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On Problems of Cloud Computing Application to Organize Online Learning in Higher Education

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Application of advanced information and communication technologies (ICT) allows not only to improve the quality of education process but provides the teachers with completely new forms and possibilities of knowledge representation not possible when traditional methods of teaching are used. Nowadays, online learning is considered to be the most striking example of providing convergence of traditional and new potential methods of organizing educational process. Learning Management System (LMS) is considered to act as a specific platform online learning is based upon providing the possibilities for e-learning resources creation, adapted for online learning, integration of advanced forms of content presentation, interactive work, and educational content consolidation together with software related. The most effective way to organize LMS support in the current context is cloud computing application. The LMS is realized as cloud server providing the ability to scale the system depending on the increased number of users, centralized content storage and management. Access to the LMS can be made anywhere in the world, at any time, this allowing for easy development of individual educational curricula, thereby increasing the quality of education. In this respect, the LMS system is very convenient for teachers' collaboration work within on-line learning process when they work with different institution and in different places.

Cloud computing is undoubtedly a noteworthy approach to the organization of online learning, possessing a number of important advantages. This approach appears to have a potentially large scope of application.

Keywords: online learning, cloud computing, Learning Management System, information and communication technology, educational content presentation.

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Introduction

Requirements for educational programs realization conditions listed in the third generation of Russian Federal State Educational Standards (FSES 3+) of higher education underline the necessity to apply e-learning and distance learning technologies, these being an integral part of educational process: “During his/her standard period of education every student should gain an individual and unlimited access to all e-library systems and e-learning environment of an educational institution... from any point with access to Internet, both inside the organization, and out”(Russian Federal State Educational Standards of the third generation (FSES 3+). Item VII., 2015).

Characteristic Features of Online Learning

At present realization of the conditions set forth is possible only through advanced information and communication technologies (ICT) application. What is more important, from our point of view, their usage offers completely new forms and possibilities to represent knowledge which cannot be implemented with traditional methods of teaching (Internet-portal: E-learning.ru.)

For example, lectures representation on the Internet gives the possibility to users to get educational materials with all the changes made; video podcasts technology application makes it possible to view lectures and performances both live and recorded; computer tests serve as an efficient students' knowledge evaluation tool. Application of the ICT in higher education is not limited to the examples mentioned, of course; the usage of new information technologies in e-learning environment is much more versatile, being implemented in online learning.

Online learning is considered to be a specific form of educational process, which can

be determined by a number of characteristic features:

1. *Presentation of educational content in digital form.* It is important to mention that representation of educational resources in digital form does not simply mean mechanical digitization of educational materials (e.g., scanning paper books), but preparation of specially developed resources implying the presence of hyperlinks, full text search capabilities, interactive elements usage etc. Digital forms of educational materials really increase their usability, and result in students' capability to consume information more efficiently. In fact, these educational resources as e-learning ones are the main type of content used in online learning.

2. *Information and communication technologies application to gain access to educational content, this being a key aspect of online learning.* Online learning assumes easy Internet access to get educational and auxiliary materials available on 24/7 anywhere in the world. In other words, accessible online learning content should be created using common means of information representation (Web-browser, Flash players, etc.) (Oliver, 2010). Actually, the same technologies are used to access content, this work with educational resources on the Internet being both local (i.e. in the computer lab or university network) and remote. Educational content is assumed to be created specifically for the use in the model under operation.

3. *Content adaptation to modern methods of obtaining information.* To improve the efficiency level of information consumption by students, e-learning content should correspond as much as possible to up-to-date information obtaining means modern Internet user has got accustomed to. One should focus on mobile devices support, this being the dominant Internet resources access method nowadays. Another typical content adaptation example is its integration with popular

social networks and services, thus allowing for taking full advantage of their potential to implement the tasks of modern education.

