CLOUD-BASED E-LEARNING IN EDUCATIONAL INSTITUTIONS: CONCEPTS AND REVIEW

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ABSTRACT

The recent revolution in Information and Communication Technology (ICT), internet technology and its speed has grown widely into the sharing of knowledge in the world of education. An e-learning system requires several hardware and software resources; all educational organizations are not able to meet the expense of such investments and environments, so cloud-based e-learning is the best solution. Due to Cloud Computing characteristics and benefits, it has become a natural platform to provide more effective e-Learning systems. The study of the literature review is executed by 71 research paper published in national and international journals, conferences, white papers concerning to model, framework, and architecture of cloud-based e-learning. In this review paper e-learning and cloud computing with their key characteristics, services, deployment model, benefits and limitations are discussed. The review paper also provides landscape to develop a unified and comprehensive cloud-based e-learning model for undertaken research work.

KEYWORDS: *Cloud Computing, E-Learning, SAAS, PAAS, IAAS*

INTRODUCTION

At present in the digital age education is very essential to mankind; it contributes to making the dynamic personality, better livelihood and better understanding. As the emergence of new technology, it has become easy to acquire education in various ways. One of the most promising systems for education is e-learning; e-learning is used for learning and teaching through the use of information and communications technology (ICT). Some others terms are also used to depict this method of educating and learning, those are distance learning, web-based learning, virtual learning, cloud-based e-learning, and open schooling. Adoption of cloud computing in educational institutions gives a pool of registering resources with its dynamic adaptability and use of virtualized resources through the Internet. The resources can be servers, application software, platforms, infrastructure segments, and services. Acquisition of cloud technology becomes helpful to the educational organizations to be able to reach accumulation at affordable cost with fast cum effective privacy, security, communication power, flexibility, and accessibility.

E-Learning

Learning through electronic media and accessing the courseware online or of-line through the internet is known as e-learning [1]. E-learning is electronic learning and typically this means using an electronics devices to deliver course, program or content in an educational institution as well as to give business training in a corporate era [2]. Several

synonyms are used for E-learning like WBT (Web-Based Training), CBT (Computer-Based Training) and IBT (Internet-Based Training). E-learning is a mechanism that let one share skills and knowledge over computer or network, in this mechanism content is delivered through electric media like Internet, audio or video tape, satellite TV, CD-ROM, etc. It can be self-paced or instructor-led; it includes media in the form of image, text, animation, streaming video and audio. There are at least two entities involved in an e-learning system: the students and the trainers.
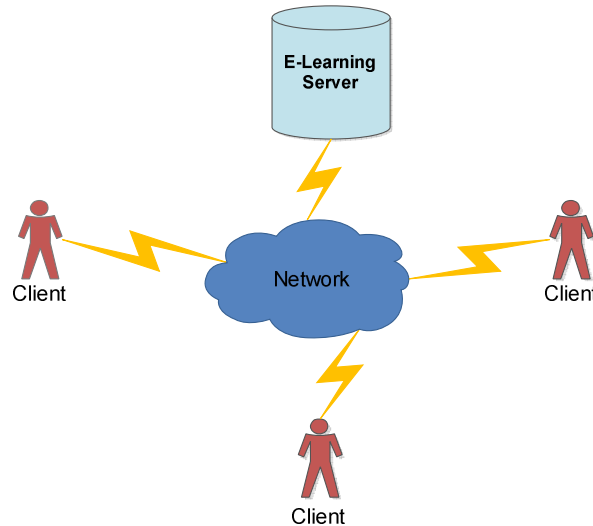

Figure 1: E-Learning System

The basic architecture of e-learning includes a database server, application server, and communication infrastructure connected with the client; it is depicted in figure 1

Cloud Computing

Cloud computing is an extended concept of grid computing. There are many definitions of cloud computing but the definition given by The National Institute of Standard and Technology (NIST) covers all vital aspect of it. "Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction"[6]. Cloud computing is a type of Internet-based computing that provides shared computer processing resources and data to computers and other devices on demand [3]. As depicted in figure 2. Cloud computing is a last one phase of six distinct computing paradigms phases [8].
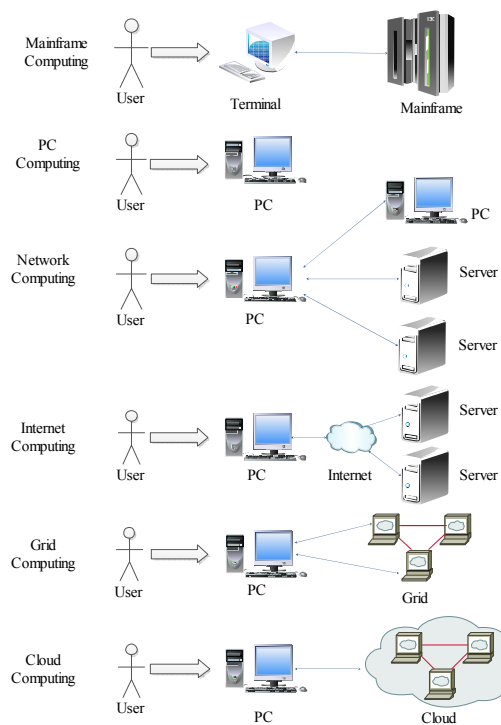
Figure 2: Six Computing Paradigms

