

# A Comprehensive Survey on E-Learning System in Cloud Computing Environment

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**Abstract:** Internet broadband connectivity content has created a global phenomenon in which information and communication technology (ICT) is being used to transfer education. Cloud computing is becoming an attractive technology due to its dynamic scalability and effective usage of the resources and it can be utilized under circumstances where the availability of resources is limited. E-learning systems have high infrastructure requirement that are necessary to provide concurrent service to that amount of student which actually succeeds the capabilities of a conventional web server. Cloud computing provides the platform to support e-learning as it delivers the computing resources both hardware and software as a service over the internet. In this paper, we will provide a comprehensive survey on e-learning systems in cloud computing environment and converse assorted proposed solutions. The proposed e-cloud provides the opportunity of flexibility and adaptability to use the computing resources on demand and resolve many problems like data security, performance, Centralized data storage, privacy, accessibility, Pay per usage, back up and reduce the cost of maintenance and improved performance of document format compatibility. There are many cloud services providers that educational system like Amazon, Google, Yahoo, Microsoft etc.

**Key words:** E-learning, Cloud computing, Resources, Information and Communication technology (ICT), Internet

## 1. Introduction

Today global network has boosted the e-learning among many institutions with the integration of learning technologies with enormous IT infrastructure. The E-learning is a learning approach based on internet technology to initiate, implement, control and support learning which has enhanced flexibility and efficiency to traditional method of education [1]. E-learning currently has overwhelmingly been adopted and is becoming a likely alternative to the traditional method of attending and learning in the classroom. It integrates learning tools, materials and training content and services to enable efficient and economical delivery of educational content in a configurable infrastructure. Cloud computing is not an exception; it has become a suitable platform architecture for E-learning system and education services [2]. Cloud computing is becoming an attractive technology due to its dynamic scalability and effective usage of the resources it can be utilized under circumstances where the availability of resources is limited. In this paper, given that comprehensive survey on e-learning systems in cloud computing environment and discuss different researchers' concepts, proposed modals and focus some key points about e learning on cloud. According to the previous work converse assorted proposed solution and try to express the different comparison like different development cloud modals, traditional learning and common learning, e-learning and clouds based e-learning systems and show the characteristics or features to the diverse author's concepts. E-learning systems have highly infrastructure requirement that are necessary to provide proposed e-cloud opportunity. The National Institute of Standards and Technology (NIST) Cloud computing as "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"[3]. Cloud computing offers a value proposition that is different from traditional enterprise IT environments. By providing a way to exploit virtualization and aggregate computing resources, cloud computing can offer economies of scale that would otherwise be unavailable [4]. According to the Adhyapak [5] confirmed that the demand for education development within the society is growing all the time and therefore quality, improved and advanced e-learning solutions is obligatory which is demanded and must go in hand with technology dynamics and consequently, the adoption and use of cloud computing is essential. [6] affirmed that a number of institutions have now embraced the E-Learning by incorporating the cloud computing technologies within the academia therefore offering a more flexible, scalable, efficient and reliable learning content. Cloud computing provides the resources on demand and resolve many problems like data security, performance, Centralized data storage, privacy, accessibility, Pay per usage, back up, instant software updates, easy monitoring of data, Minimize investment on hardware resources, reduce the cost of maintenance and improved performance of document format compatibility. There are many cloud services providers that educational system like Amazon, Google, Yahoo, Microsoft etc.

The rest of this paper is structured as follows: Section 2 describe cloud computing into an e learning as its architecture of infrastructure to sustainable and flourishing E-learning and demonstrate the comparison different development cloud modal; Section 3 illustrate e learning and traditional learning systems compared the various features in table; Section 4 Spotlight on cloud based e-learning approaches and show the characteristic of e learning and cloud based e learning; Section 5 illustrate the essential characteristics in the cloud environment; Section 6

focus on the key benefits of cloud based e learning; Section 7 challenges for e learning cloud; At the end demonstrate the comprehensive survey table and spotlight the different author work and assorted proposed model in Section 8; followed by the conclusion in Section 9.

