The cloud-based learning environment of educational institutions: the current developments

Mariya Pavlivna Shyshkina
Department of Educational Institutions Informatization, Institute
of Information Technologies and Learning Tools of the NAES of Ukraine,
9, Maksyma Berlynskoho str., Kyiv, 04060, Ukraine
marple@ukr.net

Abstract. *The purpose* of the article is to describe the state of the art of cloud-based learning environment formation and current developments of its design, the main *task* – analyze of cloud-based learning tools and services use at the educational institutions in Ukraine, the *object* – the cloud-based learning environment, the *subject* – the cloud-based learning environment of educational institutions, the main *research method* is analysis and design.

The current tendencies of cloud computing technologies use as the e-learning platform of educational institutions in Ukraine are described. The state of the art of cloud computing services application is revealed. The results of a survey of cloud-based learning tools and services use at the educational institutions in Ukraine are presented. The holistic trends of cloud-based learning environment development are described. The results of holistic learning modeling are reported. Perspective ways of cloud-based learning environment development at the educational institutions in Ukraine are exposed.

Keywords: e-learning; cloud computing; learning environment; open education.

М. П. Шишкіна. Хмаро орієнтоване навчальне середовище освітніх установ: поточний стан

Анотація. *Мета* даного дослідження полягає в описі поточного стану формування хмаро орієнтованого навчального середовища, його становлення та проектування, *основним завданням* є аналіз хмаро орієнтованих засобів навчання та сервісів, якими послуговуються в навчальних закладах України, *об'єкт дослідження* – хмаро орієнтоване навчальне середовище освітніх установ, *предмет* – хмаро-орієнтоване навчальне середовище, *основний метод дослідження* – аналіз та проектування.

Описані сучасні тенденції використання хмарних технологій в якості платформи електронного навчання у навчальних закладах України. Розкрито сучасний стан застосування хмарних сервісів. Представлені результати опитування стану використання хмаро орієнтованих засобів

навчання та сервісів у навчальних закладах України. Описані тенденції розвитку навчального середовища на основі хмари. Представлені результати холістичного моделювання, описані перспективні шляхи розвитку хмаро орієнтованого навчального середовища у навчальних закладах України.

Ключові слова: електронне навчання; хмарні технології; навчальне середовище; відкрита освіта.

Організація: Відділ інформатизації навчально-виховних закладів, Інститут інформаційних технологій і засобів навчання НАПН України, вул. М. Берлинського, 9, м. Київ, 04060, Україна.

E-mail: marple@ukr.net.

The processes of innovative development of educational space, which is created within the educational institution, are to account for tendencies of emerging learning technologies development and improving ICT innovation. So as to estimate the possible ways of learning environment modernization and search for new engineering and technical solutions of its organization the cloud-based trends should be considered [4; 7; 11; 12]. The main focus is on shifting from a mass introduction of separate software products to integrated and combined environment supporting distributed network services and cross-platform tools [7; 5; 12].

1. The current trends of research of cloud-based learning environment

Cloud computing (CC) is an important trend of open learning technologies development. It gives new possibilities for an e-learning organization while changing the entire notion of the e-learning platform [1]. This technology implementation supposes flexible and adaptive use of resources and services while the platform itself may be dynamically formed and accessed by the user [1]. This creates a potential for individualization of the process of education, formation of personal learning trajectories of students, selection and use of appropriate technological tools [1; 7].

Unfortunately, the dissemination and use of modern ICT-based techniques and tools in a learning environment of higher education is characterized by a number of negative trends [12], including such as:

– deepening the gap between the level of development of modern information technological platforms of e-learning and current supply of educational institutions with the facilities and services of information communication networks;

– deepening the gap between the needs of modern society in improving the quality of education and outdated technologies to train employees and to

supply educational services.

Due to the formation of innovative ICT infrastructure of the institution there is a way to solve some of the aforementioned problems. Cloud computing technology is to create a high-tech learning environment of the educational institution, enhancing many accesses to learning resources at different levels and domains. On this basis, it is possible to combine corporate resources of the university and other on-line tools, adapted to learner needs, within a united structure [8; 9]. It would combine the training resources of educational and industrial projects, covering different levels of training, including training of both students and pedagogical personnel.

