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Review

Cloud computing advantages over Traditional e-learning

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Abstract

In this article, we displayed an overview of the current state of The Structure of Cloud Computing for e-learning. Our goal is to present how significant the idea of moving e-learning systems onto Cloud is? And what are the advantages of moving e-learning systems onto Cloud? It is well known that traditional e-learning was a huge offer from the developing technology to support learning systems, but it suffers from some problems; especially those related to budget issues. With the rapid growth of technology, the cloud computing is a new offer that helps overcome these problems and brings new environment for e-learning systems.

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1.Introduction

Conventional classroom-based learning (traditional learning system) suffers from a lot of problems. It is expensive, takes a long time and the results can vary. It has limited attended location and time. Web-based learning offers several advantages over conventional classroom-based learning [1]. The e-learning approach offers an alternative that is faster, cheaper and potentially better.

E-learning is a computer based educational tool and system that enables any one to learn anywhere and at any time suitable for him/her. Among learning technologies, technology has advanced so much that the geographical gap is bridged with the use of tools that make students feel as if they were inside the classroom. At the same time, many disadvantages attacked e-Learning such as, they are weak on scalability at the infrastructure level. Several resources can only be deployed and assigned for specific tasks so that when receiving high workloads, the system needs to add and configure new resources of the same type, making resource achievement and management very expensive [2]. By time, with the technology's continuous development, cloud computing brought many advantages over the traditional e-Leaning.

2.Literature Review

Danny Manongga et al.[2]implemented a model which provides services such as, IaaS, PaaS, and SaaS, for e-learning in the educational environment in Salatiga. They used Moodle technology as e-learning applications that are installed on the Cloud. Moodle is a software package for a training purpose- web and internet based training commonly known as a Learning Management System (LMS), Course Management System (CMS), or Virtual Learning Environment (VLE). This study has shown the main components of the e-Learning system that is placed on OpenStack cloud computing. OpenStack is an open source cloud computing software for building dependable cloud infrastructures. OpenStack's aim is to allow any organization to build and offer cloud computing services using open source software running on standard hardware. The result of this study showed that the features of the cloud computing platform using the OpenStack method is quite appropriate for migration of learning system, so that it is able to form learning environments fully and efficiently, provide personalized contents, and facilitate the adaptation to the present model of education[2].

Abu El-Ala et. al, [3] presented in their research a creative environment derived from both virtual and personal learning environments based on cloud computing. This environment contains mixture of tools and techniques to improve the educational procedure. The proposed environment focuses on designing and monitoring educational environment based on reusing the existing web tools, techniques, and services to provide Browser-based-Application. The researchers tried to illustrate how to use cloud computing to improve the education process specifically in the Arab world. They stated that the problem is no longer to verify the importance of e-learning but it is to change to e-learning. Most educational institutions break down the barrier of establishment when they plan to move to e-learning systems which require many hardware and software resources. To solve such a problem the institutions can use the educational cloud. It provides a great solution to this problem, making it easy for any educational institution that wants to transform its system into an e-learning system. It will have two choices, whether to build its own private cloud or to go to a specific service provider to take a share in a pubic cloud after defining some parameters [3].

Fekry Fouad[4] highlighted in his paper the contribution of e-learning standards with the cloud computing standards and the impact on using cloud computing for e-learning systems. He provided an analysis for the important issues in current e-learning systems through a comprehensive comparison between e-learning systems before and after moving to a cloud computing environment. Fekry was using a generic frame work for cloud-based e-learning systems for his comparison. The results of his research showed that moving e-learning onto a cloud computing environment will support the e-learning in a large

deal. Cloud-based e-learning can reduce the cost of the development team, technical support team, testing effort, requirement elicitation load of daily backup management, and the cost of overall project expenditure [4].

3.Traditional E-learning

E-learning is the topic related to the virtualized distance learning by means of electronic communication mechanisms, specifically the internet. E-learning is the use of approaches with different functionalities (e-mails, Web pages, forums, learning platforms, and so on) as a support of the process of teaching/ learning. The e-learning is defined as an internet enabled learning. Components of e-learning can include contents of multiple formats, management of the learning experience, and an Online community of learners 'content developers and experts [1]'.

