html), *Stanford Online* (http://online.stanford.edu/course), *Udacity* (http://www.udacity.com), and *edX* (https://www.edx.org).

Project Udacity was created for education democratization and improving the training on computer science. Courses are offered as video lectures based on integrated tests, homework; there are also video conferences, forums in the format of «student-teacher», «student-student». As a pedagogical concept the model «learning by doing» is used. The assignments for each lecture are intended to help students to understand the concept and ideas presented during the lessons.

Coursera Project offers free online courses of leading American universities. Courses include lecture notes, homework assignments, tests, and exam questions. Unlike the project Udacity, Coursera project offers courses not only at computer science but other courses including «economics, finance and business», «mathematics and statistics», «society, network and information», «public and social science, health, medicine, and biology».

EdX offers interactive online classes and MOOCs from the world's best universities. Online courses from MITx, HarvardX, BerkeleyX, UTx and many other universities. Topics include biology, business, chemistry, computer science, economics, finance, electronics, engineering, food and nutrition, history, humanities, law, literature,

math, medicine, music, philosophy, physics, science, statistics and more. EdX is a non-profit online initiative created by founding partners Harvard and MIT.

MIT OpenCourseWare is a web-based publication of virtually all MIT course content. OCW is open and available to the world and is a permanent MIT activity. For higher engineering education courses in electrical engineering, systems engineering, computer science, engineering and economy (total 2150 courses) would be useful.

Stanford Online offers a variety of professional education opportunities in conjunction with many of the University's schools and departments. Stanford Online also offers an array of free online courses (including some engineering disciplines and computer science) taught by Stanford faculty to lifelong learners worldwide.

The main goals for teachers of Ukrainian universities during training on MOOC are: to use methods of MOOC for improvement of traditional and distance learning, qualification improvement, improvement of existing and development of new educational courses on the basis of the obtained knowledge and experience.

3.3 IT professional certification programs

Gap between knowledge that a student gets in a higher school and the actual need of economy in highly qualified professionals is one of the main problems of higher education in Ukraine. Certification programs are popular now at helping contemporary specialists (graduates, students) to improve their skills and knowledge required in the work practice. Certification enables IT specialists and students to acquire up-to-date and needed skills at the job market that are of value for employers, as well as to improve the level of their professional capabilities.

To provide services on a competitive level the modern specialist must know the latest technologies. They must be well trained to achieve this. Modern information technologies are developing so fast that it is quite difficult for professionals to remain competent and qualified enough specialist without specialized training.

Professional certification enables IT professionals to complete training and receive formal confirmation of their knowledge and skills of the latest ICT. The most recognized certification system now is a so-called international IT certification which allows to obtain a certificate from a vendor/manufacturer of a product. For many years the leaders at this field are hardware, software, networking and telecommunications equipment, etc. manufacturing companies (Microsoft, Google, HP, Cisco, Oracle, IBM and others).

Cloud technologies have opened entirely new opportunities for self-education and knowledge and skills improvement for students and graduates of IT specialties. Certification programs provide unlimited technical possibilities for the instructors of ICT disciplines to improve students and professionals skills.

In that context certification programs are one of the actual ways to obtain the necessary knowledge and skills in the field of cloud technologies, which are

currently being offered by leading cloud providers including Microsoft, IBM, HP, Google, Cisco, VMware, and others.

3.4 Using cloud technology at teaching mathematical, natural, and professional courses

Examination of the experience of ICT using in IT students higher math teaching in the US has provided an opportunity for scientists of the Kryvyi Rig National University (Rashevskaya 2013) to affirm that now development stage of the higher engineering school leading medium at IT students higher mathematics learning are online ICT and cloud services of general purpose (learning management system, allocation of open learning materials system, communication and collaboration facilities) and special purpose tools (computer mathematics web-system: *webMathematica*, *WolframAlpha*, *MapleNet*, *SAGE*, *vxMaxima*, mathematical editors, trainers, training web-expert systems) which are an integral part of the *mobile mathematical environment* (Slovak, Semerikov, Tryus 2011). Different models of ICT and cloud technologies usage at IT students higher mathematics studying are being implemented at the Ukrainian technical universities, particularly at CSTU.

For teaching IT students at CSTU and other Ukraine's universities free cloud environment are used for program development in different programming languages (*C, C++, Html, Java, JavaScript, Pascal, Perl, PHP, Python, Ruby, SQL, Visual basic, Scheme*). They include the following browser programming system: Scratch.mit.edu, PascalABC.NET, IDEOne.com, CodePad.org, CollabEdit.com, editor.condex.net/pythonv3, TouchDevelop.com.

The virtualization technology provides big opportunities for training students in computer majors, work with operating systems and computer networks in real time. This advantage is used in the teaching of such courses as «Operating systems», «System programming», «Parallel and distributed computing», «Computer networks», «Information Security». There are a specific virtual environment and the necessary software for various disciplines. Use of cloud technology at higher mathematics and other mathematical, natural and professional courses teaching for IT students majors allows to reach the high mobility level of students and teachers. The textbooks content together with other electronic educational resources, support facilities of mathematical and professional activities are carried in the web environment which substantially expands the range of ICT tools that can be used for training.