As for the design of the cloud-based learning environment the service models and a set of instrumentation tools with a system of methodological and technological support for the learning process development should be created. But first there is a need to estimate pedagogical benefits of particular ICT, the possible learning output of its use to make a good decision of the necessary tools and services. Therefore, the primary research of cloud-based learning process settings, and the problems of innovative educational technologies development become a subject of current research.

There is a need to examine CC as a possible e-learning platform for an educational institution, taking into account some didactic, methodical, technological, organizational and other use features, to make good decisions as for its pedagogical benefits and most fruitful trends of use. For this aim, the Joint laboratory «Cloud Computing in Education» (CCELab) was created on the basis of Kryvyi Rig National University and Institute of Information Technologies and Learning Tools of the National Academy of Educational Sciences of Ukraine in 2012, http://cc.ktu.edu.ua/. The main goal of the CCELab is methodological and experimental research of emerging e-learning technologies and exploration of different aspects of cloud computing application for education and personnel training. The virtual laboratory CCELab is available at http://www.ccelab.ho.ua to reflect currents state of research and exchange opinions.

So, main aims of CCELab are:

– coordination of research and development on the problems of using cloud technology in education, carried out at the Institute of Information Technologies and Learning Tools of the National Academy of Pedagogical Sciences of Ukraine, in National University of Kryvyi Rig, other universities and institutions;

– development, testing, implementation and experimental approve of cloud cloud-based e-learning platforms, tools and services;

– investigations on cloud-based learning environments modelling and applications;

– experimental study of cloud-based e-learning infrastructures for education and training of professionals;

– research for fundamental, methodical, technological, organizational and other use features, presupposition of an introduction and perspective ways of use of cloud technologies in education.

– publication and discuss of results of scientific and experimental study of the laboratory;

– participation in the organization of international and national scholarly conferences, seminars and more.

As defined by the National Institute of Standards and Technology USA (NIST), cloud computing is a model of user-friendly network access to the general fund of computing resources (such as networks, servers, data files, software application and services) that can be quickly provided with minimal managerial effort or interaction with the provider. So, the essence of the concept of CC is to provide end users with dynamic access to services, computing resources and applications (including operating systems and ICT infrastructure) over the Internet [7].

The benefits of cloud computing in the field of e-learning systems development and use are characterized by the following factors:

– abandon the installation, support and maintenance of licensed software, which could be ordered as an Internet service;

– the ability to multi-channel updating and use of collections of educational resources of an organization;

– solving intellectual privacy problems and authorization;

– support of distributed learning processes, due to virtual projects development;

– reduction of equipment cost while dynamically increasing the hardware resources such as memory, speed, throughput, etc.;

– support of processes cumbersome calculations and maintain large volumes of data;

– providing mobility of learning using cloud communication services [9];

– availability of a variety of e-learning systems and resources for many educational institution.

Due to the development of cloud computing technologies capabilities of access and functionality of electronic resources has been increased. By this reason, creating of effective methods of educational resources quality evaluation will improve the efficiency of their use. So, cloud computing technology is a promising direction of development of electronic resources uses giving way to the elaboration of improved methods of multiple accesses to electronic resources collections and being a uniform methodology of a single platform, the basis for the development and testing, improvement and

development of integrated methods for assessing the quality of these resources.

2. State of the Arts of Cloud Computing Technologies Application

To show the state of the arts of cloud based learning environment development and the rate of cloud-based services use by educational personnel in Ukraine the survey was made within the framework of the International internet-seminar «Cloud Computing in Education» held by CCELab in December, 2012, http://cc.ktu.edu.ua/report.html. At this seminar, there were 127 members from the 54 educational institutions from 22 cities of 18 regions of Ukraine. As the participants were those, concerned with the problems of CC, so they were those, being well acquainted with the modern trends of technological development, and their organizations were well equipped and oriented for the use of advanced ICT.