Phase 1: In phase one, using dummy terminals many users shared powerful mainframes. Terminals were basically monitors and keyboards.

Phase 2: stand-alone personal computer became powerful enough to meet the mass of users needs.

Phase 3: provide computer network that allowed personal computers, laptops, and servers. They connected together through local networks to share resources and increase performance.

Phase 4: Show that the local network was connected to other local networks forming a global network such as the internet to utilize remote applications and resources.

Phase 5: Brought computing technology to grid computing, that provided shared computing power and storage through a distributed computing system.

Phase 6: Cloud computing technology that exploits the sharing of available resources on the internet in a scalable and simple way.

It provides services by means of the internet as per the demand of users. The services include providing hardware resources, platform, and tools for developing and debugging the application and various services such as Gmail which are offered by the cloud provider. Users have to pay only for what they have used. So, it is very beneficial for users to as it consumes less money and can be accessed from anywhere through the internet.

Cloud Computing Characteristics

NIST and ISO/IEC have described essential characteristics of cloud computing, that present a different view for cloud computing.

Table 1: Summarize the Main Characteristics of Cloud Computing with the Example [4] [5] [7]

Characteristics	Description	Example
On-demand self-service	A consumer can access services or.	Web portal, New York Times and NASDAQ
Broad network access	Services of Cloud computing are supports heterogeneous client platforms accessible over the network, it	Mobile devices like tablets, smartphone, and laptop.
Resource pooling	The Service provider resources are pooled between multiple customers according to their demand. Resource may be virtual	Storage, processing, memory, and network bandwidth.
Rapid elasticity	Resources are provisioned and can be scaled up and down rapidly and elastically.	Extension of Service or Node in Existing Nodes
Measured service	Resource/service usage is constantly monitored, measured, and reported which support optimization of resource usage	Pay per usage service, like data service, active users account
Multi-tenancy	A feature where resources are shared between multiple tenants and their data are isolated from and inaccessible to one another.	Amazon AWS is multi-tenant at the hardware level. Force.com is multi-tenant at the DB level in that its users are sharing data in the same DB tables.

Cloud computing service model: Cloud computing has the following three layers which are depicted in figure 3 [9].
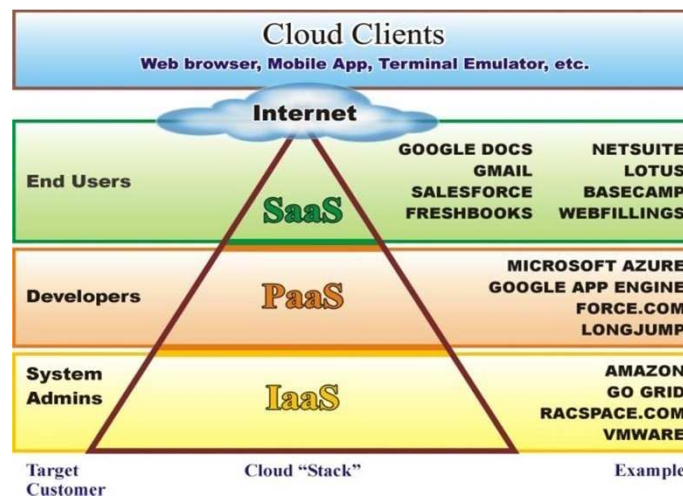
Figure 3: Layers of Cloud Computing Service Model

- Infrastructure as a Service (IaaS): IaaS provides hardware as a service that includes firmware, servers, network, storage, applications as well as operating systems and virtualization of hardware resources. This layer represents the combination of different hardware and firmware that make cloud technology absolutely wonderful.

- Platform as a Service (PaaS): PaaS provides a platform to create an application. It provides tools and software to build applications, both for the developing and execution. It presents the tools that a developer needs, having indirect access to the IaaS services and thus to the infrastructure.

- Software as a Service (SaaS): Last service level is SaaS, offers software application as a service; rather than

buying software package user can use this software on the basis of pay as you go. This is the most basic service provided by the cloud.

