A Survey on Utilizing Cloud Services in the E-learning Process

Zaydoon Mohammad Hatamleh[1], Eslam Najim Badran[2], Bilal Mohammad Hatamleh[3]

(1. Al Ain University of Science and Technology, UAE; 2. Emirates Institute for Banking and Financial Studies, UAE;

3. Abu Dhabi Vocational and Training Institute, UAE)

Abstract: Cloud computing has become one of the most persuasive emergent technologies to provide anywhere anytime accessibility and scalability. It is an optimized and cost effective platform for various enterprises, including Higher Educational (HE) institutes. The integration of e-learning and cloud computing has shown potential benefits for HE institutes, but poses challenges such as data privacy and security, system integration, training, and the motivation to adopt emerging systems. The aim of this paper is to discuss the integration of cloud computing (service and deployment models) and e-learning to highlight the benefits and challenges of cloud computing for e-learning in HE institutions.

Key words: LMS; cloud deployment models; SaaS; PaaS; IaaS

JEL codes: L86, M15

1. Introduction

In the early 1990s, the concept of learning management system (LMS) was used to develop the e-learning platform. Due to rapid growth in information and communication technologies (ICTs), the LMS-based e-learning platforms have been transformed into a centralized learning environment (i.e., Moodle: http://moodle.org, Blackboard: http://blackboard.com, Learn, Research, Network: http://dotlrn.org) and become an integral part of educational institutes. The lack of expertise in HE institutes in exploiting ICT, the funding necessary to train staff, and the need to both support and manage appropriate infrastructure can severely damage not only the institute's reputation but also the learning experience for both students and teachers (Bora et al., 2013; Carol et al., 2014). To overcome these challenges, cloud computing has been of great interest in recent years due to its dynamic scalability, accessibility of resources, flexibility, and interoperability through provisioning of virtualized resources through three different service models over the internet (Phankokkruad, 2012; Shirzad et al., 2012; Laisheng et al., 2011).

2. Cloud Computing: Service and Deployment Models

Cloud computing, as defined by Mell and Grance (2011, p. 2), is "a business model for IT that enables

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Zaydoon Mohammed Hatamleh, M.Sc. in Computer Information Systems, Lecturer, Department of Management Information Systems, College of Business Administration, Al Ain University of Science and Technology; research areas/interests: cloud computing, e-learning, patterns recognitions and extraction. E-mail: zaydoon.hatamleh@aau.ac.ae.

Eslam Najim Badran, M.Sc. in Computer Science, Lecturer, E-banking & IT Department, Academic Program, Emirates Institute for Banking and Financial Studies; research areas/interests: cloud computing, reverse software engineering. E-mail: eslamb@eibfs.com.

Bilal Mohammad Hatamleh, M.Sc. in Computer Science, Instructor, ICT department, Abu Dhabi Vocational and Training Institute; research areas/interests: cloud computing, GPS: surveying, navigation, geofencing. E-mail: bilalhat@gmail.com.