There are a lot of e-learning software that are used widely in various levels of education, such as universities, schools, and institutes. E-learning software provides a lot of benefits beyond classroom-based learning. The main benefit in the reduction of costs due to the IT physical environment is no longer needed [2].Also it can be accessed from any place, at any time. In addition, teachers can easily update the study materials that include multimedia contents in a user friendly approach, making them easier for students to understand the concepts. Finally, e-learning can be viewed as an approach that emphasizes the variation of learning material between teachers, reviewing their own materials for improvement at any time and from any place [2].

Among learning technologies, web-based learning offers several advantages over classroom-based learning. A physical environment is no longer required that leads to the reduction of costs, freedom of time and place. Moreover, the number of students is not limited by the area of a physical classroom. Additionally, the learning material is easy to be continuously updated. The teacher may also incorporate multimedia a content to provide a friendly framework and to facilitate the understanding of the concepts [5].

Some disadvantages can be listed for web-based learning (e-learning). First is the efficient use of these resources, where the lab PC and server will be underused in the evening and semester holidays. On the other hand, resource usage becomes very high during the day and the period of the semester. In addition it should also consider the costs associated with computer maintenance and licenses for every software package used. Second is the rapid growth of the number of students, teaching contents, services provided and resources available, has made e-learning system grow at an exponential level. With such problems, many educational institutions with limited resources and infrastructure face difficulty to continually keep up with this growth[2].

E-Learning Security Concerns

The basic security concern of e-learning technology usually arises when this type of learning is used to improve the functionality of traditional learning environment. These concerns are listed below [6]:

1-User authorization and authentication:

The user authorization is very essential and important when it comes to e-learning. In general the e-learners are from distant places, so a user ID and a password is essential. With the use of these two, one can login into the e-learning server and can access the features.

2-Entry points:

Entry points are the number of terminals where a possibility of security break may occur in the case of e-learning. As there are a number of clients in distant locations for each e-learning server, there are lots of entry points for each of them and the possibility of a security threat is more. The number of entry points should be reduced in order to get rid of this threat.

3-Dynamic nature:

One of the major concerns with the e-learning is that more processes are available in the dynamic sessions where a process can join and end the session without the notice of the others. This has opened much security infracts where they can easily attack the server and the client locations.

4-Protection against manipulation:

It is one of the key tasks to be implemented in an e-learning environment. It can be kept hidden from the other users by using certain techniques like digital signatures, firewalls etc. Similarly several other measures have to be taken in order to avoid manipulation from the registered users.

5-Non-Repudiation:

In the step of information security, cases of data loss or infection with virus, Trojan horse and other malicious treats are common. The system must be provided with the capability that the data is not damaged by these attacks.

Social Aspects of Security

In an online e-learning environment, students need to upload their soft copy of assignments. This kind of methods in e-learning technology brings the threats and vulnerabilities from internet to e-learning systems. To overcome these problems, basic security requirements such as the integrity, confidentiality and availability need to be applied. These security concerns are explained in more detail below [6]:

-Confidentiality:

Information and data sent Online should be kept confidential and not to be disclosed to an unauthorized third party. Under e-learning view, students like to get the assurance that their submitted soft copies of assignments Online, are kept discreet and only handed to their teachers on the e-learning environment.

-Integrity:

Information and data is not accidentally deleted or changed, and it should be kept accurate as in the original form. Students feel assured if integrity standards are maintained. This can only happen when their assignments submitted to teachers are kept safe in the original format without any further editing by others.

-Availability:

The reliable information should be present for access and modification by authorized people. Information present in e-learning servers must be present for students and teachers or other authorized people on a timely manner for their work. Students need assurance for uninterrupted reliable e-learning system to submit their assignments.

4.E-learning Based on Cloud Computing

With these disadvantages of e-learning based on internet, e-learning based on cloud computing is present to overcome these problems and provide a new environment for the e-learning system.

Cloud computing is the delivery of computing as a service rather than a product, whereby shared resources, software, and information are provided to computers and other devices and utilities [7]. It is a computing model in which IT resources provide a variety of services, and is available to users through the internet connection. Danny Manongga [2] defines the cloud computing as the provision of infrastructure, platform and software as a service (IaaS, PaaS, and SaaS) on the basis of simply, pay per use [2]. Although cloud computing is a technology services through the use of information on the internet, there are several requirements that must be met by an Internet-based service to be categorized as cloud computing [8], namely:

1) The services must be on demand.
2) The services must be flexible or scalable.
3) The services must be available and fully managed by the provider while users only need an Internet connection to operate the service.
4)The services must be measurable.
5) The services must be resource pooling. The cloud references a distributed collection of computing resources where the applications can be located anywhere on the accessible networks. In the cloud, there is a large pool of available virtualized resources such as hardware, development platforms, and ideally services [8], [2].