There is a new form of training – mass open distance learning courses (MOOC). The leading forms of the training organization are cloud oriented lectures, practical and laboratory classes.

4. EXPERIENCE OF CSTU ACCORDING TO THE IMPLEMENTATION OF INNOVATIVE TEACHING TECHNOLOGIES

Cherkasy State Technological University (CSTU), where the authors work, is one of the leading state educational establishments in Ukraine providing the country with highly qualified specialists. Throughout its more than 50-years-old existence CSTU has proved to be a well-known outstanding regional institution due to its achievements in educational and scientific fields.

Our graduates are a new generation professionals ready to organize an effective production under market economy conditions on the basis of modern technologies. At present CSTU has the necessary scientific and material basis to broaden the field of research in different directions currently important for both, Cherkasy region and Ukraine.

CSTU is a typical representative of the Regional Technical University of Ukraine, which prepares future IT professionals. So it has all the problems stated above in this activity. Here are some practical steps for the university to solve them.

1. The E-learning system of CSTU based on system Moodle 2.5.4 is designed and implemented for the realization of the blended model of learning, improvement of traditional teaching, conducting ~~of~~ various types of controlled teaching activities of students, as well as for testing of created distance courses. About 120 teachers have been trained for the use of distance learning technologies. They have created more than 250 distance courses.

The E-learning System of CSTU is intended for supporting the learning process of full-time, distance and external students, for management of their individual work and for monitoring and executing control and assessment of students' educational achievements in automated mode. The E-Learning System of CSTU is integrated with the electronic university library.

E-Learning System of CSTU is made accessible to all students and teacher staff and administration of the higher school according to the rights of access to the information resources and its subsystems.

For the successful software support, monitoring and assessment of blended learning in E-Learning System of CSTU is created with its full elements structure. It includes course structure, course scheduling, course curriculum, initial control, course modules, accounting-graphic and projects database, final test and general knowledge assessment tasks. Each module has its organization structure of the course.

Learning process organization in e-learning system is connected with individual task completion, examination, computerized questionnaire, discussions on Internet forums and chat.

The qualification project (Tryus 2012) describes in details the system e-learning in higher school on the basis of Moodle and its peculiarities in use for all types of education in learning process management.

2. The University received free license program of the IT Academy Microsoft (software package DreamSpark) for the software from Microsoft. The University makes extensive use of open source system and problem-oriented software, cloud technology to the educational process in the computer field. At CSTU Information Technologies and Systems Faculty cloud-oriented IT infrastructure with use of Google and Microsoft Office 365 services is being implemented.

3. In January 2013 the Memorandum about the establishment of Research and Teaching Center of HP was signed between the HP Company and CSTU. Today there are 25 such centers in the leading universities of Europe.

4. The Test Center on the basis of Certiport company was created in cooperation with HP in CSTU. This center has trained 30 teachers on the program HP ATA (Accredited Technical Associate), which provides training and certification of IT professionals in 4 areas: Networks; Server & Storage; Connected Devices; Cloud. Besides, CSTU professors who teach computer courses study at courses provided with Coursera, Udacity, EdX projects. Note that every year approximately 20% of the Information Technologies and Systems Chair of CSTU graduates are trained in Microsoft Virtual Academy, HP Accredited Technical Associate, other educational programs and get certificates.

5. The graduates of computer specialties of University take 70% of positions in the leading IT companies throughout the region. They joined the students to develop the real IT projects and startups, some of which have already received international recognition.

6. In CSTU the "IT job Fair" is regularly held for students of computer specialties in which the leading IT companies of the region under Ukrainian Hi-Tech Initiative can participate. The results of the "IT job Fair" demonstrate that many students get the motivation for teaching and mastering the future profession, and about 20% of participating students find places of their future jobs. In addition, the University resolve the teaching programs of professionally-oriented courses of computer specialties in order to fill them with new content.

7. In Cherkasy State Technological University regularly organized International Scientific-Practical Conference "Information Technologies in Education, Science and Technology" (ITEST) (website of the ITEST: itont-2014.cdtu.edu.ua). The conference purpose is to stimulate the research in the field of information-communication technologies (ICT), definition of perspective ICT directions application in science, education and technique, exchange of scientific information and practical achievements in this field, establishment of closer relations between universities and scientific institutions of different countries, encouraging young people to scientific research. Co-organizers of these conference are: Educational and Scientific Complex "Institute for Applied Systems Analysis" NTUU "KPI",

Institute of Information technology and methods of learning NAPS Ukraine, International Research and Training Centre for Information Technologies and Systems Academy of Sciences of Ukraine and Ministry of Education, Science of Ukraine, Eastern Washington University (USA), University of Silesia in Katowice (Poland), Space Research and Technology Institute Bulgarian Academy of Sciences BAS (Bulgaria).

