

# Privacy in Cloud Based E-Learning

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## ABSTRACT

The advent of cloud computing in recent years has brought the attention of many education institutions to enjoy its benefits. Cloud computing provides services and storage through the internet. Many cloud service provider (CSP), such as Amazon, Google, and Microsoft, are improvising cloud computing services to be obtainable for vast amount of clients. It is noted that privacy issues have been highlighted as a strong challenge in implementing cloud computing. There are many studies on cloud computing privacy area and on e-learning system privacy area that have been conducted. However, this paper has found significant gaps in the literature when it comes to relating cloud computing and e-learning system in terms of privacy. Moreover, there are no existing privacy standards or privacy framework for e-learning based cloud. Thus, there is a need to clarify the potential privacy issues, and privacy requirements for e-learning based cloud. In this paper, the concerns of cloud computing privacy and requirements of e-learning system privacy will be addressed. The researchers found those concerns are not adequate and more should be identified in terms of e-learning based cloud.

## KEYWORDS

Cloud Computing, E-learning, Privacy, Personal Information, Cloud Based E-Learning, , Benefits, Requirements.

## 1. INTRODUCTION

Information technology and communication evolve every single day and it brings many benefits to the people around the world. The current trend is the cloud computing adoption in providing services and storage through the internet. This paper will discuss the significant gap found in literature regarding the privacy of cloud computing in e-learning environment. In addition,

this paper will also address the concerns of cloud computing privacy and requirements of e-learning system privacy. A systematic search of this topic was performed. Researchers searched databases such as IEEE (Institute of Electrical and Electronics Engineer), and found relevant information from journals, government reports, web pages, and books. In addition, manual searched was also conducted using Google and Google Scholar.

## 2. CLOUD COMPUTING

In 1990, Ian Foster and Carl Kesselman changed the way of how the computing is used by creating the infrastructure to connect various regional and national computational grids, and produced global resources to support new modules of applications [1]. However, in 1999, Salesforce, a global enterprise software company started providing applications that can be used by a simple website. The applications were transferred to clients through the internet, and they are becoming widespread. Cloud computing as grid computing has the facility to make the resources more usable at a lower cost, and allow access to multiple amounts of processing.

People used to carry their data around on disks and recently switched to thumb drive or memory sticks. By using cloud computing, people have the ability to access and manipulate information stored on remote servers. For example, using email services such as Yahoo, Gmail, and Hotmail. These email services manage all the sources that a personal account needs. When the users want to access their email, they only need to open a web browser, and log in.

There are many definitions and explanation of cloud computing. There is yet no single, commonly agreed definition of "cloud computing." *The National Institute of Standards and Technology (NIST) has defined it as follows "Cloud computing is a model for enabling 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."* [2].

According to a range of CSPs, cloud computing is generally divided in two types: Private Cloud and Public Cloud. However, they can also be extended to hybrid cloud or community clouds that are mixed from Private clouds and Public Clouds.

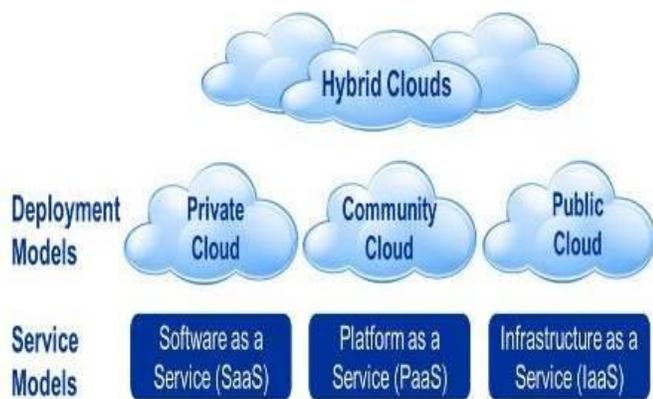


Figure 1 Cloud computing model [3]

### 3. E-LEARNING

The rapid growth of information and communication technologies (ICTs), especially the Internet and other related technologies have positive effect on the education process. This fundamental effect has been illustrated in the form of e-learning. E-learning is a broad term that includes the use of a computer to support learning in a wide variety of learning strategies and ICT applications for exchanging information and acquiring knowledge. The ICT applications contain radio, television, compact discs, video conference, mobile technology, web-based technologies, discussion forums, and other

methods of communication [4]. E-Learning takes advantage of the latest gadgets which can add value to all the traditional learning methods like classroom learning and textbook. E-learning has been variously defined depending on technological transformation and mediated human interactions. However, the American Society for Training and Development (ASTD) [5] is considered the world's largest association dedicated to train learning and development professionals, with having more than 4,000 members outside the United States from more than 100 countries and more than 43,000 professionals have attended its programs. Thus, it can be considered a reliable resource for defining learning technologies. *"E-learning is as a broad set of applications and processes which include web-based learning, computer-based learning, virtual classrooms, and digital collaboration .Much of this is delivered via the Internet, intranets, audio-visual aids, videotapes, satellite broadcasts, interactive TV programmes, and CD-ROMs."*

