# The Cloud-based Learning Environment of Educational Institutions: the Current Developments

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**Summary.** The current tendencies of the cloud computing technologies use as e-learning platform for educational institutions are described. The results of a survey of the cloud-based learning tools and services use in educational institutions in Ukraine and the current developments of the Cloud Computing in Education Research Laboratory are presented. The holistic trends and perspective ways of the cloud-based learning environment investigation are described.

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

**Introduction**

The processes of innovative development of a learning space, which is created in educational institutions, are to account for tendencies of learning technologies improvement on the basis of emerging ICT. 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 [5, 7]. 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 [5].

**The State-of-the Art**

Cloud computing (CC) technology is now one of the leading trends in the formation of the information society. Due to the Gartner prognosis 50 % of the Global 1000 companies will retrieve their data at public clouds till the end of 2016. The IaaS market will grow at 47.8% [5]. The survey of CC use in educational institutions of the USA was made in 2013 showed that 98% of the educational institutions already introduced cloud-based techniques (Bill Klug) [6].

According to the recent research [2, 5, 6], the problems of implementing cloud technologies in educational institutions so as to provide software access, support collaborative learning, implement scientific and educational activities, support research and project development, exchange experience and others are especially challenging. The formation of the cloud-based learning environment is recognized as a priority by the international educational community [1, 3, 4, 5, 6, 11], and it is now intensively developed in different areas of education, including mathematics and engineering [10].

***The purpose of the article*** is to describe the state of the art of the cloud-based learning environment formation in educational institutions and to expose the current research results and developments on its application.

**The Research Method**

The *research method* involved analysing the current research (including the domestic and foreign experience of the cloud-based learning services application to reveal the concept of investigation and research indicators), examining existing models and approaches, estimating the current state of research development, considering existing technological solutions and pedagogical experiments, surveys and expert evaluations.

**1. The Current Trends of Research of the 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, 2]. 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 [11]. 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, 2, 11].

Along with the emergence of cloud computing, the number of objects, developments and domain applications are continually growing, which indicates the rapid spread of the innovation [11]. The concept of *the cloud-based learning environment* is now in line with the wider trend; that is to say, the ICT environment of the university, where some didactic functions as well as some fundamentally important functions of scientific research are supported by the appropriately coordinated and integrated use of cloud services [11]. The *aim* of the cloud-based learning environment formation is to meet the users' educational needs. To do this, the introduction of cloud technology in the learning process should to be holistic and carried out according to the principles of *open education*, including meeting the following needs: the mobility of students and teachers, equal access to educational systems, providing qualitative education, and forming and structuring of educational services [1, 11].

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 [11]. 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 [9].

So, the 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 Educational 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 cloud technologies application in education.
- publication and discuss of results of scientific and experimental study of the laboratory;
- participation and organization of international and national scholarly conferences, seminars and more.

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 update, use and retrieve collections of network educational resources of an organization;
- solving intellectual privacy and security problems of e-learning resources access;
- support of distributed learning processes, due to collaborative work and projects development;
- reduction of equipment cost while dynamically increasing the hardware resources such as memory, processor capacity, throughput, etc.;
- support of processes of cumbersome calculations and maintain large volumes of data;
- providing mobility of learning using cloud communication services;
- availability of a variety of e-learning systems and personalized access.

Due to the development of the cloud computing technologies the capabilities of access and functionality of electronic learning resources has been increased. So, the cloud computing technology being a uniform methodology of a single platform is a promising direction for its development, testing and design.

**2. The Survey results of the Cloud Computing Technologies Application**

To show the state of the art of the 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" that was held annually since December, 2012, http://cc.ktu.edu.ua/report.html. At this seminar, there were more than 120 members from 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: "What type of the cloud-based services is mainly used in your educational institution?" the responses showed that 78% of participants chose SaaS (Software-as-a-Servise), 29,3% – PaaS (Platform-as-a-Service), 22% – IaaS (Infrastructure-as-a-Service); and 31,7% – DaaS (Desktop-as-a-Service). The results are presented at Fig. 1. (The entries are not excluded).

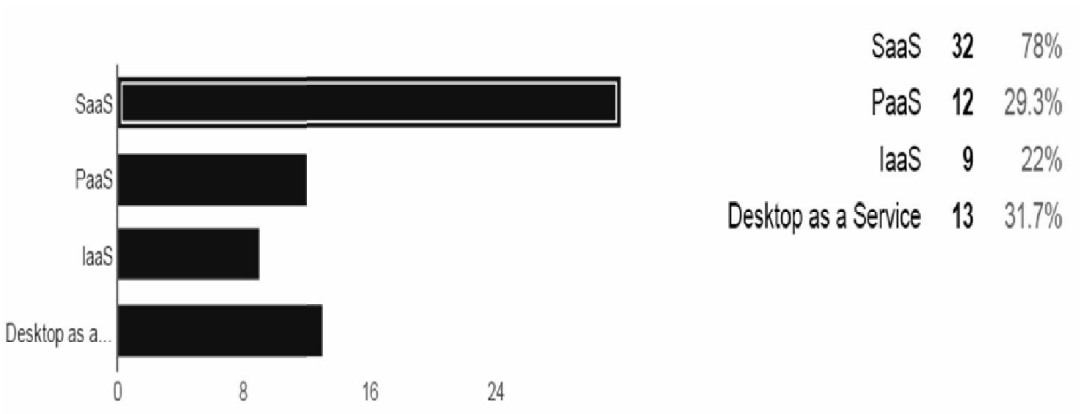


**Fig. 1.** The results of the survey for CC use at the institutions of higher education in Ukraine (2015).

For the question: "For what activity types do you use cloud services?" the results were the next: 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 % (Fig. 2, the entries are not excluding).