convenient, on-demand network access to a shared pool of IT resources that can be rapidly provisioned with minimal management effort and minimal interaction with the cloud service provider". Based on the top of modern data centers, cloud computing architecture incorporates three layers: namely, Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), as shown in Figure 1 (Mell & Grance, 2011).
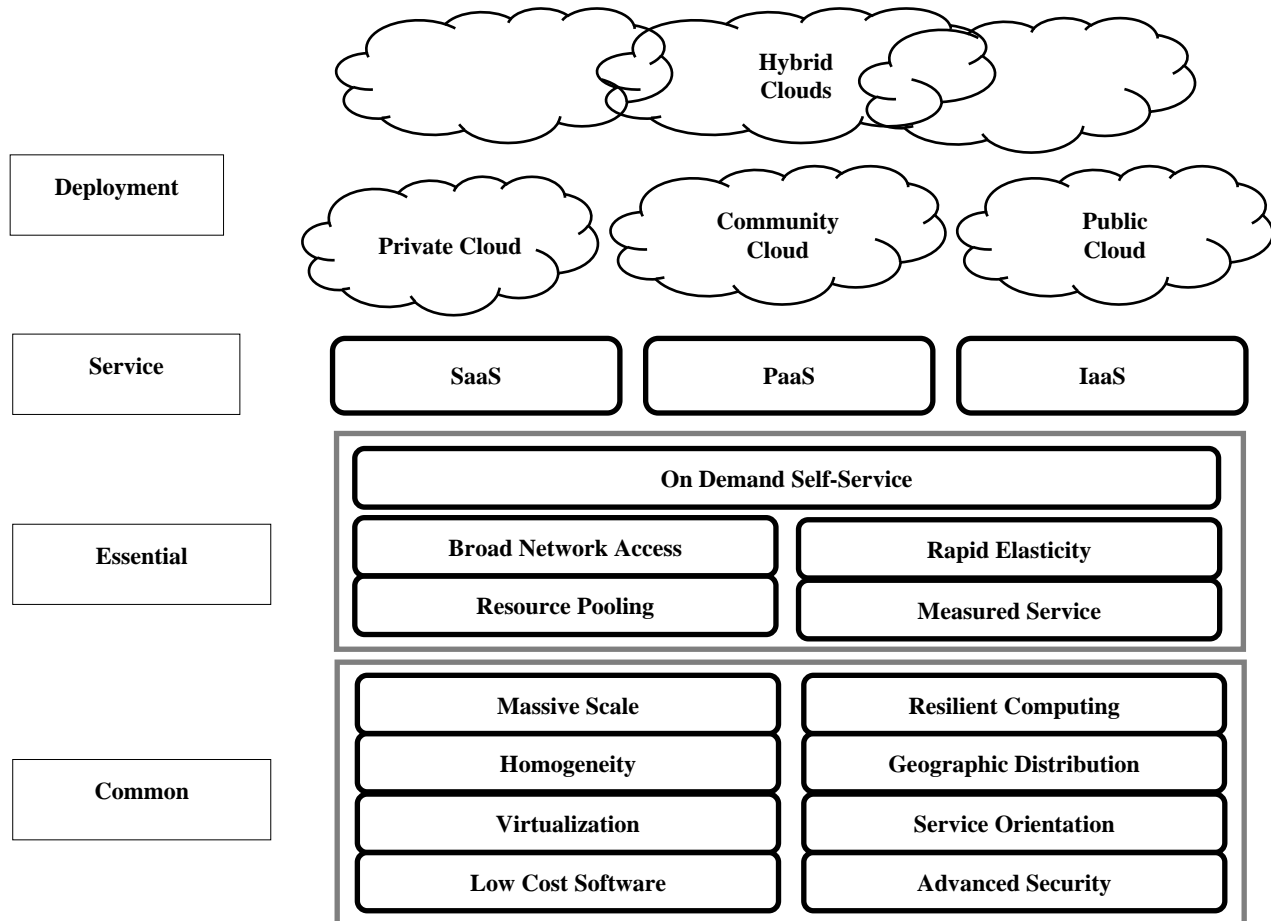

Figure 1   Cloud Framework by National Institute of Standards and Technology (http://ornot.wordpress.com)

Infrastructure as a Service (IaaS): IaaS virtualizes network resources such as computing power, network connectivity, and storage, and repurposesthem as provisioned services to consumers.

Platform as a Service (PaaS): PaaS provides development and deployment platforms to organizations by renting hardware networks, storage, and operating systems over the internet. It requires no downloading or installation of software. Examples include Windows Azure, Facebook, Google App Engine, and Amazon EC2 service, where developers can develop and host their applications (Tsai et al., 2010).

Software as a Service (SaaS): SaaS enables the availability of software application to end-users all over the internet. Example includes email and applications such as virtual learning environments.