To the question: «How can you characterize the learning environment of your educational institution?» the responses showed that 48 % of participants considered it to be a computer oriented (COE), 36 % – to be a computer integrated (CIE); and 14% – to be personalized, i.e. cloud-based (PE). The results are presented at Fig. 1. (The entries are excluded).
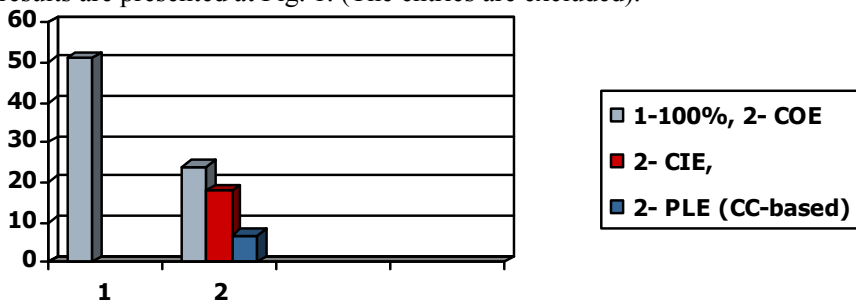

Fig. 1. The results of the survey for CC use at the institution of higher education in Ukraine

For the question: «For what activity types do you use cloud services?» the results were the next, (Fig. 2, the entries are not excluding):
  – organization of collaborative learning – 50 %;
  – learning resources management and delivery – 42 %;
  – electronic document processing – 30 %;
  – office applications – 24 %;
  – learning, professional communities – 28 %;
  – web-conferences, webinars – 34 %;
  – electronic libraries – 18 %;
  – data retrieving – 13 %.
As it appears from the study, the cloud-based services are widely used in

educational institutions still its use is not systematic, it is not organized into the united system, it is not consciously and purposely oriented to pedagogical aims. So there is a current need for the upgrading of ICT competence of educational personnel of informatization of education, mainly those engaged with providing educational systems with emerging ICT, in particular, public administration employees.
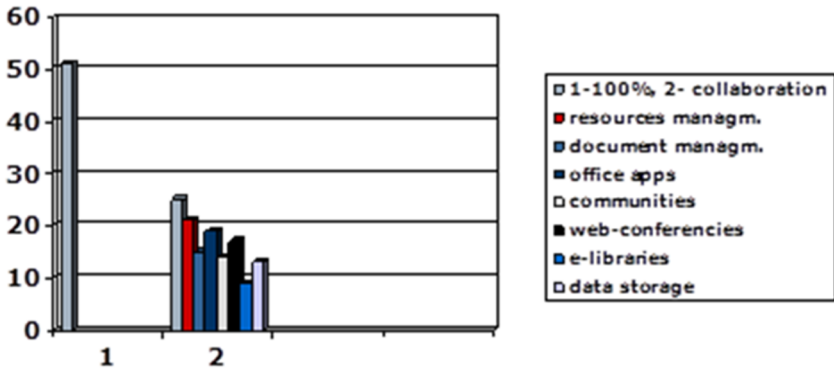

Fig. 2. Application of cloud-based services at the educational institutions in Ukraine

3. A Holistic View for Learning Environment Design

While taking the problems of cloud-based environment design, it should be noted especial importance devoted to holistic trends in its organization.

The idea of holistic learning occurs in relation to personnel training, concerning to different components and interactions within educational organization. It may touch upon certain types of activity, collaboration and resource management processes, engaging the entire organization at all levels, to occupy different stages of educational development. So, the design of the learning environment, developed in [6] is to show main components and types of interactions within the different learning process settings.

The holistic approach is to consider the problems of innovative development of the area as a whole, encompassing not only the technological investment projects, but also an introduction of social and organizational innovation [2; 12]. It supposes education and training of productive forces of the area in accordance with local priorities, social and technological aims of development [2]. This requires the combined efforts of both business and social, scientific and educational institutions to determine the most preferred ways of development. These processes are implemented through the corporations and consortia of organizations, which are based on a distributed network structure of training and professional development [12]. Integration of educational spaces of educational institutions is realized within educational

clusters. Clusters are a form of cooperation in the field of science, research and innovation, when there is an amalgamation of companies and organizations that are related to the kind of industrial activity [12]. Cooperation may take the form of information exchange; resources sharing, pooling in terms of the processes of training and employment of personnel.