### 4. CLOUD BASED E-LEARNING

E-learning offers various advantages to educational institutions such as flexibility, diversity, and measurement. However, the recent e-learning applications need large investments in infrastructure systems [6]. Consequently, numerous educational institutions are starting to take advantage of modern applications hosted on a cloud that can allow users to complete jobs that usually require licensing, installation, and maintenance.

E-learning based cloud is one of cloud computing trends. It is the cloud computing on educational field for e-learning systems. Cloud computing is the next generation of many technologies and infrastructures. However, e-learning is not excluded. Cloud based e-learning provides to all e-learning necessities such as hardware and software resources to improve traditional e-learning technologies. The learning resources are hosted in cloud servers; these resources are available for education institutions by renting from Cloud Services Providers (CSP) [7]. Many education

institutions recognized the significance of applying cloud computing. This technology allows education institutions to focus on their learning rather than focusing on complex computer configuration [8].

## **5. PRIVACY**

Privacy rights or obligations are related to the collection, use, disclosure, storage, and destruction of personal data or personally identifiable information [9]. The concept of privacy is affected by many factors such as countries, cultures, and regulations. It is constituted by public expectations and legal interpretations. Thus, an accurate definition is extremely complicated even if it is impossible. However, for the purposes of this research, researchers have accepted the definition adopted by American Institute of Certified Public Accountants and the Canadian Institute of Chartered Accountants *“The rights and obligations of individuals and organizations with respect to the collection, use, retention, and disclosure of personal information.”*

Privacy is very important and necessary for individuals. People are different when they are under observation and when they have some privacy.

## **6. BENEFITS OF CLOUD COMPUTING IN LEARNING**

Cloud computing allows educational institutions that do not have the sufficient technical capability to access all necessary resources and infrastructure on demand. Cloud computing is a perfect choice for educational institutions which are essentially under pressure on budget in order to perform their systems without extra cost for infrastructure. The cloud computing has brought about many advantages for educational institutions and below are listed some:

### **6.1. Software Feature**

In cloud computing, there is no need to download or install any software; only an Internet connection is required. Applications can be accessed through network from various devices.

The cost of licensing for the software packages are dealt by CSP, so there is no need to upgrade the user side system when new service packs or patches are released [10].

### **6.2. Hardware Feature**

In the cloud computing, there is no need to use specific devices, any devices with minimal hardware requirements (Smartphone, Ipad) could be successfully used as cloud clients [10].

### **6.3. Support**

In the cloud computing, the hardware and software are in the service provider side, thus, the maintenance of hardware and software is simplified, and there are lesser problems for the IT team. In addition, applications that take extensive storage capacity is easier to be used in the cloud environment compared to the same when used by the organization on its own. Also at the user level, what the users mostly needs is a simple web browser with Internet connection [11].

### **6.4. Availability**

In the cloud computing, there are some levels of high availability that can be reached. These levels can be application level, data centre level, infrastructure level and geographic location level. Technically, cloud computing is the virtualization of hardware resources technology to ensure the stability and reliability of the infrastructure and avoids even a single point of failure.

### **6.5. Lower Costs**

The main advantage of cloud computing is the reduction of the cost of hardware, software, power, networking, and storage, with high levels of expertise in hand. Cloud users do not have to invest in expensive new computing equipment and shift the cost to a more manageable operational expense. The cloud computing also reduces the burden of IT systems and helps organization focus on their tasks rather than on technology issues. In addition, CSPs that have experts in a specific field can provide additional services that an organization may not be able to afford or get without cloud computing [7].

## 6.6. Improved Performance

Weak applications performance causes organization to lose customers and reduce employee productivity. However, applications are increasing rapidly and need storage, RAM, and CPU capacity. By optimizing available resources in cloud, organization can take advantage of high performance in cloud environment to perform their task on demand.

Cloud computing presents various powerful benefits, with the appropriate adoption, cloud-computing can offer significant cost savings, good performance, and a higher level availability.