8. During last years Ukrainian universities including CSTU actively do research at using cloud technologies in education, including engineering education. In 2012 a joint research laboratory on the use of cloud technologies in education in Kryvyi Rig National University and Institute of Information Technologies and Training Means of NAPSU (http://cc.ktu.edu.ua) was established. Video is available on http://www.ustream.tv/channel/cc-seminar. The results of this work are discussed at scholarly conferences and seminars held at different levels including The International Workshop «Cloud Technologies in Education'2013» (CTE2013) (website of the seminar: http://tmn.ccjournals.eu/index.php/cte/2013). Presentation of reports on the seminar is available on the website http://cc.ktu.edu.ua/?p=163. Co-organizers of these seminars are: Institute of Information Technologies and Learning Tools of the NAPS of Ukraine, Kryvyi Rih National University, Cherkasy State Technological University, National Technical University "Kharkiv Polytechnic Institute", Taras Shevchenko National University of Luhansk, Kherson State University, Eastern Washington University. The best reports will be published in the electronic journal «Information technologies and teaching facilities» – scientific reviewed electronic edition, providing information to readers and is available at: http://journal.iitta.gov.ua.

CONCLUSION

1. The activity of technical Universities that train future IT professionals should focus on the organization of the educational process through innovative educational and informative and communicative technologies, the use of which can ensure the creation of a single educational and scientific informative environment in the University in which teaching activity of students will be a specific model of their future careers in the conditions of information society.
2. The rapid spread of cloud computing sets the task of integrating cloud services in the management system of educational institutions, changing their IT infrastructure, and implementation of innovative technologies in education.
3. Modern Internet technologies do not only change the world around us, but also actively allow the introduction of innovation in education. This does not only change the form, but also contents and methods of education. As a result of these Internet innovations we can intensify the motivation of students for new knowledge, enhance the process of teaching and learning, as well as influence and improve the overall quality of education.

REFERENCES

Collis, B., 2001: *Learning in a digital world: experiences and expectations*. Kogan Page Limited, London, 231 p.

Exploring Ukraine. IT Outsourcing Industry, [online] at http://hi-tech.org.ua/wp-content/uploads/2012/08/Exploring-Ukraine-IT-Outsourcing-Industry-20121.pdf, (accessed 26 August 2014)

Heinze, A., *On The Use Of Blended Learning*, [online] at http://www.ece.salford.ac.uk/proceedings/ papers/ah_04.rtf, (accessed 26 August 2014)

Key indicators of higher education in Ukraine at the beginning of the school year 2013/14, *Statistics Social Services*, [online] at http://ukrstat.org/uk/druk/publicat/kat_u/publposl_u.htm, (accessed 26 August 2014) [In Ukrainian]

Rashevskaya, N., 2013: *Application of learning environments for support the teaching process of higher mathematics: the experience of the U.S.* / N.V. Rashevskaya, N. M. Kyyanovskaya // Pedagogical science: theory, history, innovative technology: scientific journal. – Sumy: Sumy SPU named after A. S. Makarenko, 2013. – № 2 (28). – P. 295-304 [In Ukrainian]

Seidametova, Z, Ablyalimova, E., Medzhytova, L., Seitveliyeva, S., Temnenko, V., 2012: *Cloud technologies and education*: under the gen. ed. Of Z. S. Seidametova. – Simferopol: «DIAIPI», 2012, 204 p. [In Russian]

Slovak, K., Semerikov, S., Tryus, Y., 2011: *Mobile mathematical environment: current status and prospects*, Scientific Journal NEU Dragomanov, Series 2. Computer-oriented learning systems, Kyiv, 2011, No. 12 (19), pp. 102-109 [In Ukrainian]

Smirnova-Trybulska E., 2007: *Distance learning with the use of MOODLE: teaching guide*, Ailanthus, Kherson, 2007, 492 p. [In Ukrainian]

The NIST Definition of Cloud Computing, [online] at http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf, (accessed 26 August 2014)

Tony Shan, 2009: *Cloud Taxonomy and Ontology*. February 2009, [online] at http://cloudonomic.blogspot.com/2009/02/cloud-taxonomy-and-ontology.html, (accessed 26 August 2014)

Tryus, Y., 2012: *Innovative information technology in teaching mathematical courses*, Bulletin of the National University "Lviv Polytechnic", Series "Informatization of higher education", Lviv, 2012, No. 731, pp. 76-81

Tryus, Y., Cahala, T., 2013: *Innovative Educational Technologies in Training IT Professionals in the Technical Universities of Ukraine*: ICEER'13 Conference Proceedings: International Conference on Engineering Education

and Research, iCEER-2013, Marrakesh, Morocco, July 1–5, 2013, P. 614-621: ISBN 978-9954-9091-2-6

Tryus, Y., Gerasimenko, I., 2012: *Combined training as innovative educational technology in higher education*. Theory and methods of e-learning: a collection of scientific papers, issue III, 2012, P. 299-308 [In Ukrainian]

Tryus, Y., Yatsko, O., 2013: *Theoretical and practical aspects of computer course «Information technology» for blended learning of future economists*: E-learning & Lifelong Learning, Monograph Sc. Editor Eugenia Smyrnova-Trybulska, University of Silesia, Studio-Noa, 2013, 587 p., pp. 329-342. ISBN 978-83-60071-66-3