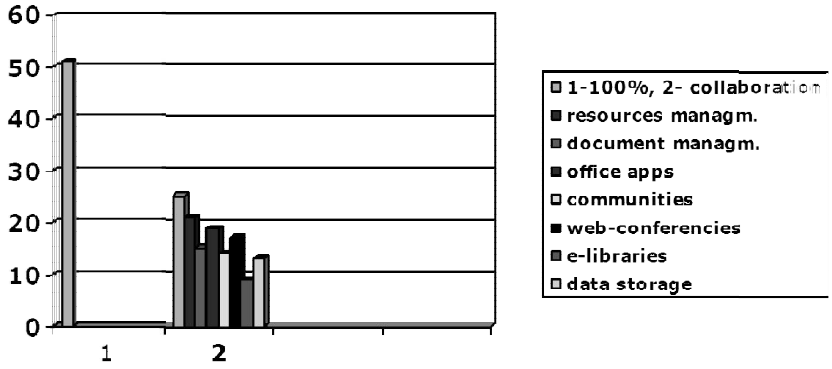


**Fig. 2.** Types of activities with the cloud-based services at the educational institutions in Ukraine (2013).

For the question: "What type of the cloud-based platform or services are used in you institution?" the results were the next: Google Apps for Education – 76%; Microsoft Office 365 – 51,1%; Special Software (for example, the SageMathCloud) – 17%; 10,6% used public cloud services, for example, Amazon, Microsoft Azure or others); 6,4% used services of the private cloud (Microsoft Azure, Xen, WMWare or others). These results are presented at Fig. 3, the entries are not excluding.

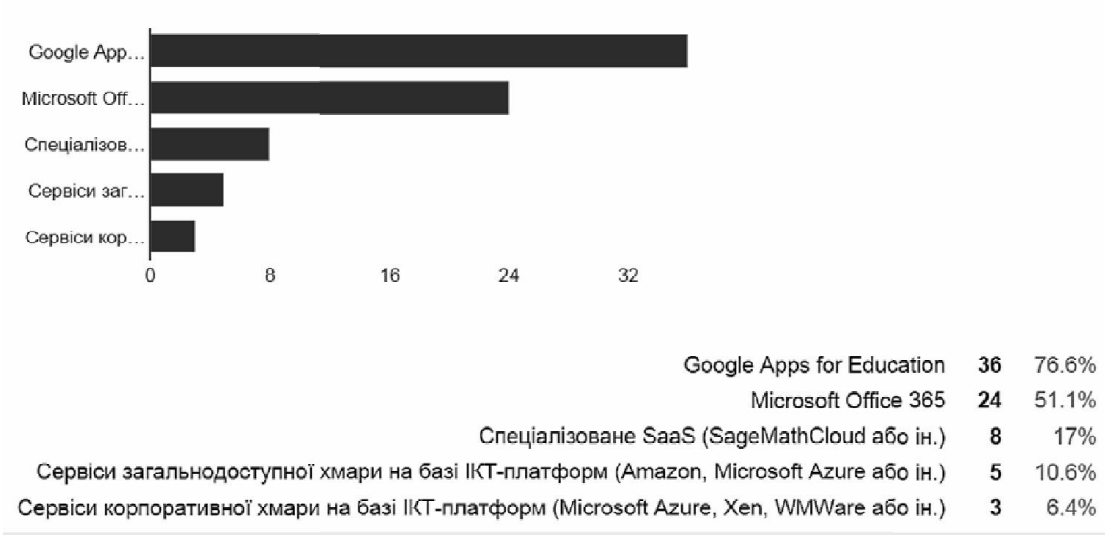


**Fig. 3.** Application of cloud-based platforms and services at the educational institutions in Ukraine (2015).

As it appears from the study, the cloud-based services are widely used in educational institutions still its use is to be more systematic, to be organized into the united system, to be 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 [9].

While taking the problems of cloud-based environment design, it should be noted especial importance devoted to holistic trends in its organization [8].

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 [8] is to show main components and types of interactions within the different learning process settings.

The cloud-based learning infrastructure is to support the processes of holistic learning basing on a model reported in [8, 9]. 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.

**3. 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 the cloud computing technologies, functionality of electronic learning

resources collections significantly increased. This gives added value to recourses elaboration approaches [12].

The social benefits will help to increase educational potential of ICT and make available the best examples of training resources due to their flexible and learner-adaptive access [11].

There are promising trends for future research work as for CC application in education [2]:

- the fundamental and applied research on teaching different subjects involving the use of CC;
- the specification of engineering and pedagogical characteristics of ICT tools and other computer-based learning tools that are oriented for the use in the cloud infrastructure;
- the development of teaching curriculum improving approaches in view of cloud technology using;
- the techniques for appropriate training and retraining of teachers, teaching and educational staff and management staff of the institutions elaboration and application.

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

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**Облачноориентированная учебная середа образовательного учреждения: состояние развития**

**М. П. Шишкина**

**Аннотация.** Освещены нынешние тенденции использования облачных вычислений в качестве платформы электронного обучения. Представлены результаты опроса об уровне использования облачных инструментов и услуг в учебных заведениях Украины. Охарактеризовано состояние исследований, проводимых Лабораторией облачных вычислений в образовании в последние годы. Отображены холистические тенденции в построении облачно ориентированной среды обучения и перспективные пути исследований.

***Ключевые слова:*** *электронное обучение; облачные вычисления; среда обучения; открытое образование.*