Cloud computing provides services at anytime, anywhere and that can be accessed from any device in such a way that the user is not responsible for where the services or applications are located, or how they are maintained or updated. All this and more will be the responsibility of cloud computing service providers [3].The five essential characteristics of a cloud model are: on demand self-service, broad network access, resource pooling, rapid flexibility, and measured

service [2].It has three service models; software, platform, and infrastructure. Cloud computing has four deployment models Private, Community, Hybrid, and Public Clouds [2];[6].

Types of Clouds for Deployment

There are different types of clouds for deployment [9]; [10]; [6]:

•*Public Cloud:*

A public cloud can be accessed by any subscriber with an internet connection and access to the cloud space.

•*Private Cloud:*

A private cloud is established for a specific group or organization and limits access to that group only.

•*Community Cloud:*

A community cloud is shared among two or more organizations that have similar cloud requirements.

•*Hybrid Cloud:*

A hybrid cloud is essentially a combination of at least two clouds, where the clouds included are a mixture of public, private, or community users.

Cloud Computing Services

Cloud computing services were listed as follows [4]; [11];[7]:

•*IaaS:*

Infrastructure layer corresponds to IaaS(Infrastructure as a service) is the lowest layer of the network. It is the supply of hardware as a service, that is, servers, net technology, storage or computation, as well as basic characteristics such as Operating Systems

•*PaaS:*

Platform layer corresponds to PaaS(Platform as a service) that made a higher level of abstraction on the base of Iaas layer. It is an integrated set of software with all the requirements that a developer needs to build applications, both for the developing and for the execution stages.

•*SaaS:*

SaaS(Software as a service) is a software distribution model, designed for web delivery, a user can deploy and access through the Internet hosting. It is to offer software as a service.

•*Cloud clients:*

Users who access cloud computing using networked client devices, such as desktop computers, laptops, tablets and smart phones.

Requirements for Building a Cloud Infrastructure

For the architect assigned with constructing a cloud infrastructure, there are seven key requirements that need to be addressed when building a cloud approach. These requirements include [12]:

1-Heterogeneous Systems Support:

cloud management providers must integrate traditional IT systems within in order to truly meet the requirements of the data center. Companies that don't support technologies from the likes of Cisco, Red Hat, NetApp, EMC, VMware and Microsoft will fall short in delivering a true cloud product that fits the needs of the data center.

2-Service Management:

Service offerings should include resource guarantees, metering rules, resource management and billing cycles. The service management functionality should tie into the broader offering repository such that defined services can be quickly and easily organized and managed by the end user.

3-Dynamic Workload and Resource Management:

In order for a cloud to be truly on-demand and elastic while consistently able to meet consumer service level agreements (SLAs), the cloud must be workload- and resource- aware. The system must be able to dynamically prioritize systems and resources on-the-fly based on business priorities of the various workloads to ensure that SLAs are met.

4-Reliability, Availability and Security:

To be fully reliable and available, the cloud needs to be able to continue to operate while data remains intact in the virtual data center, regardless if a failure occurs in one or more components.

5-Integration with Data Center Management Tools:

Within most data centers, a variety of tools are

used for provisioning, customer care, billing, system management, directory, security and much more. Cloud computing management solutions do not replace these tools and it is important that there are open application programming interfaces (APIs) that integrate into existing operation, administration, maintenance and provisioning systems (OAM&P) out of the box.

6-Visibility and Reporting:

The need to manage cloud services from a performance, service level, and reporting perspective becomes vital to the success of the deployment of the service. Data center operations have the requirement of having real-time visibility and reporting capabilities within the cloud environment to ensure compliance, security, billing and charge backs as well as other instruments, which require high levels of granular visibility and reporting.

7-Administrator, Developer and End User Interfaces:

One of the primary attributes and successes of existing cloud-based services on the market comes from the fact that self-service portals and deployment models shield the complexity of the cloud service from the end user.