## 7. CLOUD COMPUTING PRIVACY

There are various concerns of cloud computing that has been raised regarding the security and privacy. These concerns include compliance, storage, retention, destruction, audit and monitoring, and privacy breaches. The details of each concern are as following:

### 7.1. Access

When an organization moves to the cloud, all information is generated, processed, controlled, stored, and operated by the CSP. Nevertheless, cloud users have a right to be familiar with what personal information is being held, and they have a right to make a request to stop processing. The main concern is whether the organization is able to provide their users with access to all personal information and to comply with users' requests.

### 7.2. Compliance

There is the possibility that personal and sensitive data could be moved within an organization across organizational boundaries without having the adequate controls to guarantee compliance and protection of the information. Noncompliance with internal or external privacy policies causes loss of reputation and credibility with their users. In addition, the cloud computing users need to ensure that their private data is protected or not, and private data is stored separately from others or not. If user data is combined with another user data, this data will be more vulnerable [12]. For

example, in public cloud, viruses may be transmitted from one user to others. These viruses might affect the availability or integrity of other data located in the same CSP. Thus, an organization that wants to subscribe on cloud computing must be aware of the privacy compliance requirements, applicable laws, regulations, standards, contractual commitments that govern this information, and who is responsible for maintaining it [9]. In addition, transparency with respect to information handling practices allows individuals to be informed about how their data is handled within the cloud and defines the responsibility of people and the organization in handling their personal information [13].

### 7.3. Storage

Gellman [2009], claimed that the disclosure and remote storage might have opposite consequences for the legal status and protection of personal information. Storing information in many sites in the cloud may have significant implications on the privacy [13] In addition, conflicting issues may also arise because the distributed information in the cloud may have different legal location laws that apply at the same time [14]. Thus, the users and organizations want to know where their data is stored, whether it is transferred to another data centre in another country, or it commingled with data from others which use the same CSP [9]. The transfer of personal information is limited by privacy legislation in many countries. However, the CSP may transfer information without the authorization of the organization, resulting in a possible violation of the country's law. If international companies want to take advantages of cloud computing systems services, they have to know which countries are hosting their data, and the country laws that manage their data [12]. For example, a Malaysian company wants to know where the personal data will be located, thus it will show which specific laws will be applied on their data. The Malaysian company may agree to use CSP in Singapore. However, the data of this company could be transferred to China, the UK, or to the US.

### 7.4. Retention

There are some retention concerns in cloud computing. This concern may arise in the future. However, in the case of CSP stops services for any reason or the CSP may decide to mortgage the data if there is a contention, the organizations must plan for how long their data will have this retention in the cloud, the retention policy that governs the data, the owner of the data (organization or the CSP) [9].

### **7.5. Destruction**

In cloud computing, the data is stored in various locations. As a result, there is a concern of data destruction in the cloud. There is a concern of data destruction in the cloud. This concern is involved in the way of destroy the data at the end of the service. The organizations want to ensure the CSP do not keep additional copies and it will not be available to other cloud users.

### **7.6. Audit and Monitoring**

The stored data in the cloud requires certain levels of audit logging, alert generation, activity reporting, and data retention to guarantee that only authorized users can get access to it [15]. In addition, it is important to have a suitable technique to prevent cloud providers from using user's data without user's permission. It seems unlikely there is any technical way can completely prevent cloud providers from the use of data in all cases [16], so there is a need for combination of technical and nontechnical procedures to achieve this.

### **7.7. Privacy Breaches**

Many CSPs like Google have come under heavy breaches related to data collection and privacy. In case of these breaches happened, the cloud users need to know when and how the breach has occurred. The CSP responsible for managing the breach notification process (and costs associated with the process) and how the breach is determined [9].

With all of listed concerns, it is clear the cloud computing has a vital impact on the privacy of personal information. Organizations are recommended to develop framework for ensuring all these concerns are tackled before using or

processing data in the cloud. On the other hand, these concerns are general and there is a need to identify whether these concerns are adequate to meet the privacy requirement of cloud based e-learning or not.

## **8. E-LEARNING PRIVACY**

E-learning systems need to get information about users to personalize the learning experience to the individual learner. This information includes the student contact, preferences and relations information [17]. In addition, e-learning systems usually store some basic information in the user (learner) profile. Therefore, it is clear that most of this information is very sensitive in the context of privacy. CAUSE, [18] highlights relevant requirements to provide a framework for privacy of users' information in an electronic learning environment.