These service models can be deployed through four different deployment models: Private Cloud, Community Cloud, Public Cloud and Hybrid Cloud, as shown in Figure 2 (Shunye et al., 2014; Mell & Grance, 2011).

Private Cloud: A private cloud is a dedicated cloud operated solely by an organization. Private or enterprise clouds can exist on premise or off premise and are managed by organizations or third parties.

Community Cloud: A community cloud is shared by various organizations to support a specific community of shared interests/concerns.

Public Cloud: A public cloud is available for general public use. It can be available for free or through a pricing model to individuals or enterprises.

Hybrid Cloud: A hybrid cloud is an integration of two or more cloud deployment models (private, community, or public) to fulfill a business's needs.
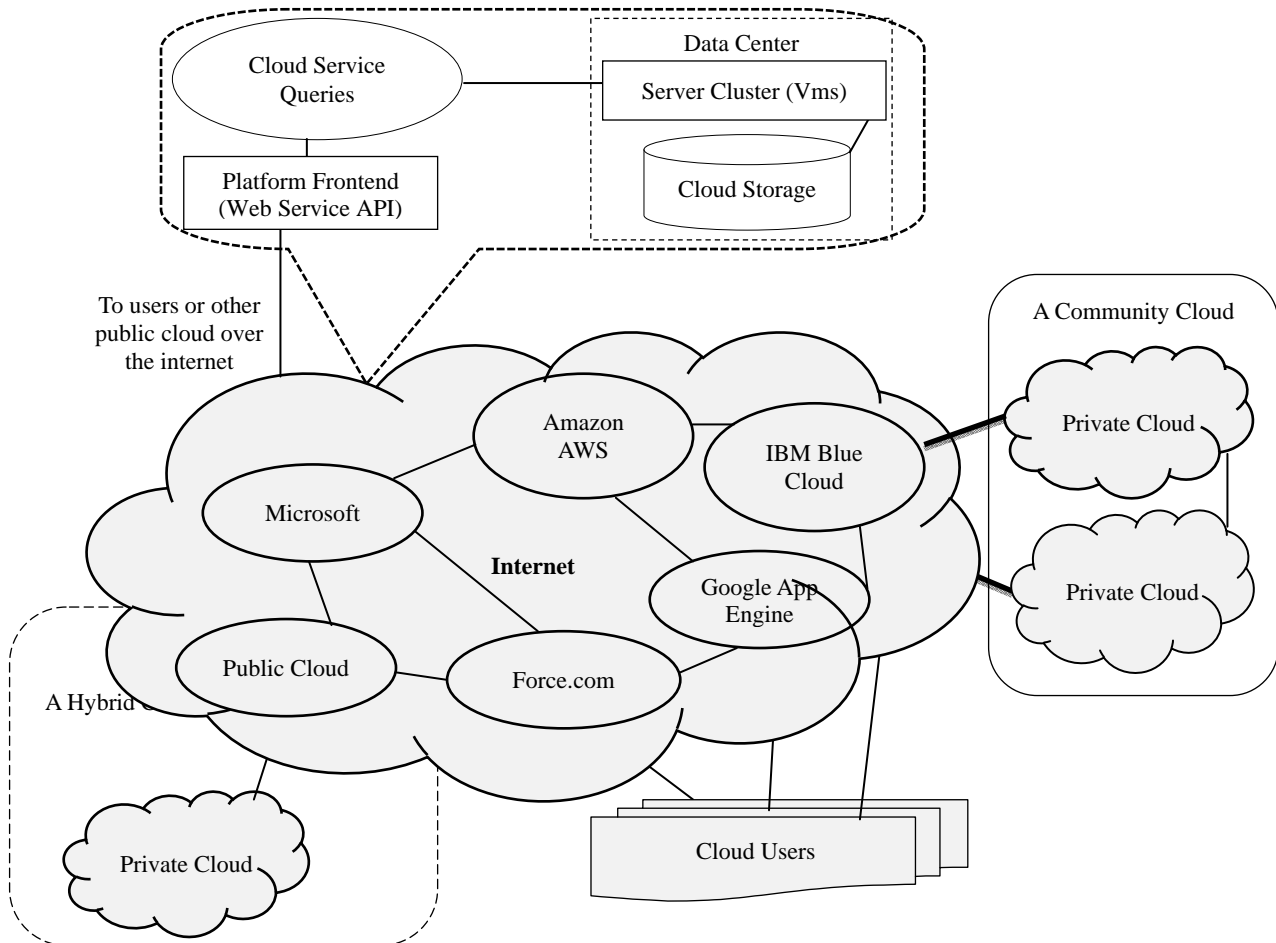

