Cloud Computing in Education

Introducing Classroom Innovation

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1.   Introduction: Cloud as an Emerging Force in Education

Technology advancements have always had an important impact on industry development, affecting even the most traditional systems such as education. Following the general change of people's habits and the world's job market structure, the education sector has gone through a large-scale transformation over the last few years.

A set of turbulences in the education sector was triggered by the emergence of cloud computing technology, which took the worldwide classrooms by storm and reshaped most of the processes related to learning, teaching and administration. Cloud computing has remained one of the most talked-about trends of the decade due to its potential to facilitate information access, improve collaboration and reinvent traditional IT structures.

The concept of cloud computing has its various interpretations and applications, but it primarily refers to technology that delivers powerful computing resources via the web. The benefits of introducing these systems are most frequently discussed in relation to business, but its impact on the education sector is no less significant. Educational institutions all over the world have already adapted the cloud to their own settings and made use of its great potential for innovation.

The following chapters will discuss some of the most important applications of cloud computing in education, with an aim to provide an all-encompassing insight into the modern ways of learning and teaching.

2.   Definitions of Cloud Computing

Generally, cloud computing may be defined as a set of hardware and network resources that combine the power of multiple servers to deliver different kinds of services via the web. The U.S. National Institute of Standards and Technology gives the following definition of cloud computing:

> 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.

Although the cloud includes a broad set of different services, its most widely used applications are:

- email services such as Gmail or Yahoo! Mail
- online data storage solutions such as Dropbox or Box
- other kinds of applications accessible online.

When discussing the applications of cloud computing technology it is important to mention its three most important categories: a) **Software-as-a-Service (SaaS),** which refers to any type of software program that is managed remotely and delivered via the web; b) **Platform-as-a-Service (PaaS)**, which includes a set of application infrastructure services, such as platform and OS, that are rented from a vendor, and c) **Infrastructure-as-a-Service (IaaS)** that is yet another provisioning model for outsourcing compute resources on demand.
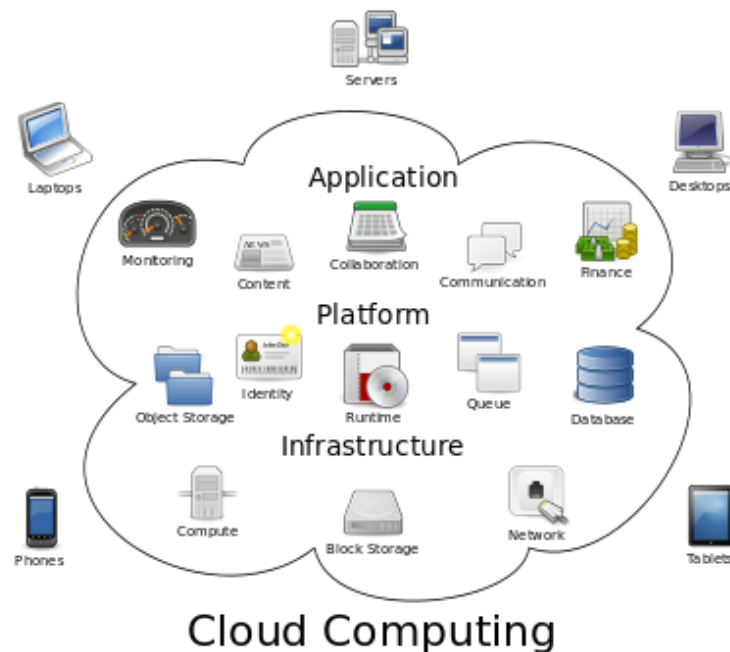

Image source: Wikipedia

In education, each of these three models plays an important role in general education transformation. By storing complex IT infrastructure on remote servers, cloud vendors make advanced computing tools available to institutions, companies or organizations at low prices, which is what contributed to a rapid adoption of these services. Additionally, new provisioning models have triggered proliferation of various cost-efficient business intelligence software programs, collaborative platforms and web applications, the adoption of which is often seen as a major form of innovation in different settings, including education.