## 2. Basic Concept of Cloud Computing

A cloud pass on to a diverse that is measured IT resources and design to the IT environment according to the client needs and fulfill the purpose of slightly provisioning scalable. Cloud computing provides a group of computing resources with its dynamic scalability and virtualization usage as a service from side to side the internet. This technology is more affiant and cost effective by centralized data storage, process and bandwidth.

### 2.1. Cloud Service Models

The term “service” refers to an encapsulated task abounding to cloud clients that is the type of service that cloud providers and distribute to the customers.

#### 2.1.1 Software as a Service (SaaS)

SaaS is deployed over the internet and provides the services on demand, through a subscription, in a “pay-as-you-go” model. According to the [7], the provision of software applications to customers by the cloudservice providers which typically are running on the provider’s infrastructures and areaccessed through client’s browser (e.g. Google Apps and Salesforce.com).

#### 2.1.2 Platform as a Service (PaaS)

This cloud service modal is the platform for the establishment of software and delivered over the web. This layer providing the facilities to maintain the whole application so that advance life cycle contains structure, performance, procedures and sustains the prosperous web applications, services on the internet. PaaS enables SaaS users to develop add-ons, and also develop individual web based applications, reuse other services and develop collaboratively in a team [8].

#### 2.1.3 Infrastructure as a Service (IaaS)

Infrastructure layer (IAAS) has the bottom layer of the cloud services and provide the services on demand. Users can household to provide Standard services as well as (computing power and storage resources). It turn the memory, storage and computing power into a virtual whole resource pool for the entire industry to provide the required of computing power and storage resources [9].

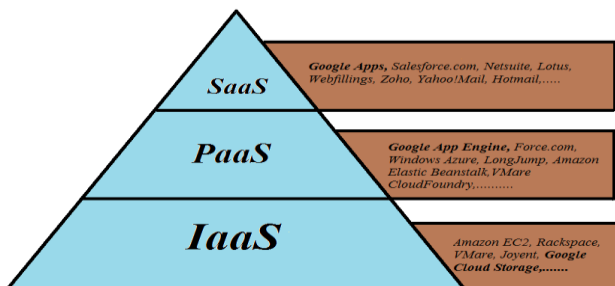


Figure.1.Illustration of the layers for the Services Oriented Architecture [10]

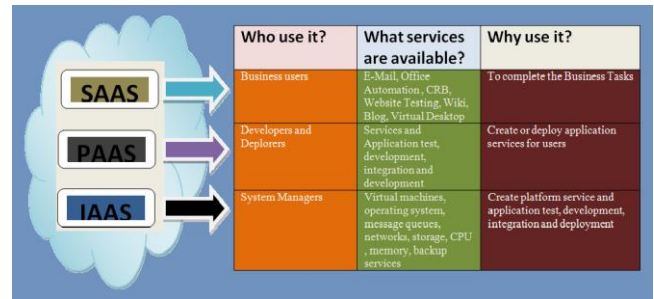


Figure. 2. Types of Cloud Models

### 2.2. Cloud Deployment Models

Cloud computing is a representation on demand network access and the collection of organize resources such that servers, networks, storage, applications, services etc which can be provisioned and released with minimal management effort or service supplier interaction. According to the NIST definition cloud replica is composed of five essential characteristics, three service models, and four deployment models.

**2.2.1 Private Cloud:**The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises. [11]

**2.2.2 Community Cloud:**Community cloud infrastructure deployment that is shared by many organizations from a specific community with universal concerns.

**2.2.3 Public Cloud:** Public cloud is a cloud computing operation model in which infrastructure is made available to general public, storage and other resources. These services are free or offered on a pay-per-used.