### **8.1. Notification**

Learning system users must be notified if their information is being collected, who is collecting, whom it is being collected from, the reason of collecting, and the steps taken to protect the confidentiality, integrity, and quality of the information.

### **8.2. Minimization**

Minimization refers to the nature and the quantity of information collected from users. Taking into account gathering the minimum amount of information, and deleting the information when they are done with it.

### **8.3. Secondary Use**

For purposes of personalizing e-learning, the learning systems need to collect information about the users. The collected data must be used only for the purpose of which it was collected, even if at the same institution or for a use compatible with that purpose.

### **8.4. Consent**

Consent principle involves consent strategies and data sensitivity. It relates to what user information can be released without user authorization. If any education institutions need additional user

information to be disclosed, the users must sign a release. In addition, education information may be released to other institutions that have made a request. The data sensitivity is different from user to others for example, users may not mind releasing their information in a campus print directory, but the users might feel differently if this information is available on the Internet.

### **8.5. Need to know**

The e-learning system can allow access to personal information only if there is need to know the information as part of an official and legitimate educational interest and in conformity with disclosure agreements.

### **8.6. Information Security, Integrity, Accountability**

- a. Information security is related to protection of information from loss, damage, inappropriate access, and unauthorized disclosure or use of sensitive.
- b. The term of integrity is that only authorized users are allowed to access and modify personal data.
- c. Accountability is the ability to clarify security events.

### **8.7. Data accuracy, inspection, and review**

The collected data from the users must be accurate and the users have the right to check their information and to request modifies if they feel it should be change. In addition they have the right of inspection and review of data captured through transactions and automatic logging.

### **8.8. Education and Awareness**

The education institutions have a fundamental responsibility to educate their users about privacy rights and potential implications of use and misuse of personal information. This education is beyond a simple notification and approval which is knowledgeable.

The e-learning has become an important tool for education. It may also be the most complex and challenging tool that education institutions deal with. However, the success of e-learning requires facing many challenges, especially the information security and privacy. Education institutions must be aware and define clear requirements to protect users' privacy.

## **9. DISCUSSION**

The advent of cloud computing in recent years has brought the attention of many education institutions to enjoy its benefits. Cloud computing provides services and storages through the Internet. Most of applications and data are stored on multiple cloud servers that can be accessed at anytime and anywhere through the Internet [11]. However, as more and more information of education institutions are stored in the cloud, concerns on privacy are beginning to grow. In addition, all this sensitive information about education institutions is dispersed in many locations, even across the national borders; as a result, information privacy faces many challenges such as access, storage, compliance, retention, destruction, audit and monitoring, breaches and controversy of various legal systems.

Privacy is one of the main issues that delays the growth of the cloud computing [16][19] [20] Those issues impose strong obstacle to the adoption of cloud technologies [12]. Previous researches have highlighted numbers of concerns related to privacy and cloud computing. However, with all these concerns, it is found those concerns are inadequate to meet the e-learning privacy requirement and more should be identified in terms of e-learning based cloud. For example, the requirements of minimization, education and awareness are not mentioned in cloud computing privacy concerns. In addition, retention and destruction of data concerns are not mentioned on the e-learning privacy requirement. This is a result of not having well defined clear requirements for ensuring personal privacy with lack of clarity in what education institutions need to protect users' privacy. In order to implement e-learning based cloud on educational institutions effectively, educational institutions need to clarify the

potential privacy issues, and privacy requirements for e-learning based cloud.

## 10. CONCLUSION AND FUTURE WORK

The rapid expansion of cloud computing occurs faster than the development of appropriate base that ensures standards are maintained. There is a growing concern for the collection and dissemination of the personal information that is implemented in the cloud. There are the needs of organizations to develop privacy procedures, because they are responsible to protect their users' privacy. It is no wonder that the cloud is facing challenges of ensuring information privacy. In the same way of e-learning based cloud, the privacy is at risk due to the express rapid technology advancements that easily allows privacy infringements. Currently, there are no existing privacy standards or privacy framework for e-learning based cloud. Therefore, educational institutions are obliged to develop an e-learning based cloud privacy framework to ensure that privacy requirements of users are met.

This paper had raised the issue of privacy in cloud based e-learning with the concerns of cloud computing privacy and requirements of e-learning system privacy. The gap found from literature contributes the knowledge to the researchers in related field. In addition, the education institutions and CSPs who are providing cloud based e-learning services can benefit the discussion in this paper to effectively take over these privacy issues. We are now working on developing metrics that will assist in identifying and gathering cloud based e-learning requirement.