Figure 2   Cloud deployment models (Shunye et al., 2014)

3. Cloud Computing and E-Learning

Though it is appealing to approach the adoption of cloud technology from the technical perspective, it is important to first analyze this in the context of the e-learning perspective. There has been much interest in the SaaS cloud model, which is supported by service oriented architecture (SOA), and includes quick implementation, minimal maintenance, and support from HE to vendors to deliver enhanced e-learning experience to both students and teachers (Masud & Huang, 2014; Basal & Steenkamp, 2010).In a study by Lassila and Poyry (2007), it is proven that the adoption of SaaS helps students and teachers to take advantage of online learning and teaching through LMS, such as Moodle and Blackboard, due to its service-centered approach. With the advancement in Web (Web 2.0/Web 3.0, Semantic Web), teachers, students and administrators can access and share resources with a

single click (Basal & Steenkamp, 2010).

The consumers (i.e., HE institutes) buying the services based on IaaS will be responsible for managing infrastructure and therefore require relevant computing expertise. This makes IaaS expensive and difficult to adopt in the context of HE institutes for e-learning. Compared to IaaS and traditional approaches to providing services, SaaS helps not only to reduce software licensing and vendor deployment costs, but also eliminates the investment and maintenance required to upgrade hardware and software (Madan et al., 2012). Consider Moodle Hosting (http://www.moodlehosting.com/saas-hosting/) as an example: without the expertise, infrastructure, maintenance, etc. of IaaS, HE can exploit Moodle as SaaS to enable students and teachers to flexibly shape their learning experience system with low costs (i.e., Table 1). Similarly, Decebo (https://www.docebo.com/) provides a SaaS based e-learning system. The prices mentioned below are low compared to adopting traditional e-learning systems, which also require standalone dedicated servers, software licensing, installation, maintenance and upgrades, electricity, backup, administration, and 24×7 availability.

Table 1　SaaS Moodle

	SaaS-500	SaaS-1k	SaaS-2k
Active Moodle Users	500	1000	2000
Disk Space	15 GB	30GB	45 GB
Users	Unlimited	Unlimited	Unlimited
Courses	Unlimited	Unlimited	Unlimited
Monthly Prices	$49	$99	$149
Annual Price	$490	$990	$1490
Setup Fee	Nil	Nil	Nil

Source: http://www.moodlehosting.com/saas-hosting/

The most critical factors responsible for influencing the decision to adopt cloud deployment model are cost, privacy and data security, scalability and flexibility. Compared to private and community cloud models, public cloud offers higher scalability, flexibility and lower costs, but possesses higher security challenges (AoC, 2012; Siladi & Mizurova, 2013). A cloud computing deployment model offering e-learning for HE institutes is vulnerable to security, privacy and data confidentiality issues due to the availability of data over the cloud. HE institutes should consider adopting the private SaaS cloud deployment model to facilitate enhanced security, scalability on demand, and rapid deployment to minimize risks.

4. Benefits of Cloud Computing for E-learning

The adoption of SaaS based cloud computing for e-learning systems in HE institutes offers various benefits. These benefits can be categorized as (Hashemi et al., 2012; Madan et al., 2012; Masud et al., 2013; Carol et al., 2014):

Low Cost: It helps HE institutes save money by adopting ICT at a lower cost. The pay per use approach also makes the cloud computing adoption a cheaper and scalable option.