**2.2.4 Hybrid Cloud:**This deployment model consist of two or more type of the (private, community, public) models.

Table.1.Comparative study between Public, private and hybrid cloud [12]

Public Cloud	Private Cloud	Hybrid Cloud
Availability of Elastic and Flexible Environment	Scope of Security and Confidentiality	Offer flexibility, control and security
Pay for Use Service	Greater Customization	Data centre consolidation
Freedom of self service	Maximum Protection	Risk transfer of workload
Resource Availability andReliability	Own Dedicated Resources	Optimum Utilization of resources
Amazon EC2, Google App Engine, IBM Blue Cloud and Widows Azure	Amazon Virtual Private cloud, Eucalyptus Cloud Platform, IBM Smart Cloud, Microsoft Private Cloud	Requirement of both on-premises resources and remote server based cloud infrastructure

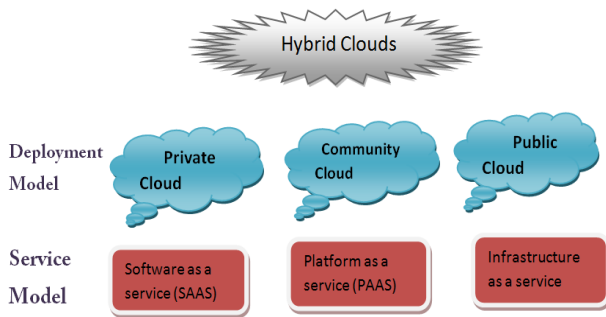


Figure 3. Cloud computing model [15]

### 3. Basic Concept of e-Learning

E- Learning is internet or electronic based learning process it delivers the digital content, provides a learner-orient environment for the tutors and learners. It is also referred to as computer based training, internet-based learning, web-based training, and online learning [14]. E-learning supports the virtual environment. Electronic education has been using new technologies such as social networking and educational forum; they should introduce themselves as the chosen style. According to all that was expressed: e-Learning can be defined a form of education using technology and electronic devices and in the broader internet and web technology [15]. In this table express and comparison traditional learning and e – learning .spotlight on the features of learning needs. According to the future requirement show the comparison both learning systems. Describe the characteristics both learning environment.

Table.2. Compare the traditional learning and e-learning [15]

Features Compared	Traditional learning	E-learning
Focus on learning	Teacher-cantered	Student-Cantered
Motivational Features	Create a spirit of competition and jealousy in learners	Create a spirit of cooperation and teamwork in learners.
Time and place limit	A timeframe for all and A special place for all (limited)	Period of time , which is determined by the receiver and every place that the receiver is able to access the learning content(no limits)
How to respond	Predefined responses	Reconstruction of replies when confronted with the problem
Content compatibility	In the initial shape and remain unchanged	Change According to the users.
Educational Prerequisites	Physical space for students and physical space foe educational resources	Virtual space to save educational resources without the need of physical space to locate the students
Up to date educational resources	Fixed content and usually old	Dynamic content and usually update
Forms of educational content	Educational content was one dimensional and focus was on book	Multiple learning content (audio, video, multimedia) and interactive.

### 4. e-Learning Based Cloud Computing

Cloudsupport e learning educational system and offer the low hardware cost and fast connectivity. Provide the services on demand with pay per use mechanism and accomplish the modern learning requirements. In this table express and comparison e – learning and cloud base e-learning .spotlight on the characteristics of learning needs. According to the requirement show the contrast both learning systems common learning and e-learning based on cloud computing. Illustrate the characteristics both learning environment.

Table 3. Common e-learning vs. e-learning based on cloud computing [15]

Characteristics	Common e- learning	E-learning based on Cloud Computing
Hardware costs	High cost of maintenance	Low cost of maintenance
Storage capacity	Fixed capacity	Dynamic capacity
Requires specialized knowledge within the enterprise	Use of E-learning professionals	Using a computer technician
Implementation period	Very long	Shorter than the common method
Processing power	Initial and fixed	In terms of demand
Security, Trust and Related Issues	Internal maintenance more Security and trust	External maintenance reduce Security and trust
Overall costs	Initial investment, fixed and up	pay-per-use

The e-learning cannot completely replace teachers; it is only an updating for technology, concepts and tools, giving new content, concepts and methods for education, so the roles of teachers cannot be replaced. The teachers will still play leading roles and participate in developing and making use of e-learning cloud. Moreover, the interactive content and virtual collaboration guarantee a high retention factor. On the other hand, E-learning cloud is a migration of cloud computing technology in the field of e-learning, which is a future e-learning infrastructure, including all the necessary hardware and software computing resources engaging in e learning. After these computing resources are virtualized, they can be afforded in the form of services for educational institutions, students and businesses to rent computing resources [16].

