A Review on Cloud Computing Implementation in Higher Educational Institutions

Pazilah Darus *[1], Ruziana Binti Mohamad Rasli [2], Nor Zuraida Gaminan [3]

[1] *Department of Information Technology and Communication, Politeknik Seberang Perai, Seberang Perai, Pulau Pinang, Malaysia,*
pazilah@psp.edu.my
[2] *Department of Information Technology and Communication, Politeknik Tuanku Syed Sirajuddin, Pauh Putra, Perlis, Malaysia,*
adiana1984@yahoo.com
[3] *Department of Information Technology and Communication, Politeknik Tuanku Syed Sirajuddin, Pauh Putra, Perlis, Malaysia,*
nz_mg@yahoo.com

Abstract

The main purpose of this paper is to review the cloud computing implementation in higher educational institutions. This paper will look at the advantages, disadvantages, and the usage of cloud computing in higher educational institutions. A total of seventeen conference and journal papers are being reviewed and important information are extracted from these papers. In the last part, a conclusion of what had been reviewed is presented.

Keywords: *Cloud Computing, Higher Educational Institutions, Implementation*

1. Introduction

The Malaysian Education sector has seen a vast increase in higher education field since several decades ago. Within the past 10 years, there is a big increase in student enrolment to Higher Education Institutions and the global recognition in different aspect such as publications, researches, patents, institution's quality and number of international students' enrolment to Malaysian higher education institutions. Government try to push its best to bring education to its highest level. In 2013, Malaysian Education Ministry started to draw a plan called "Pelan Pembangunan Pendidikan Malaysia 2015-2025 (Pengajian Tinggi)" as a higher education plan developed by Malaysian, for Malaysian in order to drive Malaysia as a high income developed county. There are ten important components in this plan. This paper is motivated based on the forth and the ninth components which are producing quality TVET graduates and global online learning and teaching, respectively. As the main TVET institutions, Department of Polytechnic Education under Ministry of Education strive to produce its graduates that are capable on technical, theoretical and communicational skills.

In order to achieve it, the ninth components must works interrelated to the forth components. However, the main problem in using normal teaching and learning implementation is the cost. Ruda (2012) stated that there are some higher educational institutions that do not have sufficient hardware or software to provide students full learning environment and experience due to lack of cost. With the financial crises, higher educational institutions are trying to deliver more quality educations on less cost (Wang & Xing, n.d.) Not only that, traditional education and training method limit classroom activities that were carried out (Akcay & Armutlu, n.d.) This paper discusses the importance of cloud computing as the main medium in the educational and learning fields. This paper also reviews several countries that had already implemented cloud computing in their education system.

2. Cloud Computing

In recent years, cloud computing is widely being deployed and used due to dynamic scalability and usage of virtualized resources (Allabbadi, 2011). It is a computing method based on the Internet that by using this method, the shared software, hardware resources and information could be used by computers and other devices on demand everywhere in the world (Zhao *et al.*, 2011).

According to Akande and Belle (2014), there are three types of service model based on the types of resource being offered which is Software as a Service

International Journal of Scientific Engineering and Applied Science (IJSEAS) - Volume-1, Issue-8,November 2015
ISSN: 2395-3470
www.ijseas.com

(Saas), Infrastructure as a Service (IaaS) and Platform as a Service (PaaS). Table 1 shows the usage of each service model and its functionality. Zhao *et al.*, 2011 added these service model provides users with browser access, software and data which are stored in the data centre.

Table 1: Service model Usage and Functionality

Software as a Service (Saas)	Infrastructure as a Service (IaaS)	Platform as a Service (PaaS)
It provides access to user on the applications over the range of devices using a web browser in the Internet. The content can be access anytime and anywhere allowing knowledge sharing among the users	It provide access on the computing resources over the Internet. Such resources can be storage, processing, and networks. By using IaaS, user can save their content over the cloud with needing to worry on the management and maintenance of the resources.	It provides the user the ability to deploy and control their own applications onto the cloud. The responsibility of managing, and controlling the underlying infrastructure are done by the service provider.

As reviewed, according to Akande and Belle (2014), SaaS is the most common service model used by higher educational institutions compared to other service model.

3. Cloud Computing In Education System

Cloud computing provides a lot of advantages to users all over the fields. Cloud computing allow users to access software, infrastructure and platforms anytime and anywhere all over the Internet. There are several research papers that focuses on Cloud Computing in Education Systems. The impact of cloud computing in education has gained awareness to many researchers and countries (Masud & Huang, 2012).