## 11. REFERENCES

- [1] McKinsey, "Power Unbound: The Emerging Importance of Grid Computing," retrieve from [http://www.grid.org.il/\\_Uploads/dbsAttachedFiles/McKinsey\\_Grid\\_Computing\\_Exec\\_Brief.pdf](http://www.grid.org.il/_Uploads/dbsAttachedFiles/McKinsey_Grid_Computing_Exec_Brief.pdf), Sep 2013
- [2] P.Mell, and T. Grance, "The NIST Definition of Cloud Computing," Recommendations of the National Institute of Standards and Technology, Special Publication 800-145, September 2011
- [3] Attenda, "The Evolution of Enterprise Infrastructure as a Service," retrieve from

<http://www.attenda.net/eazines/partners/100910/partner-sub1-Cloud-0910.asp> Sep 2013

- [4] S. R. Sahu, and M. Singhal, "E-learning: A Myth or Reality," Workshop on Information Resource Management, DRTC, Bangalore March,2002
- [5] American Society for Training and Development ASTD. retrieve from <http://www.astd.org/>, Oct 2013
- [6] A. S. Sife, E. T. Lwoga, and, C. Sanga, "New technologies for teaching and learning : Challenges for higher learning institutions in developing countries," International Journal of Education and Development using Information and Communication Technology (IJEDICT), 2007, Vol. 3, Issue 2, pp. 57-67.
- [7] D.K. Viswanath, S.Kusuma, and S. K. Gupta, "Cloud Computing Issues and Benefits Modern Education," Global Journal of Computer Science and Technology Cloud & Distributed Volume 12 Issue 10 Version 1.0 July 2012.
- [8] M. Mircea, and A. I.Andreescu, "Using Cloud Computing in Higher Education: A Strategy to Improve Agility in the Current Financial Crisis," IBIMA Publishing Vol. 2011 (2011), Article ID 875547, 15 pages.
- [9] T. Mather, S. Kumaraswamy, and S .Latif, "Cloud Security and Privacy," California O'Reilly Media, Inc., 2009
- [10] P. Pocatilu, F. Alecu, and M. Vetri, "Using Cloud Computing for E-learning Systems," Recent Advances on Data Networks, Communications, Computers. 2009.
- [11] A. Ghazizadeh, "Cloud Computing Benefits and Architecture in E-Learning," 2012 Seventh IEEE International Conference on Wireless, Mobile and Ubiquitous Technology in Education.
- [12] M. Zhou, R. Zhang, W. Xie, W. Qian, and A. Zhou, "Security and Privacy in Cloud Computing: A Survey," 2010 Sixth International Conference on Semantics, Knowledge and Grids.
- [13] S. Pearson, and A. Charlesworth, "Accountability as a Way Forward for Privacy Protection in the Cloud," HP Laboratories HPL-2009-178
- [14] R. Gellman, "Privacy in the Clouds: Risks to Privacy and Confidentiality from Cloud" World Privacy Forum [http://www.worldprivacyforum.org/pdf/WPFCLOUD\\_Privacy\\_Report.pdf](http://www.worldprivacyforum.org/pdf/WPFCLOUD_Privacy_Report.pdf), Feb, 2009
- [15] N. Dogra, and H. Kaur, "Cloud Computing Security: Issues and Concerns," ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 3, Issue 3, March 2013.
- [16] S.Lar, X. Liao, and S.A. Abbas, "Cloud Computing Privacy & Security Global Issues, Challenges, & Mechanisms" 2011 6th International ICST

Conference on Communications and Networking in China (CHINACOM).

- [17] B. J.-Blaz, and T. Klobucar, “ Privacy provision in e-learning standardized systems: status and improvements,” *Computer Standards & Interfaces* 27 (2005) 561–578.
- [18] The association for managing and using information resources in higher education ( CAUSE), “ Privacy and the Handling of Student Information in the Electronic Networked Environments of Colleges and Universities ,” A white paper developed by a CAUSE task force in cooperation with the American Association of Collegiate Registrars and Admissions Officers 1997
- [19] A. Waqar, A. Raza, H. Abbas n, and M.K. Khan, “A framework for preservation of cloud users’ data privacy using dynamic reconstruction of metadata” *Journal of Network and Computer Applications* 36 (2013) 235–248.
- [20] I.H. Chuang, S.H. Li, K.-C. Huang, and Y. H. Kuo, “An Effective Privacy Protection Scheme for Cloud Computing,” Center for Research of E-life Digital Technology National Cheng Kung University, Tainan, Taiwan. 2011.