3.   Services Available to Educational Institutions

Leading cloud providers have recognized the importance of adjusting their computing services specifically to the needs of educational institutions. These include customized software packages at low prices that more institutions can afford. Some of the most widely used educational platforms are listed below.

3.1. Microsoft for Education

Microsoft is one of the companies whose services have been reforming education for more than two decades. The Microsoft's cloud is currently available to the educational institutions in the following forms: Office 365 for Education (formerly Microsoft live@edu), Business Productivity Online Suite (BPOS), Exchange Hosted Services, Microsoft Dynamics CRM Online and Office Web Apps.

Microsoft Office 365 Education, a cloud-based communication and collaboration tool is currently used by 110 million students, faculty and staff (March, 2014)

3.2. Google Apps for Education

Google Apps for Education is a widely used platform for outsourcing free web-based email, calendar and documents for collaborative study. Google has initiated two important campaigns for introducing improvements in the education sector.

Chromebooks for Education is one of the most important Google's projects aimed at education innovation. Malaysian Ministry of Education has recently joined the project and introduced 4G high-speed internet access and Samsung Chromebooks in 10,000 national schools in 2013.

Another important Google's initiative is *Tablets with Google Play for Education*, which enable educators to smoothly implement the latest technology solutions into classrooms and make useful apps available to their students.

3.3. AWS in Education

Amazon's AWS cloud is an education-friendly set of services that provides cost-efficient solutions to universities, community colleges, vocational schools and K-12 schools and districts. AWS users have at their disposal computing and storage resources that contribute to a creation of flexible IT infrastructure in these institutions.

4.   Benefits of implementing cloud technologies

Educational institutions are among many organizations that find cloud computing systems useful for simplifying admission and administration processes, as well as improving general staff communication. By outsourcing infrastructure, platform or software as a service, educational institutions can benefit in terms of both cost reduction and efficiency.

As reported by most of the organizations currently using the cloud, the primary benefit of this platform is its cost-efficiency. The cloud represents an ideal place for large organizations to store, process and analyze data because it requires minimum hardware investments. Besides this, by implementing

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cloud-based software tools, such institutions get constant access to different collaborative environments and mission critical applications.

In *A Report on Local Capacity to Plan, Implement, Sustain and Evaluate Large-scale Technology Initiatives* from 2012, NCPDI Instructional Technology and NC Education Cloud Leadership notes:

> LEAs have begun the migration to Cloud Computing services to: a) save money by eliminating on-site hardware and software, b) reduce the pressure on under-staffed technology organizations by shifting support responsibilities to the service providers, and c) simplify client device configurations by using web accessible applications.