Masud and Huang (2012) added, with the result of significant challenges arising from efforts in adopting new and emerging technologies, Higher Education system needs to move together in a constant state.

However, using traditional methods, Higher Education (HE) systems cannot caters all the new software, updated platform and high technology infrastructure due to lack of financial help and cooperation between the institutions. Li *et al.* (2014), listed four main problems in basic traditional education resources sharing. First, lack of the sense to share education resource where by institution with good reputations protect their high quality resources on some level. Not only that this institutions does not see any benefits in doing resource sharing and therefore they tend to keep all the good resources for themselves. Second,

Majority of research suggested Software as a Service (Saas) for educational purposes compared to the other two service models. From all the papers and journals that had been revised, the software that can be used by higher education institution are listed below.

Akande and Belle (2014) listed five softwares using SaaS service models. By using Saas, big vendors like Microsoft, IBM, Oracle and SalesForce.com offers various educational software and applications in less cost. The software that can be used by academician and students are Microsoft 365, SalesForce.com, Google Big Query, New Relic, and Rack Space Email. Wong and Xing (2011) listed out Google Apps and Zoho Office. Al-Shuwaier *et al.*, (n.d.) listed six application based on the big companies and its application. Amazon, Microsoft, Google, IBM, HP and Amanda and Zmanda are the companies that offers SaaS service models.

4. Usage of Cloud Computing For Academician and Student

This paper will investigates the typical usage of cloud computing in Higher Education System based on existing countries that implemented it. To maintain the quality, competitiveness, and innovation of higher educational institutions, there is a need for the institutions to offer the students with quality education equipped with updated software, high technology hardware and good facilities. All these criteria's are really expensive and unaffordable. Therefore cloud computing is the only solutions to get all these criteria. By using cloud computing, users can pay for the resources (software, hardware and

infrastructure) as a basis and just focus on their core business strategies such as teaching, doing research, publishing paper or journals and giving training to staffs.

Some advantages of what Cloud Computing can offer to higher educational institutions such as Polytechnic are discussed below. In order for Malaysian Polytechnic to implement Cloud Computing, these key attributes must be fully understands. Breivold and Crnkovic discussed on these six key attributes which are resource utilization, multi tenancy, elasticity, on demand self-provisioning of resources, ubiquitous access, and operational expense model. Akande and Belle (2014) listed seven advantages of using SaaS in Cloud Computing. These key attributes are the access of cloud computing are unlimited, no installation needed by the institution, reduce cost, ease of use, little time to set up, scalable on the number of cloud users, improved collaboration and knowledge sharing amongst institution. Knowledge sharing amongst institution is really important in Polytechnic since Malaysian Polytechnic consists of 36 polytechnic all around Malaysia and by using cloud computing, the institutions can share all the resources and instead of that, uses low cost in maintaining and implementing the resources. Allabbadi (2011) added five main advantages of Cloud Computing which are on-demand self-services, broad network access, resource pooling, rapid elasticity and measure service. The advantages of these three authors can be combined together since there are advantages that are discussed in their paper redundant on each papers.

5. Existing Cloud Computing Implementation In Education Systems

Due to the vast advantages of CC implementation in business, many higher educational institutions have already utilizes Cloud Computing in their system. Through the implementation of Cloud computing, users are able to control and access data via the internet. The main users of a typical higher education cloud include students, faculty/department, administrative staff, Examination Branch and Admission Branch as shown in Figure 1. All the main users of the institution are connected to the cloud. Separate login is provided for all the users for