- In addition, such other service models find by NIST that are classified as anything as a Service (XaaS) like [5]:

- Hardware as a Service (HaaS): HaaS offers only the hardware as a service.

- Database as a Service (DaaS): DaaS is provided database as a service to abstain the intricacy and operation cost of a database; if it is hosted in the own network of an institute.

- Storage as a Service (SAAS): In SAAS a company rents storage space in their infrastructure to a mid-sized company or smaller business or individual. That lacks the budget or technical person to manage own storage.

- Communications as a Service (CAAS): It is leased from a single vendor. It can be embrace collaboration and video conference applications using mobile or fixed devices, instant messaging (IM), voice over IP (VoIP or Internet telephony). The CAAS provider is responsible for guaranteed Quality of Service (QoS) and all hardware/software management.

- Monitoring as a Service (MAAS): Monitoring-as-a-service (MAAS) is a framework that facilitates monitoring infrastructure and/or applications whether on-premise, hosted or in a hybrid environment.

Cloud Deployment Models

The NIST definition identifies the following four cloud deployment models [10]

Table 2: Research Methodology used in Identified Paper

Cloud Deployment Model	Definition	Example
Private	It is exclusively available for a single organization, An organization operates it, but it might be managed by a third party.	Service may exist off-site, A Personal organization
Public	In this model infrastructure is made available to the general public. User can access services through internet from anywhere.	Google, Amazon
Hybrid	It is the integration of two or more type of the above cloud computing models.	E-Commerce Web Site
Community	It is shared by many organizations over common concern	Bank and Trading Firm

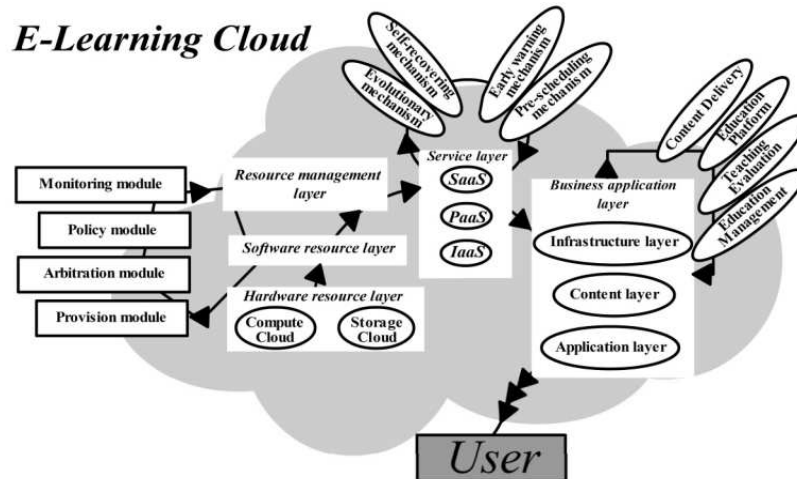Cloud-based E-Learning architecture is made of five layers as depicted in figure 4 [11]

Figure 4: Cloud-Based E-Learning Architecture

- Hardware resource or Infrastructure layer: This layer provides resources such as Intranet, Internet, system software, firmware, and hardware. The infrastructure layer is located at the lowest level of cloud service middleware, the basic computing power like main memory, physical memory, CPU is provided by this layer.

- Software resource layer: It contains the operating system and middleware. Middleware technology provides a unified interface for software developers, so they can develop many applications based on software resources and embed them in the cloud andmaking them accessible for cloud computing users.

- Business Application layer: this layer is the integration of various e-learning components. It also includes an interface to interact among users. This layer is used for content creation, content delivery, and assessment.

- Service layer: It contains three types of services namely, SaaS (Software as a service), Paas (Platform as a service), IaaS (Infrastructure as a service). It let the client make use of various resource and software through the internet without being concerned about maintenance, up-gradation and purchase fees and paying only of their usages.

- Resource management layer: Resource management is important to achieve high utilization of available resources. By combining cloud computing scheduling strategy and virtualization, on-demand free flow and distribution of software over various hardware can be achieved.

Literature Review of Adoption of Cloud Computing in Education

The literature has been collected from various research papers and reviewed in a systematic process. The expected results will be of immense benefit to prospective cloud-based e-learner.

In the study and analysis of literature review it is revealed that, out of the 71 paper, 13 percent papers are related to cloud-based e-learning model, 11 percent for architecture, 6 percent related to framework, 21 percent had exploratory study that explores the implementation and use of cloud computing services, 25 percent paper covers the challenges and issues of e-learning using cloud.