4. *Interaction forms with users, based on Internet servers their clients got accustomed to.* The process of online learning requires interactive work with students based on Internet users' interaction methods familiar to them. Such forms of collaboration cover webinars, virtual discussion platforms, online conferences, chat rooms and other means of Internet users' interactions, IP-telephony and unified communications systems being among other things, thus allowing internet users to participate in online conference being connected to it using a stationary (landline) telephone.

In authors' opinion, online learning is considered to be the most striking example of effective and comprehensive use of new information and communication and e-learning technologies providing convergence of traditional and new potential methods of organizing educational process.

Learning Management System (LMS) – the Basis for the Organization of Online Learning

Organization of online learning to support to the full the possibilities provided by the above mentioned features, requires using a specific platform, supporting all the functions necessary to work with content and services, a Learning Management System (LMS) acting as a platform of the kind possessing the key features as follows:

1. *Quick and easy creation of educational content adapted to online learning requirements, i.e. e-learning resources creation and editing.* It should be emphasized that e-learning resources can be created with the help of the tools the Learning Management System is empowered with, thus facilitating e-learning resources development

process, however, no special skills are needed to implement the task. Another significant feature of the LMS is supporting popular formats of e-learning resources, thus allowing to import educational materials developed in other systems or bought from other providers into the system applied.

2. *Integration of modern forms of content representation and users' interaction into educational process,* those covering webinars, virtual discussion platforms, multimedia learning applications, video conferences, etc. As a rule, typical LMS structure comprises the tools necessary to deploy and flexibly adjust corresponding services if required (Gebhard, Shin, & Seger, 2011).

3. *Providing students with Internet access to educational content through a variety of devices* (PCs, laptops, tablets, smartphones, etc.), the task of the LMS in this context being an adaptive content presentation. This feature makes it possible to efficiently stream educational content to devices of different classes basing on their characteristics, i.e. special content layout for mobile devices, whose screens are not able to show the amount of information equal to that on desktop monitors to the full. Such function of the LMS as instant content conversion depending on the device used is considered to be very important while playing video for instance.

4. *Consolidation of educational content and related software to facilitate its storage, management and provide administration tasks.*

Classical LMS outline demands for appropriate infrastructure support availability. Servers and data storage devices providing system's deployment and content storage together with communication devices connecting the LMS to local and global networks, thus, providing users with Internet access, are the first in the rank of importance.

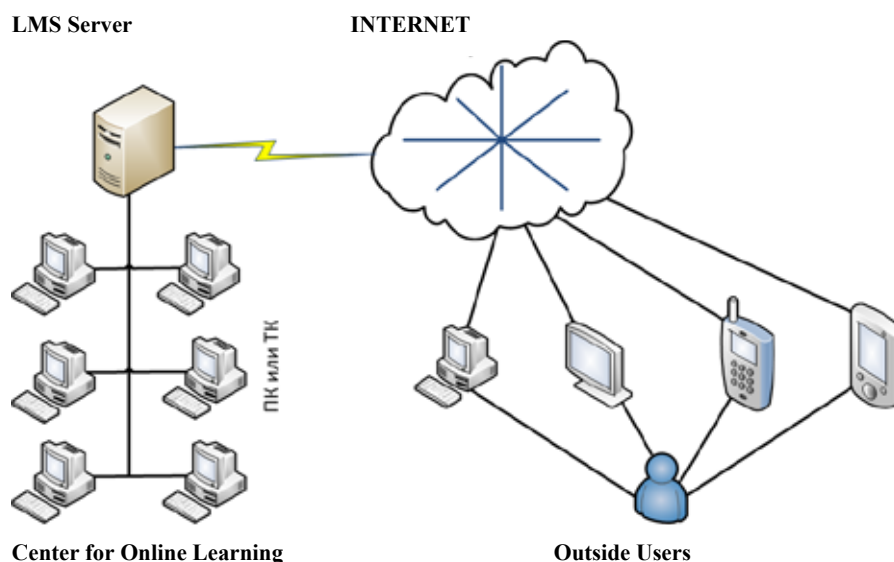


Fig. 1. Classical LMS Outline for an Institution of Higher Education (The drawing is created by D.A. Makarov)

In fact, the LMS undertakes managing educational content on basic level, maintenance of corresponding databases, user access rights differentiation, assigning rights to different categories of users, data backup, and similar practical tasks.