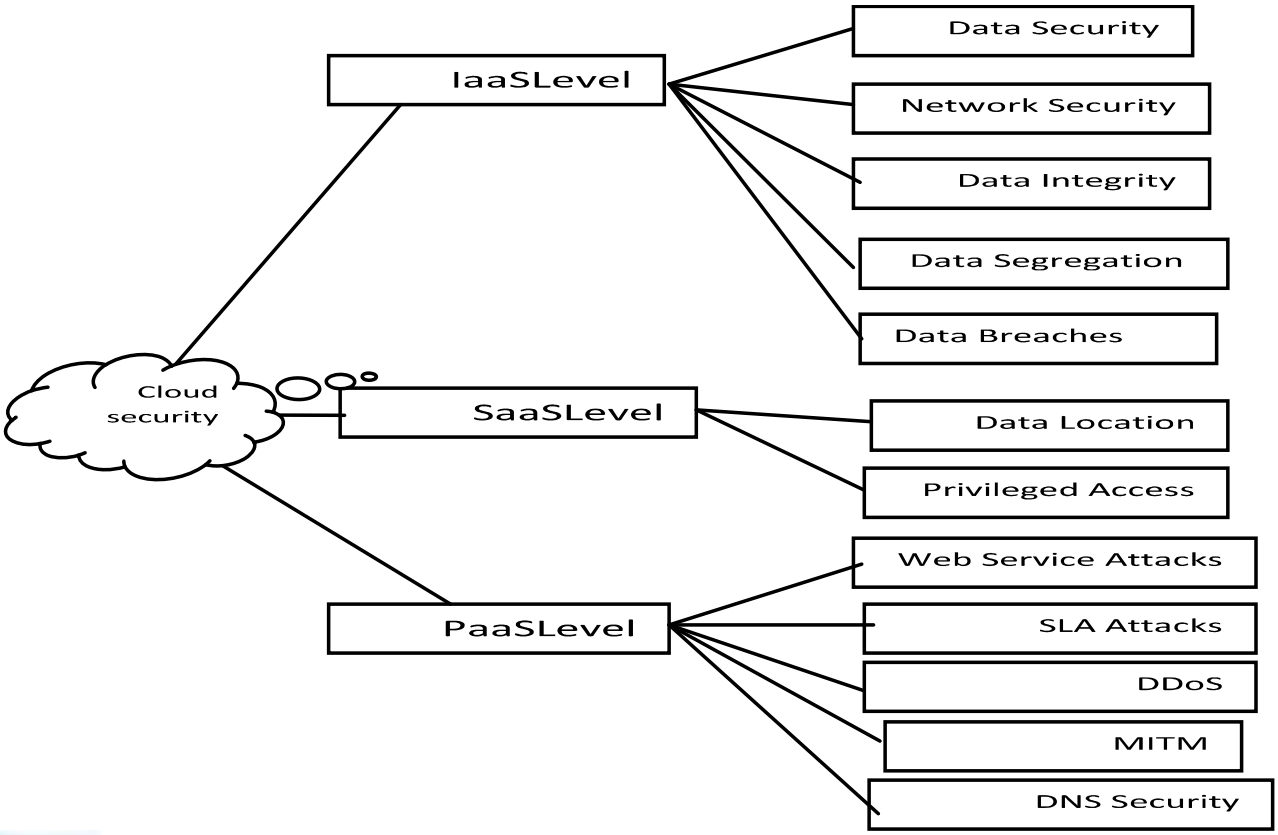
This helps by driving adoption and by decreasing operating costs as the majority of the management is offloaded to the end user.

Cloud Computing Security

Security is one of the primary concerns in the greater context of cloud computing as it relates to cloud based e-learning. From 2005-2011, security has been in the top four IT issues as published by Educause(a "non- profit association whose mission is to advance higher education by promoting the intelligent use of information technology")[13].When shifting e-learning into the cloud, the main security concerns are about confidentiality, integrity and availability. Security remains as an integral component of the top ten IT issues in 2012[13].