Table 3: Gives an Outline of the Research Methodology used by the Identified Paper

Research Methodology	Percentage of Total Papers	No. of Paper
Cloud-Based E-learning Model	13%	9
Architecture	11%	8
Framework	6%	4
Exploratory study/ Overview	21%	15
Survey/Analysis	10%	7
Literature Review	4%	3
Create Service/ Tools	4%	3
Issues and Challenges	25%	18
Case study / Comparison	6%	4

Earlier researcher has a given number of model, architecture, and framework for adopting cloud-based e-learning. The model shows detail structure, functionality, and method of how the system works. The architecture of organization generally depict the system components and how they interrelated; while the framework is generally a layered structure that supports a particular approach and serves as guidelines for a specific purpose. In literature assess we identified 11 papers that presented comprehensive model, framework or architecture. A review of the identified paper is presented below;

Ji-Hye Bae et. al. [12] developed smart learning authoring tools for smart devices. The learning contents created through project-based learning were in different formats such as image, video clip, and PDF file. The researcher focuses on contents sharing and distribution, they do not provide the basic smart learning functions that could create active communication and collective intelligence. It will enable more convenient learning environment if a function that helps with communication such as social networking service.

Shah Murtaza et. al. [13] proposed a fundamental and unified cloud computing model which is helpful for clients, vendors, users, professionals, academicians and researcher involved in the enlargement of cloud computing services and solution in the education system. Moreover the extension of this research work is the implementation of the cloud computing model to enhance and bridging the gap in the education system.

Mohammed Khaleel et. al. [14] proposed the architecture of e-learning based on cache management and web services. It will provide learners with efficiency, availability and high performance of resources and learning devices moreover the architecture employs local storage as a cache is proven convenient in any system requiring multiple user access for any number of materials with minimal cost.

Abderrahim El Mhouti et. al. [15] proposed the most common architecture and continues to work on the design of an e-learning environment using cloud dedicated to the collaborative production of e-learning contents as learning objects. The extension of their research will be related to aspects of security, privacy, and confidence in cloud-based e-learning.

Abderrahim El Mhouti et. al. [16] suggested a Multi-Agent System based architecture that combines the advantages of LMS, MAS, and cloud computing to build a collaborative e-learning platform. In this architecture, each agent is coupled with the components of an LMS. As part of this work, the researcher working on the implementation of the platform using Moodle as cloud-based LMS and the JADE (Java Agent framework for Distance learning Environments) platform as a MAS framework development.

Nungki Selviandro et. al. [17] discussed the current challenges and state in e-learning and then explained the previously projected architectures of cloud computing. The researcher also proposed an e-learning model with the cloud that consists of five layers namely infrastructure layer, platform layer, application layer, access layer, and user interface layer. In future researcher will perform an evaluation of the use of cloud-based e-learning.

Samesh Ghallabi et. al. [18] proposed a cloud computing approach for the federation of personalization efforts through it the user can easily access the reusable and ubiquitous learning component. In future researcher envision implementing and validating the proposed approach. They will choose the platform that allows the realization of a federation of the learning components.

Vincent Tam et. al. [19] reported an on-going project and proposed a cloud-based eLearning game namely the iGame@Cloud system to facilitate ubiquitous learning. Their work shed light on many interesting directions for future exploration.

Karim Dahdouh [20] analyzes the concept of cloud computing and describes the architecture by combining the e-learning features to cloud computing. Researcher proposes an approach of using and harnessing cloud computing services in e-learning to build an e-learning environment based on the cloud computing. Future research will include a study of the implementation strategy for migration to the proposed approach based on cloud.

Janusz Stal et. al. [21] Investigated the issue of ICT courses at economic universities. Then they proposed a blended learning framework for delivering ICT courses that support developing required skills and acquiring related knowledge. The framework was implemented at the Cracow University of Economics. The researchers present the result of a survey that examined the usefulness of the proposed framework. In future work, they want to access the level of students' personal and professional skills in relation to the actual business expectations and investigate the effectiveness of different VLE tools in the development of soft skills required by employers.

In reviewing identified papers such dimension has been noted that draws attention for more exploration to develop effective and comprehensive cloud-based learning model. The dimension are; a) Technical infrastructure b) Data privacy c) Security d) Availability e) Consistency and diversified needs.

CONCLUSIONS

In this review paper, the concept of e-learning using cloud discussed, cloud computing layers and types are studied and related work done by earlier researchers is presented. The author identified such model, framework and architecture associated with adopting e-learning using cloud services with the help of papers published in the journal. Finally in this review paper accomplished that cloud computing technology offers great opportunities of educational institutions and there is a need to develop a unified, collaborative, ubiquitous, secure and comprehensive model to improve the efficiency of e-learning based cloud computing that offers great opportunities for students to get the knowledge shared by the teachers, trainers, and institutions. Future work based on this paper includes the development of comprehensive cloud-based e-learning model.

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