The approach considered possesses a number of indisputable advantages, for example, the possibility to use computing capabilities of an institution of higher education and its network infrastructure to implement the tasks of organization of online learning. Besides, workflow of the kind facilitates significantly e-learning resources storage and management. In addition, it provides the possibility to block data trespass, this being of special importance in case different original courses or copyrighted material is provided by an institution at a fee-paying basis.

However, it should be noted that institution-based deployment of the LMS to realize online learning comes with substantial expenditures covering LMS software acquisition, its maintenance, as well as building supporting infrastructure in case it was missing during the

period of the LMS deployment, well-qualified IT staff able to provide technical support and management of the LMS though not directly involved in educational content creation being a separate problem.

One has to recognize advantages and disadvantages of institution-based deployment of the LMS to realize online learning related to financial costs and organizational efforts. In this connection, alternative methods used to organize online learning allowing to eliminate or at least compensate shortcomings of the classical outline of the LMS deployment, seem to possess a significant potential.

Cloud Computing Application in the LMS Realization

From the authors' point of view, the most effective way to organize LMS support in the current context is its deployment basing on cloud computing facilities.

Cloud computing is the most modern and advanced way of working with various information resources and services, based on the information stored in a "cloud" service

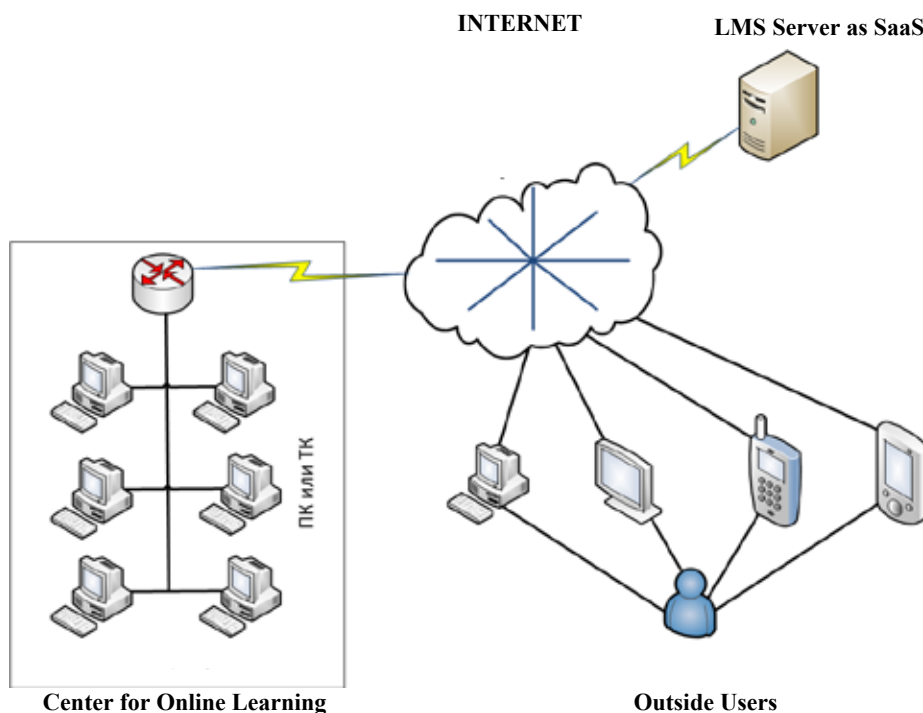


Fig. 2. LMS Operation in the “Cloud” (The drawing is created by D.A. Makarov)

supplied by appropriate cloud service provider (Chang & Wills, 2013). From the point of view of information resources consumer it means that a host provider supplies storage space on its server to client’s educational content or necessary information and services, which can be accessed anytime, anywhere in the world using any supported device (Singh, Harun & Fareed, 2013), cloud service provider being responsible for safety of the data stored in the cloud, information protection from data trespass, and providing secure and reliable access to information stored regardless of any failures to happen. As a rule, business model determining the activities of cloud service providers is realized basing on the Service Level Agreement (SLA). Within its frames the user is supplied with adequate set of services, and a number of functions required, depending on cloud rent payment amounts (for example, additional computing capabilities are provided at extra charge). Cloud computing

helps end-users stop keeping and maintaining infrastructure of their own, buying or leasing storage capacity from the providers instead.