Security Attack Types

On the other hand there are many types of security attacks in cloud based e-learning as shown in figure (2): [14]



Figure(2): Types of security attacks [Durairaj]

Cloud computing employs three service delivery models as listed below; through which different types of services are delivered to the end user. Each service model has different levels of security requirements in the cloud environment. These are Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

The types of security attacks for Software as a Service (SaaS) are:

Data Security:

Data plays a vital role in the cloud services, because many of cloud service providers store customers' data on large data centers. There is no guarantee for customers' data during transition operations. Data corruption may occur, when multiple devices are synchronized by one user. Data security can be classified into two ways: First, data owner must be content that the cloud service provider will only process the data according to the customer instructions. Second, data owner must be convinced that the cloud service provider has taken appropriate actions in cases like, during unauthorized data access, data modification, and destruction of data by intruders.

Network Security:

Enterprises store sensitive data in the cloud server and SaaS vendors can manipulate it. To protect data from leak-age of sensitive information, strong network traffic encryption techniques must be applied to manage data flow over the network, for example Secure Socket Layer (SSL) and Transport Layer Security (TLS).

Data Integrity:

Data integrity defines the correctness, accessibility, high quality, and reliability of stored data. Cloud provides integrity of data storages for customer privacy.

Data Segregation:

Data is located in the cloud in a shared environment (there are multiple tenants that are sharing a single location) so one customer's data is stored along with another customer's data. This can affect difficulty in data segregation. Customers should examine the cloud provider's architecture to make sure proper data segregation, and also customers should be aware of protocols and implementation methods of the encryption system.

Data Breaches:

Ever since data from different users and business concerns exist jointly in a cloud environment, breaking the data laws of cloud environment will certainly attack and damage the data of all the users. Therefore the cloud becomes a very important worthy target. However SaaS promotes declaration that SaaS providers can provide better security to customers' data than by conservative means. Still insiders have rights to use the data in a different way.

The types of security attacks for Platform as a Service (PaaS) level are:

Data Location:

PaaS vendors provide services for application design, application development, deployment, team collaboration, web service integration, and testing. In this statement, the PaaS cloud users access the applications of SaaS providers to get services so that the customer does not know where the data is stored and processed.

Privileged Access:

The cloud provider has the full right to access data including other users of the cloud and other third party suppliers, once data is stored in the cloud environment. Two approaches could be used by the data owner to maintain the privileged user access. First, is to choose a strong encryption method for storing data and using another encryption method for data access; second, is to maintain a high standard of confidentiality of data, legally imposing the requirements of the cloud provider through contractual responsibilities and assurance mechanisms.

The types of security attacks for Infrastructure as a Service (IaaS) level are:

Web Service Attacks:

Web service protocols are used by cloud users for getting services. Simple Object Access Protocol(SOAP) is the most balanced protocol in web services. A standard extension of security in SOAP is web service security, addresses the security of web services.

SLA Attack:

When customers have transferred their core business functions onto their committed cloud environment, they should be ensured of the quality, availability, reliability, and performance of these resources, because cloud users do not have control over these computing resources. Cloud users are expected to get guarantees from cloud providers on service delivery, which is rendered through Service Level Agreements (SLAs) to manage among cloud providers and cloud users.

DDoS Attack:

Distributed Denial of Service (DDoS) attack is an advanced version of denial of services in terms of denying the important services by giving large number of requests, which is not handled by target server.

MITM Attack:

Man In The Middle (MITM) attack is encountered when an attacker directs himself between two legitimate users. This attack is also a class of eavesdropping. The attacker sets up the connection between two users and tries to hear the communication or it reveals false information between them. To avoid these kinds of attacks, tools have been developed like, Dsniff, Cain, Ettercap, Wsniff, Airjack etc.

DNS Attack:

IaaS cloud environment deals with a risky attack vector known as DNS Attack, which translates the domain name to an IP address. The user using IP address is not realistic because it has been routed to some other cloud virtual machine instead of original address expected.

Comparison Between E-learning Before and After Moving to Cloud Computing

According to Fekry Fouad [4]the comparison between e-learning before and after moving to cloud computing can be determined as follows: Before moving to cloud computing, many requirements are needed; such as monitoring of client logs and information by a third party, need for technical IT support for failovers, need for an e-learning system development team, need for extra hardware and software resources, need to configure latest technology updates, need to arrange extra power and cooling, need for requirement gathering and elicitation , need for project management, need for coding, need for testing, need for deployments, need for daily storage and backup, all required finely huge costs. On the other hand, after moving to cloud computing, there was no need for all these requirements.