their respective work. Teachers or lecturers can upload their class Tutorials, assignments, and tests on the cloud server which students will be able to access all the teaching material provided by the teachers via Internet using computers and other electronic devices both at home and college. Access is provided anywhere and anytime with the requirements of an internet connection. The education system will make it possible for teachers to identify problem areas in which students tend to make mistakes, by analyzing students' study records. In doing so, it will also allow teachers to improve teaching materials and methods. This will not only make it possible for students to use online teaching materials during class but they will also be able to access these materials at home, using them to prepare for and review lessons. Utilization of cloud computing systems will reduce the cost of operation because servers and learning materials are shared with other colleges.
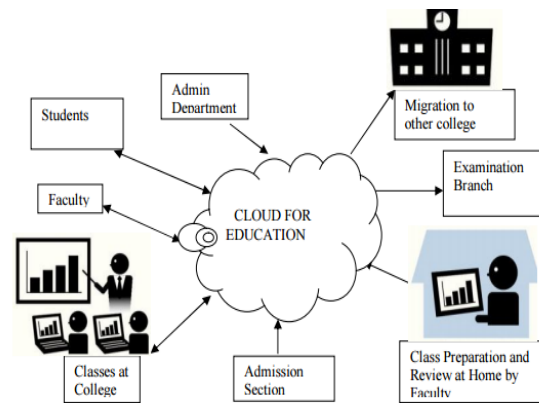

Figure 1: Diagram of cloud computing implementation in education system

The cloud computing technology had been implanted in the education system in several country such as United Kingdom (UK), Lithuania, USA and Australia.

5.1 United Kingdom (UK)

Before the use of Cloud computing, universities in UK had used Scantron sheets technology which allow the students to answer quizzes or test in the form of multiple choice questions, where the question had to be printed and then rescan to allow the machine to grade the student answers. Through the use of cloud computing, the Scantron have been

International Journal of Scientific Engineering and Applied Science (IJSEAS) - Volume-1, Issue-8,November 2015
ISSN: 2395-3470
www.ijseas.com

replaced by multiple choice questions machines installed on Learning Management System (LMS) which can be accessed by both the students and lectures through the Cloud technology which are accurate, fast and can be accessed anywhere and anytime through the use of the internet. UK also had it first Cloud school on networks in George Stephenson High School, located in Killingworth (Schoengold, 2013). Through the implementation, the lab located in the school are used to teach students via the provided technologies of cloud computing. There has been a very positive response as expansion had been implemented in 2014 for local and overseas campuses.

Figure 2: Lab design by students in George Stephenson High School which implement cloud computing technology in their teaching and learning process

5.2 Lithuania

Kaunas University of Technology (KTU) in Lithuania has been implementing cloud technology in their teaching and learning process. Central part of the cloud computing infrastructure in KTU is the Information system of Kaunas University of Technology (KTU IS). The system consists of many parts like University e-mail system, Academic Information System, Library information systems, e-learning systems (like Moodle), etc. One of the most recent services IT department of KTU provides is

Microsoft Live@Edu cloud service. Students and teachers can use @ktu.edu e-mail service (running on Microsoft Exchange). s. The environment can be used by teachers, pupils and students to learn and work together (Gudonienė et al., 2010). Both teachers and students can also use other services available in Live@Edu, such as cloud storage of 25GB, data synchronization, instant messaging and Microsoft Office applications (Word, Excel, PowerPoint, and OneNote) in the browser. The services are integrated with OpenLDAP. The directory synchronizes people data with academic information system. It lets also automatically limit the access of the students that have already graduated or left the university. To improve user authentication process even more, the web single sign-on (SSO) service is used. This service allows the developer of each university web site to integrate user authentication with already existing OpenLDAP directory. Therefore, site owners do not need to take care of users' management. At the same time users are able to use the credentials they already have to login to newly created university sites.

5.3 United States of America (USA)

In the Minnesota Online High School the use of cloud applications has actively freed the school from having to press, ship, and inventory software CDs. It also made it simpler for their IT support staff to assist students, who use a wide range of computer platforms. An even more advanced example of the use of cloud computing is the iLabCentral virtual science lab run by Northwestern University and the Massachusetts Institute of Technology (MIT). The project is a cooperative effort run by the two higher education institutions to share their high-end scientific instruments with high-school science teachers over the Internet to support virtual science labs. Kemi Jona, the Director of the iLabCentral project, argues that virtual labs are just as good, if not better than actual or physical labs, in preparing students for modern laboratory research (Young, 2009). Northwestern University is not the only institution to follow this partnering route. North Carolina State University, for example, is working with IBM to provide cloud applications, computing power, and storage space to every public school in the state. Towards the end of 2009 IBM in the United

States announced the release of its Cloud Academy which it describes as, a global forum for educators, researchers and IT personnel at higher educational institutions to pursue cloud computing initiatives, develop skills and share best practices for reducing operating costs while improving quality and access to education (IBM Advances Cloud Computing in Education, 2009).