In this context, LMS systems’ implementation in higher education as a cloud service allows to achieve a number of important advantages as follows:

1. *The ability to scale the system depending on the increased number of users* providing centralized storage and management of content at the same time. In other words, even if new online courses have been developed and the number of students has increased, still there is no need to modernize IT infrastructure of an institution or expand its computing capabilities as they can be easily bought or leased from a cloud service provider of the LMS (Aaron & Roche, 2012). In our opinion, system’s possibility to adequately cope with rapid growth in students’ number is of great importance since the possibilities of the cloud service provider of the LMS to expand its

services can easily exceed those of a separate institution of higher education. In this case, a significant growth in students' number will not come with online learning servers disruption or lowering the quality of service.

2. *Access to the LMS can be made anywhere in the world at any time convenient for the customer, and using any supported device*, this allowing for easy development of individual educational curricula, thereby increasing the quality of education. In this respect, the fact that all the necessary steps to provide round-the-clock access to the system, support of new devices, and technologies together with different types of information interaction are supplied by cloud service provider, thus letting the institution of higher education cut the services of their own.

3. *The cloud-based organization of the LMS allows teachers to distribute their work*, in case they are at some distance from their audience or each other implementing the projects of common interest in different educational institutions. It is not only the possibility for teachers to work with students in-situ that matters but also availability of necessary cloud service LMS tools for collaboration work, allowing, for example, to create ad hoc teams to develop educational content together, exchange information and materials, conduct discussions in various forms of online communication, etc. In this respect, cloud service of LMS is valuable, this system being convenient for teachers' rather than students' collaboration work in on-line learning.

4. *Educational content storage in the "cloud" improves the reliability and fail-safe features of the LMS*, no matter how paradoxical it may seem. In view of the fact that cloud service providers pay special attention to user's data storage reliability, data backup strategies and data recovery if failed, and have a distributed data storage network, the risk of data losing by cloud

service provider is minimal and is much lower than data losing risk by the institution where the LMS is located. Of particular importance is the fact that, due to cloud computing features access to information is available simultaneously at multiple sites, and in case of access failure to one of them, the user is automatically switched to the another one not disrupting the service. In the situation when access is denied to the institution-based LMS, its servers and/or servers group, where the LMS is deployed, it can totally break all services online learning is based on for all the users simultaneously. One more important detail is user's privacy as educational content stored in the cloud is physically located at the sites of the cloud service provider and is potentially exposed to unauthorized access. However, cloud service provider use different security and access partition control tools allowing to effectively resist data trespass attempts to gain access to users' content, provider's responsibility level is regulated by terms of consequent user agreement.

The following services provided by Google Inc. serve as a good example of cloud computing to be introduced into educational process of institutions of higher education (32 Innovative Online Tools to Use in 2015): Google Clever streamlines the process of logging into educational apps; Google Schoology is a learning management system to facilitate the creation of class rosters, curricula, and calendars; Google Groups is a service providing unlimited opportunities to work together on documents creation, editing and publication; Google Talk is a web client that provides real-life communication on the Internet; Google instaGrok is a search engine that generates a web of related videos, images, articles, and terms based on a student's query; Google Khan Academy contains a series of videos that emphasizes self-paced, interactive learning with a large number of online lessons

across a variety of subjects; Google Duolingo is a language-learning app and website that features comprehensive guides for nine of the most commonly taught languages; Coursera works with world-renowned universities to give users access to free online courses; Google Plotly provides a user-friendly platform in which graphs can be created and shared in a Web-based format; Google Prezi allows you to make ...interactive presentations and collaborate on projects in real time. It ... gives users new data-presentation methods; Google StudyBlue is a popular online studying platform; Google panOpen provides a platform for easily accessing and evaluating high-quality open educational resources (OERs), ... a textbook, an assessment, a collection of course materials, or even an entire course.