The cloud based solution is to solve some of the aforementioned problems, giving tools for unifying corporate resources of the university with other resources within clusters, providing a holistic solution to services representation.

The cloud-based learning infrastructure is to support the processes of holistic learning basing on a model reported in [3]. All the components of a specialist's competencies, skills and knowledge are consistently formed within the main levels of education which corresponds to the National qualification framework (levels 5-9). Thus the learning environment may occupy several levels of engineering and technical education on the basis of unite infrastructure.

4. Analysis and Estimation of Perspective Ways of Development

The important step to wider use and further introduction of new training approaches should be achieved through modernization and upgrading of ICT learning environment of educational institutions, developing of the overall level of e-learning.

Due to the development of cloud computing technologies, functionality and access to collections of electronic learning resources has significantly increased. In this regard, cloud computing is a promising direction of development of electronic resources' collections, as it allows the creation of a unified methodology for a single platform, a framework for development and testing, and for development and elaboration of integrated assessment methods' quality. This gives added value to available recourses [12].

The social issues will help to increase educational potential of ICT and add value to the best examples of available training resources due to their flexible and learner-adaptive access.

The cloud-based learning infrastructure is to give the opportunities:

– to combine the processes of development and use of electronic resources to support learner competencies;

– to insure holistic approach to professional education and training, combining both technological and social competences, development of critical skills of a learner;

– to integrate the processes of training, retraining and advanced training, at different levels of education by providing access to electronic resources of a united learning environment;

– to solve or significantly mitigate the problems of association of electronic resources of the institution into unite framework;

– to access to the best examples of electronic resources and services to those units or organizations, where there is no strong ICT support services for e-learning;

– to provide of invariant access to learning resources within the unified educational environment, depending on the purpose of study or educational level of the student, enabling person-oriented approach to learning;

– to make conditions for a higher level of harmonization, standardization and quality of electronic resources, which may lead to the emergence of the better examples of learning resources and to more massive use them.

The result of instrumentation for cloud-based learning resources collection elaboration, and development of cloud-based learning environment of an educational institution might be used within different learning and organizational, educational structures.

References

1. Armbrust M. Above the Clouds: A Berkeley View of Cloud Computing [Electronic resource] / Michael Armbrust, Armando Fox, Rean Griffith, Anthony D. Joseph, Randy H. Katz, Andrew Konwinski, Gunho Lee, David A. Patterson, Ariel Rabkin, Ion Stoica, Matei Zaharia // Electrical Engineering and Computer Sciences University of California at Berkeley : Technical Report No. UCB/EECS-2009-28. – February 10, 2009. – Access mode : https://www2.eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-28.pdf.

2. Connecting Universities to Regional Growth: A Practical Guide [Electronic resource] / [John Goddard, Louise Kempton]. – September, 2011. – X, 53, 15 p. – Access mode : https://goo.gl/cPEQ5o. – (European Union Regional Policy).

3. Shyshkina M. P. Holistic Approach to Training of ICT Skilled Educational Personnel [Electronic resource] / Mariya Shyshkina // ICTERI 2013: ICT in Education, Research and Industrial Applications: Integration, Harmonization and Knowledge Transfer. – Proceedings of the 9th International Conference on ICT in Education, Research and Industrial Applications: Integration, Harmonization and Knowledge Transferine / Ed. by Vadim Ermolayev. – CEUR Workshop Proceedings. – vol. 1000. – 2013. – P. 436-445. – Access mode : http://ceur-ws.org/Vol-1000/ICTERI-2013-p-436-445-MRDL.pdf.

4. Sultan N. Cloud computing for education: A new dawn? [Electronic resource] / Nabil Sultan // International Journal of Information Management. – 2010. – Volume 30. – Issue 2, April. – P. 109-116. – Access mode : http://www.just.edu.jo/~amerb/teaching/1-10-11/cs728/8.pdf.