Cloud based e-learning is the sub division of cloud computing educational field for e-learning systems. It is the future fore-learning technology and its infrastructure. Cloud based e learning has all the provisions like hardware and software resources to improve the traditional e-learning infrastructure. Once the educational materials for e-learning systems are virtualized in cloud servers these materials are available for use to students and other educational businesses in the form of rent base from cloud vendors.

Cloud based e-learning architecture is mainly divided into five layers called hardware resource layer, software resource layer, resource management layer, server layer and business application layer [8].

#### 4.1 Hardware Resource Layer

Hardware resource layer is the substructure layer and sometimes refers server layer. This layer is most important for the total infrastructure. Often, hardware resources are inexpensive and are not fault tolerant. Fault tolerance is provided at other layers so that any hardware failure is not noticed by the user. Utilize the multiple hardware platforms achieve the redundancy. The basic computing power such that physical server, storage and network from virtualization group for being called by upper software platform. Physical host pool is dynamic and scalable, new physical host can be added in order to enhance physical computing power for cloud middleware services [17].

#### 4.2 Software Resource Layer

Mainly these are study materials and web services for various theory subjects and for practical subjects provided by the teachers of Educational Institutions across cities, states and countries that can be accessed over the Internet. Here the entities involved are students (End Users), Teachers and Cloud Service Providers [18]. Software resource layer provide unified interface. This layer is created with the help of operating system.

#### 4.3 Resource management layer

Resource management layer is the key to accomplish loosing coupling of software and hardware resource. This layer is managing resource status teacher's resource allocation system, student resource system, payment detail and demand expected in future with the help of virtualization and scheduling ideas.

#### 4.4 Service layer

Server layer divided into three levels SaaS (software as a service), PaaS (Platform as a service) IaaS (Infrastructure as a service). SaaS provide the cloud computing services to the customer on demand. PaaS It is a platform for the creation of software and delivered over the web. IaaS Infrastructure layer corresponds to IaaS infrastructure services is the lowest layer of the network. These services layers help to cloud customers to use a variety of cloud resources.

#### 4.5 Application layer

This layer is an explicit e-learning application that is utilized for sharing learning resources and interaction among users that includes synchronous or asynchronous discussion and chatting [19]. This layer contains:

- Content production
- Education objectives
- Content delivery technology
- Evaluation component
- Management component

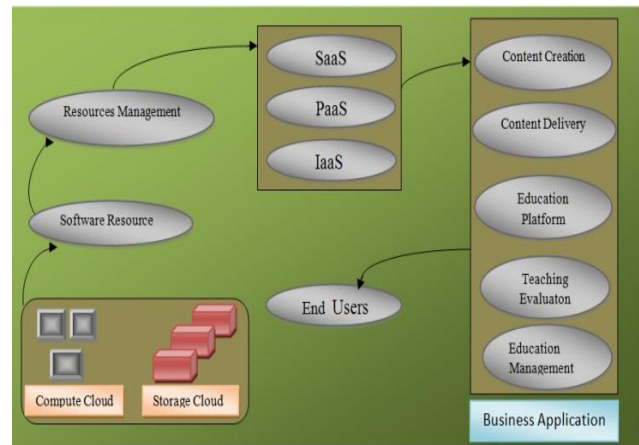


Figure 4. Architecture of e-learning cloud computing [20]

This Structure is depiction analysis of architecture of cloud computing. Figure 4, illustrate the services of cloud computing that are relate to business applications. Pictorial view shows the circular working of architecture. Computer and storage cloud gave the services of software and management resource than data pass on the three levels of services provided in cloud computing, namely, IaaS, PaaS, and SaaS. Choice this one all of these according to the user need to move on and next step contact the business applications and last end users.