5.4 Australia

It was reported online that Australian primary and secondary schools have started publishing educational content on iTunes U, which is a section 25 of the Apple Store, allowing educators to share materials in October 2009. The Western Australia Department of Education (DET), the Catholic Education Network (CEnet), the Presbyterian Ladies' College WA (PLC), and the Scotch College WA are the major drivers of this program initiative. While the DET's content is designed mainly for the professional development of teachers, the CEnet's contributions are mainly classroom-oriented. Although iTunes U was originally designed for universities and other tertiary institutions it now actively caters for secondary schools (Withers, 2009).

6. Migration to Cloud Computing

Before migrating from traditional method to cloud computing, higher education institutions need to know that there are three deployment models. This information is crucial since the functions differs on each deployment model. According to Akande and Belle (2014), the models are private cloud, community cloud, public cloud and hybrid cloud whilst Smith *et al.*, (2014) stated there are only three types, the first is Public cloud, the second is private cloud and the third is hybrid cloud. Table 3 lists out all the functionality of each deployment model based on the discussion of all the papers.

Private cloud	Dedicated to be used by single organization with different divisions. The provider or the institutions owns the infrastructure either on premises or off premises which gives advantages to the university.
Community cloud	The infrastructure is dedicated to be used by two or more organizations with similar goals and objectives. One or more service provider can own, manage, and user the cloud infrastructure which all together creates up a community. It gives more control of the infrastructure and data because the infrastructure is being owned and used exclusively by the university.
Public cloud	The infrastructure is dedicated to be used by general public. The infrastructure can be used by individuals, businesses, government's organization or general public. It is owned by service provides who control the infrastructure
Hybrid cloud	It is a combination of two or more deployment model. For example, the institutions can use private cloud for sensitive data such as student's result and personal information and the public cloud can be used to store less sensitive data.

Table 3: Deployment model
(Extracted from Akande & Belle, 2014)

7. Problem with Current Higher Education

Cloud computing can play an essential role in the success of a higher education system. However, it is difficult to adopt cloud computing storage. Even though it has been utilized widely and can benefit tertiary education system, there are several problem that must be overcome to enable cloud computing system to be implemented effectively. The problem of cloud computing relate to management, technical, security, and service.

Malaysia higher education such as Malaysian Polytechnic is still at the process of increasing efficiency and speed of Internet access. The continued weakness of the system is causing difficulties in the way of adopting a cloud computing system widely in the management of polytechnics. This is because the use of cloud computing requires reliable high-speed access to the Internet. Without an Internet connection, data cannot be stored or quickly accessed.

Lack of cloud computing expertise in Malaysia has directly complicated its implementation as a new technology. This is a challenge that prevents its use

in polytechnics. They are advised to obtain consultancy from businesses that possess the expertise and experience. Local technologists should be given training and guidance on the use of cloud computing so that data can be handled efficiently without errors.

Privacy and security are major challenges for polytechnics in adopting cloud computing. This is because privacy issues and the protection of information, especially when they switch to cloud computing are issues of importance. The polytechnics information process sensitive data and personal information of students. The main challenge in this category is security of confidential data. Owners of data that is stored and processed on servers owned by a third party are fully their responsible for it (Saleh, 2013). Higher institutions cannot control and do not know where the data is being stored. This situation can lead to data leakage resulting in loss of trust by citizen and public organization. Corporate data can be stolen from a cloud by a determined cyber-attack.

8. Conclusion

Based on the review had been done in the previous chapters, it is concluded that Cloud Computing provides a lot of advantages to higher educational institutions. By implementing Cloud Computing, it is proven that the cost that the institutions will bare will be minimal, easy access (anywhere and anytime) resources, maximizing educational resources, and sharing resources will become really easy. However, there are several drawback in implementing cloud computing which is it is difficult to adapt cloud computing storage, slow network connections in the higher educational institutions, lack of cloud computing expertise and lastly privacy and security. Therefore, in order for the higher educational institutions to implement cloud computing in their system first of all, there need to have fast internet connections to cater all the services and data transfer of the files which is still a big problem to Malaysian Polytechnic. Not only that, the institution also need to look at what is their usage for the cloud computing implementation.

References

[1] Ruda I. (2013), Cloud Computing in Education. In the 2012 IEEE Transaction.

[2] Wang B., and Xing H. U. (2011) "The Application of Cloud Computing in Education Informatization" IEEE 2011

[3] Akcay M. and Armutlu H. (n.d). Distance Education Application Architecture and Cloud Computing.