5. Zhang Q. Cloud Computing: State-of-the-Art and Research Challenges / Qi Zhang, Lu Cheng, Raouf Boutaba // Journal of Internet Services and Applications. – 2010. – Volume 1. – Issue 1, May. – P. 7-18. – Access mode : https://goo.gl/SFMMn8.

6. Биков В. Ю. Моделі організаційних систем відкритої освіти : монографія / Биков В. Ю. – К. : Атіка, 2009. – 684 с.

7. Биков В. Ю. Технології хмарних обчислень, ІКТ-аутсорсінг та нові функції ІКТ-підрозділів навчальних закладів і наукових установ [Електронний ресурс] // Інформаційні технології в освіті. – 2011. – Вип. 10. – С. 8-23. – Режим доступу : http://ite.kspu.edu/webfm_send/251.

8. Стрюк А. М. Методичні аспекти застосування хмарно орієнтованих засобів у підготовці фахівців з інформаційних технологій / А. М. Стрюк, М. І. Стрюк // Хмарні технології в освіті : матеріали Всеукраїнського науково-методичного Інтернет-семінару (Кривий Ріг – Київ – Черкаси – Харків, 21 грудня 2012 р.). – Кривий Ріг : Видавничий відділ КМІ, 2012. – С. 145-146.

9. Ткачук В. В. Хмарні обчислення як основа мобільного навчання / В. В. Ткачук // Хмарні технології в освіті : матеріали Всеукраїнського науково-методичного Інтернет-семінару (Кривий Ріг – Київ – Черкаси – Харків, 21 грудня 2012 р.). – Кривий Ріг : Видавничий відділ КМІ, 2012. – С. 54.

10. Туравініна О. М. Хмарні технології навчання у системі інформаційно-комунікаційних технологій навчального призначення / О. М. Туравініна // Хмарні технології в освіті : матеріали Всеукраїнського науково-методичного Інтернет-семінару (Кривий Ріг – Київ – Черкаси – Харків, 21 грудня 2012 р.). – Кривий Ріг : Видавничий відділ КМІ, 2012. – С. 9.

11. Чорна О. В. Світові тенденції розвитку хмарних технологій / О. В. Чорна, Н. А. Хараджян, С. В. Шокалюк, Н. В. Моісеєнко // Теорія та методика електронного навчання. – Кривий Ріг : Видавничий відділ КМІ. – 2013. – Том IV. – С. 272-284.

12. Шишкина М. П. Инновационные технологии в развитии образовательно-исследовательской среды учебного заведения [Электронный ресурс] / Шишкина Мария Павловна // Международный журнал «Образовательные технологии и общество». – 2013. – Том 16. – № 1, Январь. – С. 599-608. – Режим доступа : https://goo.gl/mzeh6j.

References (translated and transliterated)
1. Armbrust M. Above the Clouds: A Berkeley View of Cloud Computing [Electronic resource] / Michael Armbrust, Armando Fox, Rean Griffith, Anthony D. Joseph, Randy H. Katz, Andrew Konwinski, Gunho Lee, David

A. Patterson, Ariel Rabkin, Ion Stoica, Matei Zaharia // Electrical Engineering and Computer Sciences University of California at Berkeley : Technical Report No. UCB/EECS-2009-28. – February 10, 2009. – Access mode : https://www2.eecs.berkeley.edu/Pubs/TechRpts/2009/EECS-2009-28.pdf.

2. Connecting Universities to Regional Growth: A Practical Guide [Electronic resource] / [John Goddard, Louise Kempton]. – September, 2011. – X, 53, 15 p. – Access mode : https://goo.gl/cPEQ5o. – (European Union Regional Policy).

3. Shyshkina M. P. Holistic Approach to Training of ICT Skilled Educational Personnel [Electronic resource] / Mariya Shyshkina // ICTERI 2013: ICT in Education, Research and Industrial Applications: Integration, Harmonization and Knowledge Transfer. – Proceedings of the 9th International Conference on ICT in Education, Research and Industrial Applications: Integration, Harmonization and Knowledge Transferine / Ed. by Vadim Ermolayev. – CEUR Workshop Proceedings. – vol. 1000. – 2013. – P. 436-445. – Access mode : http://ceur-ws.org/Vol-1000/ICTERI-2013-p-436-445-MRDL.pdf.