### 5. Essential Characteristics in the Cloud Environment

An outsourcing Frame to the cloud the term cloud is related to internet. Cloud computing is an internet based computing where virtual shared servers deliver software, infrastructure, platform, devices and additional resources that are hosting to clients with comparable quality of service on demand but at a much lower cost. Cloud computing promotes the availability of the following five characteristics [21].

#### 5.1 On-demand Self-Service

That is the automatic provision of computing resource to clients (e.g. server time and network storage) when needed without providers interaction. [7] Consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

#### 5.2 Broad network access

It must be contained and accessed through heterogeneous platforms (PCs, & PDAs, mobile phones for instance). High bandwidth is must be available to connect the cloud servers for a student that's why cloud computing is efficient.

#### 5.3 Resource pooling

Location autonomous pooling of computing services for serving multiple clients (multi-tenancy), such resources are assigned to consumer animatedly in response to their demands. Whenever they are needed these resources allocate virtual components.

#### 5.4 Rapid elasticity

Rapid elasticity refers to the ability of the virtual cloud to expand or reduce the allocated resources quickly and efficiently to meet the requirements of the self-service characteristic of cloud computing. During examination time the requirement of resources are more and during the vacation time it is less. This allocation should be done automatically and should appear as a large pool of dynamic resources that can be paid for and whenever needed [18].

5.5 Measured Service

It provides for automatic control and optimized resource use measured in a pay-per-service use manner for the type of service provided [7].

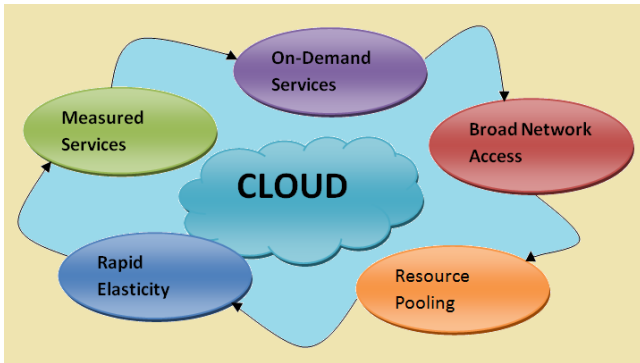


Figure.5. Essential Characteristic of cloud computing environment

This figure presented the essential characteristic of cloud computing environment. Cloud provide services on demand, supply internet connectivity is very bandwidth broad network access. Many resources offer in the e earning cloud environment. Measured services and rapid elasticity are also on cloud surroundings.

6. Key benefits of Cloud based in e-learning Computing

No.	key benefits of cloud based e learning	Description
1	Lower costs computer	To run a web application based on the cloud it is enough to have systems with low memory, less processing power, minimum storage. So PC's can be affordable for rural students and with poor financial background.[18]
2	Fewer maintenances issues	Less hardware installed no use the specific software however there will be fewer maintenance issues.
3	Increased computing power	Clouds supply more processing powers so it is very helpful for student's research, projects and other activities.
4	Easier group teamwork	Multiple students and teachers can collaborate to perform the different tasks
5	Latest Versions and software update	The Cloud always hosts the latest versions of the documents. So there is no danger of having an outdated version on the computer one is working.[18]
6	Interoperability across devices	No need to install specific software when move the data pc to Mobile.
7	worldwide access to document	Students access anywhere required document on the cloud through the geographically