[4] Allabbadi M. M. (2011). Cloud Computing for Education and Learning: Education and Learning as a Service (ELaaS). In the 14th International Conference on Interactive Collaborative Learning (ICL2011).

[5] Zhao H., Wang Y., and Yang L. (2011). Research on Distance Education Based on Cloud Computing. In the 2011 IEEE Transaction.

[6] Akande A. O., Belle J. V. (2014). Cloud Computing in Higher Education: A snapshot of Software as a Service. In the 2014 IEEE Transaction.

[7] Masud M. A. H. and Huang X. (2012). Cloud Computing for Higher Education: A Roadmap. In the Proceedings of the 2012 IEEE 16th International Conference on Computer Supported Cooperative Work in Design. ISBN 978-1-4673-12-12-7/12.

[8] Li. G and Chen G. (2011). A Novel Enhanced Education Application of Cloud Computing. In the 20122 Proceedings of IEEE

[9] Alshuwaier F. A., Alshwaier A. A. and Areshey A. M. (). Applications in Cloud Computing in Education.

[10] Schoengold, S. (2013). The First school in the cloud opens in the uk. Accessed on 6th October 2015 from http://blog.ted.com/the-first-school-in-the-cloud-opens/

[11] Gudoniene, D., Armalyte, N., Piguleviciene, J. (2010). Web 2.0 technologies in business and education. Education: Science, Study and Business. In: Proceedings of 3rd International Conference on Advanced Learning Technologies and Applications, 119–125.

[12] Young, J. (2009) New Project Promotes Virtual Science Labs, Despite Skepticism. Accessed on 6th

October 2015 from http://chronicle.com/blogs/wiredcampus/new-project-promotes-virtual-science-labs-despite-skepticism/9162

[13] Withers, S. (2009) Australian Schools join iTune U. October 13, 2009. Accessed on 6th October 2015 from http://www.itwire.com/it-people-news/training/28448-australian-schools-joinitunes-u

[14] IBM Advances Cloud Computing in Education (2009). IBM Cloud Academy Provides a global forum for Higher Ed and K-12 innovation, collaboration and research. Accessed on 6th October 2015 from https://www-03.ibm.com/press/us/en/pressrelease/28749.wss

[15] Smith A., Bhogal J. and Sharma M. (2014). Cloud computing: Adoption Considerations for Business and Education. In the 2014 International Conference on Future Internet of Things and Cloud.

[16] Saleh A. and Shahzad Q. (2013). Cloud based e-government: Benefits and Challenge. *International Journal of Multidisciplinary Science and Engineering*, Vol.4, pp. 15-19

[17] Alam M. T. (2013). Cloud Computing in Education. In the 2013 Digital Object Identifier.

computing subject for form 6 students and Information Technology for form 5 students. In 2004, earned Master's Degree in Information Technology from Department of Science Computer, University of Science Malaysia, major in Information System. Currrently, a Senior lecturer at Polytechnic Seberang Perai teaching database and programming. Have professional certification in EC-Council Network Security Administrator from EC-Council since early 2013. Research interests are including Object Oriented Programming and Cloud Computing.

Ruziana Binti Mohamad Rasli graduated from Multimedia University with a bachelor in Information Technology majoring in Software Engineering in 2006. In 2008, she successfully graduated in Master in Science (Information Technology) and currently pursuing Doctor of Philosophy (Ph.D) in Information Technology focusing in Text Mining and Graphical Knowledge Representation in the Holy Al-Quran. As a lecturer with six years of experience, now she is working at Politeknik Tuanku Syed Sirajuddin teaching networking and game technology.

Nor Zuraida Mohd Gaminan graduated with a bachelor degree in Information Technology from Universiti Tun Hussein Onn in 2008. Then, in the middle of 2014 she pursued her studies in Master of Science from Universiti Utara Malaysia and graduated in 2015. Currently she is a lecturer in the department of Information Technology and Communication at Politeknik Tuanku Syed Sirajuddin. Her interest is in mobile development.

Pazilah Darus obtained a bachelor of urban and regional planning from the University of Technology Malaysia in 1989. After graduation until late 1994, worked as Town Planning in the private sector. In 1995, earned Diploma in Education major in Sciences Computer and being a school teacher from 1995 to 2002 in secondary school. Teaching