Ease of Implementation: It saves time as well as resources by eliminating implementation and maintenance tasks.

Ease of Innovation: It provides faster access to innovation with minimal support and maintenance tasks.

Flexibility/Time: Anytime, anywhere accessibility of e-learning resources such as Moodle, Blackboard makes

the learning experience more convenient and enjoyable compared to the traditional learning approach. Teachers experience a more flexible approach to preparing content for students, assessing their work, providing marking and feedback over assignments and projects, and most importantly, quick collaboration and communication.

Ease of Adoption: The adoption of e-learning over cloud allows both students and teachers to access e-learning material through a cheap and convenient option, where students and teachers can use their own low-end personal desktops, mobiles, or tablets.

The benefits discussed above significantly lower the cost as well as efforts required to adopt cloud computing for e-learning compared to traditional on-premises systems. It makes SaaS a particularly attractive option for HE institutes that lack investment competence and professional IT resources.

5. Limitations of Cloud Computing for E-learning

Access to Internet: Access to e-learning over cloud depends on internet connectivity.

High Speed Internet Access: Web-based applications demand high speed internet connectivity and lack of this can limit the access to e-learning material over the cloud.

Dependency: E-learning over cloud means limited access to all resources. Therefore, HE institutes need to rely on service providers.

6. Challenges and Future Directions

The integration of e-learning and cloud computing is of great importance. It is true that it has the potential to enhance the learning experience, but at the same time, it has raised various research concerns regarding the difficulty in adopting cloud computing. This change in learning requires experimentation in order to successfully enhance the learning experience of students and teachers and to motivate them to adopt cloud computing.

Challenge 1–Security and Privacy: The lack of security, privacy, and data confidentiality over the cloud has been considered one of the greatest obstacles in the adoption of cloud computing (Hashemi & Ardakani, 2012; Lee, 2012).

Future Direction: Enhancing security, privacy, and data confidentiality over the cloud is of great importance and should be considered a fundamental pillar. A cloud computing deployment model offering e-learning for HE institutes is vulnerable to security and privacy; therefore, HE institutes should consider adopting a private cloud deployment model to facilitate enhanced security, scalability on demand, and rapid deployment to minimize risks.

Challenge 2–Efficient Performance: Efficient performance is a critical factor for cloud-based systems and can damage the reputation as well as learning experience (Ardagna et al., 2014).

Future Direction: Quality of service and efficient performance have been some of the influencing factors in adopting cloud computing for applications of all scale. Therefore, it should enhance the e-learning experience.

Challenge 3–Lack of Will/Motivation: Will and motivation are strong challenges influencing the adoption of e-learning platforms based on emerging technologies like cloud computing. Moore and Kearsley's (2011) study mentions that students and teachers possess traditional temperaments towards classroom learning, which influences their will and motivation.

Future Direction: It is crucial for HE institutions to define appropriate strategies necessary to understand the critical factors responsible for motivating instructors to adopt the integration of e-learning and cloud computing.

Challenge 4–Training: Stein and Harman (2000) and Moodley (2002) say that training is critical for the successful adoption of e-learning and therefore should be taken seriously.

Future Direction: HE institutions should ensure that both instructors and students are trained appropriately to learn new approaches to delivering and experiencing a new way to learn.

7. Conclusion

Information and communication technology is becoming more and more popular with HE institutions wishing to enhance the learning and teaching experiences. Adopting this new method means schools are faced with a wide range of challenges, including cost, technical resources, and resistance from key stock holders. The integration of e-learning and cloud computing provides an attractive solution to overcome these challenges and provides a wide range of benefits. But the integration highlights various limitations and challenges. It is crucial to overcome such challenges to boost adoption of cloud computing and maximize the learning and teaching experiences.

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