4.1. Higher Education and The Cloud

Cloud adoption has particularly affected the higher education sector, where the benefits of introducing these innovative systems are even more conspicuous. As noted by EDUCAUSE President and CEO Diana Oblinger,
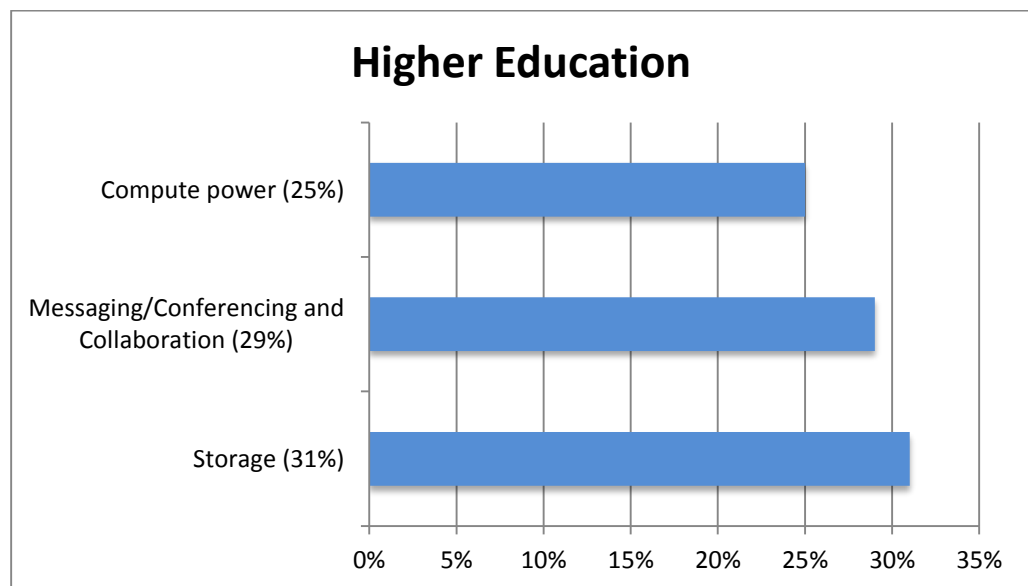
> "Higher education has always been about more than information, no matter how quickly that information can be disseminated or how much of that information can be stored. Our institutions have always been communities driven by connections—connections among faculty, students, research, education, disciplines, communities, and the institutions themselves. In the connected age, it doesn't matter where the information is, where the student is, or where the faculty member is. What matters is the value that comes from the connection. . . . In the connected age, data, collaboration tools, and communities can come together in ways never before possible. . . . Technology makes the connected age possible."
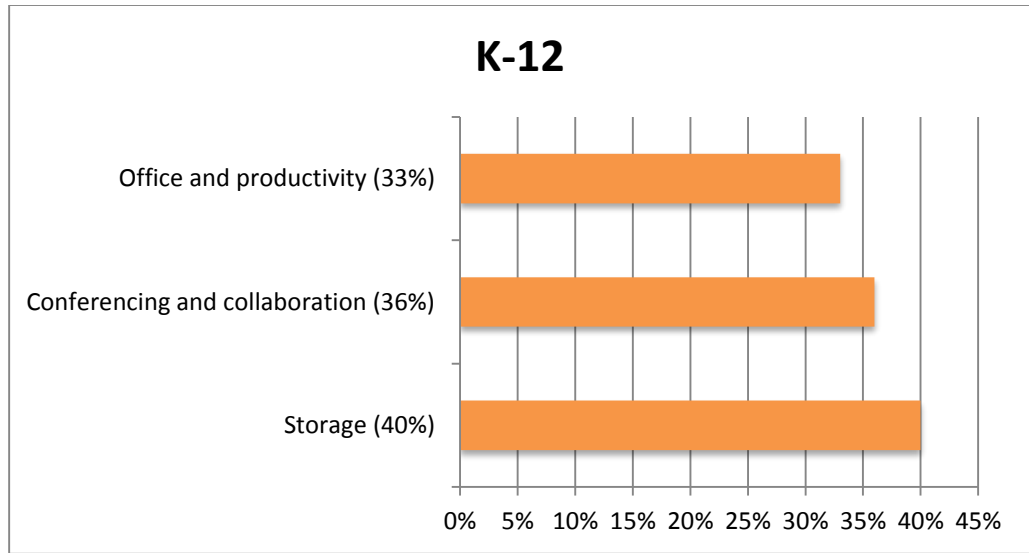
Marinela Mircea and Anca Ioana Andreescu point to the importance of analyzing this trend from the point of view of both benefits and potential drawbacks. As outlined in the table below, they identified the nine major benefits and limitations of using cloud computing in education. The summary of their conclusions is given in the table below.