8	Multitenant usage	If students requiring a specific lecture form a group and access the lecture, the cost will be further reduced[18]
9	Incentive for the Teacher	Teachers are not needed to invest anything. Still they will be getting incentives for every access of their lectures by the students.[18]
10	Better Storage Capacity	Cloud provide the better storage capacity as compare to other servers
11	Availability, fault tolerance and recovery	to guarantee a permanent service (24x7) with the use of redundant systems and to avoid net traffic overflow[10]
12	High security	In the cloud computing model, data is storied intensively. Relying on one or more data centre, the managers manage the unified data, allocate the resources, balance load, deploy the software, control security, and do the reliable real time monitoring, thus guarantee the users' data security to the greatest possible degree[22]
13	Scalability	Since the application is running on a server farm, the scalability is inherent to the system SaaS server may support many educational institutions. Therefore, as the students or teachers' need grows, the software performance will not degrade[23]
14	Energy efficiently	It is also important to reduce the electric charge by using microprocessors with a lower energy consumption and adaptable to their use[10]
15	Flexibility	Scale infrastructure to maximize investments. Cloud computing allows user to dynamically scale as demands fluctuate[24]

7.Challenges for e-Learning Cloud Computing

This table,specified that Challenges for e-Learning Cloud Computing and focus some challenges key points about e learning on cloud.

No.	Challenges for e-learning cloud	Description
1	Accessed via Web	It implies an ease of access since anywhere, any time and any one can access theapplication, greater demand for Web Development skills.[24]
2	No client-side software needed	Since the system construction and maintenance are not located in interior of educationalinstitutions or enterprises, it has reduced many costs like installation cost (as there is no installation), maintenance cost,deployment and server administration cost, total lower ownership cost, IT staff cost.[23]
3	SaaS server may support many educational institutions	Since this application is running on server side scalability in inherent to the system. Even though the student usage grows, the software performance will not degrade.[24]
4	All subscriber	Very high level of security is needed

	data held on SaaS server	by SaaS provider in order to gain trust of subscribers and sophisticated multitenant software architecture. The subscriber data is distributed between many providers and it must be integrated in order to gain overview of business, higher demand for system and data integrators.[10]
5	Virtualization	It makes possible the rapid replacement of a compromised cloud located server without major costs or damages. It is very easy to create a clone of a virtual machine so the cloud downtime is expected to be reduced substantially.[24]
6	Centralization data storage	Losing a cloud client is no longer a major incident while the main part of the applications and data is stored into the cloud so a new client can be connected very fast. Imagine what is happening today if a laptop that stores the examination questions is stolen.[10]
7	Performance and bandwidth cost	Cloud computing provides internet based services data traffic heaving with a very high bandwidth requirement. However use the fiber optic cable establish broadband network.

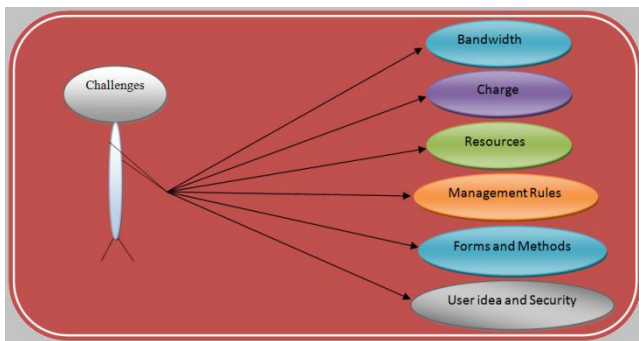


Figure.6. Cloud Computing Challenges for E-Learning

Demonstrate the cloud computing challenges for e-learning. Five major challenges of cloud computing and cloud perform efficiently to complete the user requirement. Approximating maintain the security levels according to the user ideas and provide the high bandwidth on resource level, manage all the working related to cloud. Maintains the cost in efficient manners and concern some rules to provide the benefits cloud based e learning.

**8. Comprehensive Survey Table**

In this table, given that comprehensive survey on e-learning systems in cloud computing environment and discuss different researchers' concepts, proposed modals and focus some key points about e learning on cloud. According to the previous work converse assorted proposed solution.