4. Sultan N. Cloud computing for education: A new dawn? [Electronic resource] / Nabil Sultan // International Journal of Information Management. – 2010. – Volume 30. – Issue 2, April. – P. 109-116. – Access mode : http://www.just.edu.jo/~amerb/teaching/1-10-11/cs728/8.pdf.

5. Zhang Q. Cloud Computing: State-of-the-Art and Research Challenges / Qi Zhang, Lu Cheng, Raouf Boutaba // Journal of Internet Services and Applications. – 2010. – Volume 1. – Issue 1, May. – P. 7-18. – Access mode : https://goo.gl/SFMMn8.

6. Bykov V. Yu. Models of Organizational Systems of Open Education : monograph / V. Yu. Bykov. – K. : Atika, 2008. – 684 p. (in Ukrainian)

7. Bykov V. Yu. Cloud Computing Technologies, ICT Outsourcing, and New Functions of ICT Departments of Educational and Research Institutions [Electronic resource] / Bykov V. Yu. // Information Technologies in Education. – 2011. – Vol. 10. – P. 8-23. – Access mode : http://ite.kspu.edu/webfm_send/251. (in Ukrainian)

8. Striuk A. M. Metodychni aspekty zastosuvannia khmarno oriientovanykh zasobiv u pidhotovtsi fakhivtsiv z informatsiinykh tekhnolohii [Methodological aspects of using of cloud-based tools for IT-professionals training] / A. M. Striuk, M. I. Striuk // Khmarni tekhnolohii v osviti : materialy Vseukrainskoho naukovo-metodychnoho Internet-seminaru (Kryvyi Rih – Kyiv – Cherkasy – Kharkiv, 21 hrudnia 2012 r.). – Kryvyi Rih : Vydavnychyi viddil KMI, 2012. – S. 145-146. (In Ukrainian)

9. Tkachuk V. V. Khmarni obchyslennia yak osnova mobilnoho navchannia [Cloud computing as a basis for mobile learning] / V. V. Tkachuk

// Khmarni tekhnolohii v osviti : materialy Vseukrainskoho naukovo-metodychnoho Internet-seminaru (Kryvyi Rih – Kyiv – Cherkasy – Kharkiv, 21 hrudnia 2012 r.). – Kryvyi Rih : Vydavnychyi viddil KMI, 2012. – S. 54. (In Ukrainian)

10. Turavinina O. M. Khmarni tekhnolohii navchannia u systemi informatsiino-komunikatsiinykh tekhnolohii navchalnoho pryznachennia [Cloud learning technology as part of ICT system for educational purposes] / O. M. Turavinina // Khmarni tekhnolohii v osviti : materialy Vseukrainskoho naukovo-metodychnoho Internet-seminaru (Kryvyi Rih – Kyiv – Cherkasy – Kharkiv, 21 hrudnia 2012 r.). – Kryvyi Rih : Vydavnychyi viddil KMI, 2012. – P. 9. (In Ukrainian)

11. Chorna O. V. Global trends in the development of cloud technologies / O. V. Chorna, N. A. Kharadzhian, S. V. Shokaliuk, N. V. Moiseienko // Theory and methods of e-learning. – Kryvyi Rih : Vydavnychyi viddil KMI. – 2013. – Vol. IV. – P. 272-284. (In Ukrainian)

12. Shyshkina M. P. Innovative Technologies for Development of Learning Research Space of Educational Institution. Information Technologies and Society [Electronic resource] / Shyshkina Mariia Pavlovna // Mezhdunarodnyi zhurnal «Obrazovatelnye tekhnologii i obshchestvo». – Tom 16. – Ianvar, 2013. – # 1. – S. 599-608. – Access mode : https://goo.gl/mzeh6j. (In Russian)