Many problems that face e-Learning before moving to cloud computing could be solved by cloud computing. Some of these problems are the conflict between opposing goals of different clients, either play it together, if not, they need to separate, higher risks of resource availability and failure, lack of trust in data modification before storing, rejection of service attacks in critical server health, higher risks of stress, load and congestion, difficulty to review, lack of computation and accuracy trust, lack of confidentiality, lack of trust on security policies and access control [4].

Advantages of E-learning Based on Cloud Computing Over Traditional E-learning

There are consequences and implications associated with the development of e-learning in the cloud environment as confirmed by Masud et.al,[15] : Accessed via the Web, does not require any software on the client-side, pay per use, SaaS Server can support many educational institutions, all customer data is at SaaS Server[15]. Ouf et.al, [16] give several values of cloud computing potential for education including :

1. No back up required to drive and transfer from one platform to another
2. No crash recovery needed,
3. Access from a variety of places, and
4. Flexibility. Furthermore, no stolen data, virtualization, centralized data storage, monitoring data access becomes easier[16]. Cloud computing not only saves the money needed for upgrading many labs' hardware or purchase many software licenses but it also reduces periodic maintenance operations. It also provides a high level of security and privacy [3]. Also, cloud-based e-learning can reduce development team cost, technical support team cost, testing effort, requirement elicitation, load of daily backup management, and cost of overall project expenditure [4].

Madan[11]mentioned some of cloud computing advantages like reduced upfront investment (such as software, hardware, and professional staff to maintain servers and upgrade software), reduced launching time (where days become hours) expected performance, high availability, infinite scalability, great fault tolerance capability (fault tolerance is the property that enables a system to continue operating properly in the event of the failure of some of its components), and improved collaboration, accessibility, and also mobility, allowing users to use any device(such as a personal computer (PC), or a mobile phone).

Also Riahi [17] listed some of the cloud computing advantages which can be summarized as low cost, improved performance, instant software update, improve the compatibility of document formats, benefits for students, benefits for teachers, and information security [17].

Alghali[18] listed many advantages to educational institutions when using cloud computing as follows [18]: Support from the service provider can be gained. The availability where in cloud computing, systems can automatically detect the node failure and exclude it without affecting the users system. Also, to reduce costs as cloud computing gives an opportunity to reduce the amount of money spent on IT. As well, to offer the service on-demand where cloud computing users have access to computing capabilities with 24 hours access to the infrastructure, content and software when needed without requiring human interaction with the cloud service provider CSP. Add to that, pay per use where the cloud computer users pay only for what they actually use. Another advantage is Wide Network Access, the education institutions can enhance their communication by participating with each other. Another one is Rapid Elasticity, services in cloud computing have the ability to scale resources both up and down on demand.

While the cloud based e-learning has many benefits for educational institutions, still, there are some challenges in implementing cloud computing to e-learning technology. These challenges in cloud based e-learning technology are listed below. Alghali [19] listed some of them as privacy where data privacy protection in cloud computing faces many challenges such as access, storage, compliance, retention, destruction, audit and monitoring, breaches and controversy of various legal systems. Security also plays a necessary condition of some e-learning materials. If the data is stored in cloud, the question of the security of this valuable data on unknown cloud servers arises. Reliability is a great concern as well for education institutions Legal Issues. If an organization wants to take the advantage of cloud computing system services, it has to make sure which countries are hosting their private data, and what are the country's laws that govern data [20].

5.Conclusion

We can conclude from the previous studies that the cloud computing is the best solution for all educational institutes and universities. It is not a question of reducing costs or infrastructure, rather a more efficient work and secure environments. Nowadays, all institutes and universities especially those with limited budgets have to benefit from cloud computing and improve their e-learning systems by gaining all the advantages of cloud computing. Ongoing technology development will continue moving, and will always offer something new to the world; this is the charge that has to be paid to keep the organizations up to date with dynamic technological development. All organizations have to keep reducing the gap between their current situation and the new development, in order to continue offering their services in a sufficient way. The researchers believe that cloud computing is the next big trend for an efficient e-learning system. This is for the features and capability to improve traditional e-learning system both technologically and cost wise.

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