Benefits	Limitations
Access to applications from anywhere	Not all applications run in cloud
Support for teaching and learning	Risks related to data protection and security and accounts management
Software free or pay per use	Organizational support
24 hours access to infrastructure and content	Dissemination politics, intellectual property
Opening to business environment and advanced research	Security and protection of sensitive data
Protection of the environment by using green technologies	Maturity of solutions
Increased openness of students to new technologies	Lack of confidence
Increasing functional capabilities	Standards adherence
Offline usage with further synchronization opportunities	Speed/lack of Internet can affect work methods

4.2. What Cloud Services are Used in Education?

According to the CDW's 2013 *State of the Cloud* report, **43% of higher education institutions surveyed have implemented or are maintaining cloud computing**, while this number in **K-12 institutions is 42%.** The same report gives an overview of the most popular services in these institutions:

Higher Education

- Compute power (25%)
- Messaging/Conferencing and Collaboration (29%)
- Storage (31%)

0% 5% 10% 15% 20% 25% 30% 35%

K-12

Office and productivity (33%)	
Conferencing and collaboration (36%)	
Storage (40%)	

0% 5% 10% 15% 20% 25% 30% 35% 40% 45%

5. Classrooms in the cloud: trends imposed by emerging technologies

5.1 Mobile Learning

When discussing the recent technology innovation, mass adoption of mobile devices over the last couple of years is a trend that is often put shoulder-to-shoulder with cloud computing. While businesses shift to *Bring-Your-Own-Device (BYOD)* policies, classrooms also seek out the ways to benefit from increased mobility. Although many educators still struggle to implement mobile devices in their classrooms, others have reported significant benefits in terms of:

- Student engagement
- Resource availability
- Simplification of teaching and learning processes

So far, the greatest impediment to this kind of innovation has been the cost of devices. However, with the increased availability of low-priced tablets and smartphones, it is expected that even more students would get an opportunity to get access to these tools over the next few years.

5.2. Online Academies and Open Education Platforms

The power of advanced computing technology is also reflected in the emergence of online academies and open education platforms that enable students to enroll specific courses remotely. This is an excellent opportunity for students with disabilities, as well as people who want to specialize in an area that is not available at their local institutions. The platforms such as edX and Coursera are commonly referred to as MOOCs (Massive Online Open Courses) and have created a set of new possibilities for students worldwide to continue education at no cost. Learners' motivation to participate in such courses typically falls into one of the following categories, as revealed by surveys carried out by researchers at Duke University:

- To support lifelong learning or gain an understanding of the subject matter, with no particular expectations for completion or achievement,
- For fun, entertainment, social experience and intellectual stimulation,
- Convenience, often in conjunction with barriers to traditional education options,
- To experience or explore online education.

5.3. Foreign Language Learning

One of the educational fields that was particularly influenced by the development of new generation computing platforms is certainly foreign language learning. Mobile applications and social networks have practically raised language learning onto a new level, enabling students to get in touch with native speakers and gain first-hand insight into other cultures. Specific areas of language proficiency such as casual communication and pronunciation can now be more efficiently practiced outside of a brick-and-wall classroom through different language learning applications, language forums and Skype.

These possibilities are especially convenient for students who have a limited access to native-speaking communities (such is the case with learners of English in Asia, for example). The communities such as LiveMocha, Shared Talk and Language Exchange Community are just some of the examples of how online platforms have contributed to creation of mass centers for foreign language learning and connecting people with shared interests in this respect.

6. Conclusions

Although still quite a vague term for some, cloud computing is definitely one of the major innovations that entered worldwide classrooms in recent years. With the ability to cut IT costs and at the same time create a modern collaborative environment, educational institutions can see some important benefits from moving to the cloud. Modernizing learning processes and introducing the latest technologies in classrooms encourage students to develop skills and knowledge necessary for achieving their academic and professional goals. From this perspective, it is obvious how valuable a resource the cloud is in the education sector. Together with other forms of technology implementation, the cloud can substantially increase learning opportunities for students all over the world, and eventually contribute to equipping future generations with skills and competences necessary for international career advancements.

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