Obvious advantages of the above mentioned examples of cloud computing to be introduced into educational process are as follows:

1. *Availability* – all of the Google services mentioned provide customers with educational content free of charge;

2. *Interactivity* – with cloud computing used in educational process it is possible to get feedback from customers (students), and provide interrelations between teachers, e-learning resources, and students (Dararat Khampusaen, 2014);

3. *Complementary* – cloud computing can address all elements of educational process. They can be used both in educational process directly in the classroom, and in extracurricular work. Besides, it provides different means of students' evaluation methods (Groux, 2012);

4. *Demonstrativeness* – cloud services listed above provide both teachers and students with instant access to demos, making it

possible to provide presentations resulting from both individual and collaborative work implementation;

5. *Mobility* – cloud computing users are not bound to desktops, because, firstly, there is no need to provide continuous operation of PCs, tablets, mobile phones and similar devices to realize cloud computing functions; and, secondly, even if e-learning consumers live in different parts of the world, it is possible to effectively integrate their efforts to work on projects of common interests, realize distance learning, set forth and implement the tasks (Stein, Ware, Laboy, & Schaffer, 2013). Cloud computing access is provided through any desktop computer or mobile device getting Internet access.

Conclusion

To summarize the above said, it is fair to say that cloud computing is undoubtedly a noteworthy approach to the organization of online learning, possessing a number of important advantages (Schubert, Jeffery & Neidecker-Lutz, 2010). This approach appears to have a potentially large scope of application in terms of both online learning efficiency and improving educational process quality as a whole. It meets to the full modern trends, goals and objectives declared in the third generation of Russian Federal State Educational Standards (FSES 3+) of higher education. However, it should be noted that though cloud computing is not considered to be absolutely innovative educational technology, nevertheless, it provides an extremely convenient additional tool to organize educational process. The novelty effect brought in modern educational technology, corresponds to the demands of modernity.

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К вопросу о применении облачных технологий для организации онлайн-обучения в системе высшего образования

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Применение современных информационно-коммуникационных технологий не только позволяет значительно повысить качество учебного процесса, но и обеспечивает совершенно новые возможности и формы представления знаний, недостижимые при традиционных методах обучения. На сегодняшний день онлайн-обучение является наиболее ярким примером применения подобного подхода, обеспечивая при этом конвергенцию традиционных и перспективных методов организации обучения.

Платформой, посредством которой осуществляется онлайн-обучение, является система поддержки обучения (LMS – Learning Management System), которая предоставляет необходимые возможности по созданию образовательного контента, адаптированного для онлайн-обучения, интеграции в учебный процесс современных форм представления контента и взаимодействия со слушателями, а также консолидацию образовательного контента и связанного с ним программного обеспечения.

В современных реалиях наиболее перспективным способом организации системы поддержки обучения LMS является применение облачных решений. В этом случае система LMS реализуется в виде так называемого облачного сервиса, что обеспечивает ряд преимуществ, в первую очередь – возможность масштабирования системы с увеличением числа пользователей с централизованным хранением и управлением контентом в то же самое время. Доступ к системе может в этом случае производиться из любой точки мира в любое удобное время, что позволяет легко выстраивать индивидуальные образовательные траектории для обучающихся, повышая тем самым качество обучения. Важным фактором является также и возможность распределенной работы преподавателей, например при их географической удаленности.

Безусловно, применение технологий облачных вычислений (cloud computing) представляет собой интересное и очень перспективное направление при организации онлайн-обучения, обладающее рядом уникальных преимуществ.

Ключевые слова: онлайн-обучение, облачные технологии, система поддержки обучения, информационно-коммуникационные технологии, представление образовательного контента.

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