Year	Author Name	key points and Proposed Modals
2016	Mansi et al.[14]	The objective of this paper is to provide educational environment which is based on reusing the existing web tools, techniques, and services to provide browser based application.
2016	Jackson et al.[33]	This paper majorly assesses the cloud computing adoption, benefits and issues

		and integration concepts in an e-learning system in higher education.
2016	Arvind et al.[21]	Conclude Open source cloud based E learning facilitating platform for learning in effective ways.
2016	Chetan et al.[04]	In this paper based on survey Adoption of cloud computing in Education System
2015	Ghazal et al.[26]	Introduce different models and compare to traditional e learning and cloud e learning
2015	Fekry et al.[30]	Investigated the issue of how Cloud Computing technology can be employed in e Learning systems in the favor of higher education which have limited budget.
2015	IM Venkatesulu et al.[32]	The proposed algorithm for video encryption and decryption during streaming in cloud computing takes less time as compared with RC4 and MD5 with required level of security
2015	Akilu et al.[07]	In this paper discussed the main components of e-learning platform and focused specifically on advantages and limitations of such systems with regards to our tertiary institutions.
2015	Manjeet et al.[08]	The paper highlights the concept and services provided by Cloud Computing. This paper highlights the benefits of using cloud computing for e-learning and also focuses on Cloud Computing initiatives
2015	Shipra et al.[23]	In this paper brief knowledge of e learning and computing will be given and how cloud computing will be used for the application of e learning systems with some issues and benefits of cloud computing.
2015	Zaydoon et al.[36]	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.
2014	ThanhDuy et al.[31]	With the theoretical exploration and integration of consumer innovativeness with the UTAUT2 antecedents into the same model, the paper proposes a model of E-learning adoption that explains the factors of influence on the consumer intention and use of cloud-based E-learning systems. The model was empirically tested and basically supported.
2014	Mohammed F. et al.[29]	This paper provides the optimistic impact of using cloud computing architectures based on e learning system development. It spotlights on the payback of cloud computing for e-learning solutions and the e-learning development organization confronts when this architecture is utilized.
2014	Santhi et al.[24]	In this paper, we have expressed the major components of e-Learning systems, focusing on the flexibility, convenience, easy accessibility, consistency and repeatability of this kind of systems.
2014	K.Yadav et al.[37]	In the present paper a cloud education system is introduced and how it is

		beneficial for students, faculty and the educational institutes for providing quality education.
2014	Shahriar et al.[15]	In this research at first the concept of a cloud computing based along with its benefits is introduced. Then, a new formula is suggested that showing the cost effectiveness of the cloud based e-learning.
2014	Abhay et al.[12]	In this paper, discuss MVC framework which provides more efficiency, maintainability, reusability and separate functional layers hence most of the industries uses that for system development and implementation
2013	Nungki et al.[19]	Introduce <b>the proposed modal</b> based on five layers, namely: (1) infrastructure layer; (2) platform layer; (3) application layer; (4) access layer; and (5)user layer.
2013	Najwa et al.[34]	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
2013	M. Malathi et al.[18]	In this paper we introduced <b>the proposed architecture</b> based on the clouds. This model can be effectively used in schools of remote villages, in the distance education field, for online training of business professionals, for children who cannot attend schools and people from poor financial background.
2013	Chirag et al.[35]	This paper presented comprehensive study of different e-learning based LMS

## 9. Conclusion

In this paper, providing comprehensive survey on e-learning systems in cloud computing environment and converse assorted proposed solution. Describe cloud computing into e learning as architecture discussed cloud based e-learning approaches and essential characteristics in the cloud environment. Spotlight key benefits of cloud based e learning and challenges for e learning cloud along with demonstrate the diverse comparison work of different authors in table. In the last section demonstrate the comprehensive survey table and spotlight the different author work and assorted proposed model E-learning systems have high infrastructure requirement that is necessary to provide concurrent service to that amount of student which actually succeeds the capabilities of a conventional web server. Cloud computing provides the plat form to support e-learning as it delivers the computing resources both hardware and software as a service over the internet.

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