



# A Novel Observation on Cloud Computing in Education

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**Abstract:** Cloud computing is an emerging topic in today's lifestyle in publications and among users. Cloud computing in educational sectors is going beyond classrooms as an essential service. The higher education, distance education, online education etc. uses the services of cloud computing for the flexibility available for the students. Cloud computing has new platforms for innovative teaching practice. In this paper, we have analyzed various educational sectors which use cloud computing as a service. We found that the above mentioned educational sectors are benefiting from the service of cloud computing. It needs some remedial actions to be done for its proper utilization as a service.

**Keywords:** Cloud Computing, SaaS, PaaS, IaaS, Educloud

## I. INTRODUCTION

Nowadays higher education environment is adopting innovative teaching and learning tools/techniques that are used. Computing as a service has been an exceptional growth in current scenarios [1]. The main motivation of this growth has reduced the budget and operating expenses. In this concept, no specific infrastructure is required for providing the new services in it. So, according to the need of organizations, IT resources can be allocated [2]. This facility thus used for providing convenient and on-demand access the computing resources. The IT resources are allocated to the clients by the service providers after proper discussion.

Nowadays the social as well as economic growth of a nation depends on proper education [3]. The students are gradually attracted towards the advanced technologies rather than the traditional classroom teaching. Hence in these changing trends, advanced technologies can help the society in improving the teaching and learning process. The educational institutes can be benefited by the cloud based administrations by decreasing the cost and obtaining new innovative methodologies [4]. The students can also avail the facilities without buying or installing any software on their own system. So, cloud computing satisfies the need of e-learning system which is constantly increasing to keep match with the latest technologies. Cloud computing is thus made available to the users with a significant impact on the educational environment.

Cloud computing in education can be better facilitated using the powerful computing resources. "Cloud" in computer science can be referred as a collection of servers connected to internet.

Hence, "Cloud Computing" can be described as the software and services that can be availed by the clients through internet as a facility [5]. Cloud based technologies therefore utilized for storing and accessing information and various programs over the internet. So, the cloud computing resources must be Easy access, Security, Share ability, Compatibility and Availability. Cloud computing has the ease of access in transferring the datas effectively. It also offers a high level security for the sensitive data losses. If any data loss occurs, it can be retrieved easily as it is stored in the server. The datas also can be erased remotely as per the requirement. With cloud computing, one can reach more and more diverse, students. Most of the cloud providers is truly reliable in offering their services and available 24x7 [6].

The paper is organized as follows. In Section 2, the background knowledge on cloud computing in education is discussed. Section 3 describes various works done in the field of cloud computing in education. Section 4 discusses a comparison study on different techniques. Section 5 concludes the work and presents the future works.

## II. BACKGROUND KNOWLEDGE OF CLOUD COMPUTING IN EDUCATION

In this era where internet is working like a day today handy tool for users where data can be accessed easily, cloud computing can be used to manipulate the data, configure the systems and access the applications online very easily. We do not have to worry about storage in our devices as everything is being stored in cloud provided we have required configuration and application [7] to handle it. The following are the working models in education for cloud computing is depicted in figure 1:

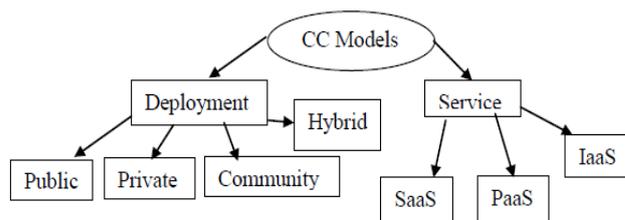


Figure 1: Cloud computing models

### A. Deployment models

The different type of access to the cloud can be defined by the deployment models, i.e., the location of the cloud. Cloud may have any of the four types of access: Public, Private, Hybrid and Community.

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**Public cloud**

The accessibility in Public Cloud [8] to the systems and services is relatively easy. It is less secure because the data stored in the provider’s data center and the provider is responsible for the management and maintenance of the data center, e.g., e-mail.

**Private cloud**

The accessibility in Private Cloud [9] to the systems and services is within an organization. It is also known as an internal or enterprise cloud. It presents increased security due to its private nature.

**Community cloud**

The accessibility in Community Cloud [10] to the systems and services is by group of organizations.

**Hybrid cloud**

The Hybrid Cloud [11] is a mixture of public and private cloud. Here, the critical activities are performed using private cloud while the non-critical activities are performed using public cloud.

**B. Service models**

After the establishment of a cloud, the deployment of cloud computing services in terms of business models differs on requirement basis. The services that the Cloud Providers [12] offer can be grouped into three categories.

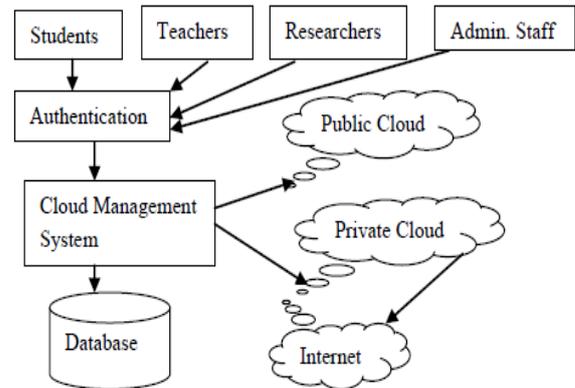
**Software as a Service (SaaS):** It represents the largest cloud market and is still growing quickly. SaaS uses the web to deliver applications that are managed by a third-party vendor and whose interface is accessed on the clients’ side. Most SaaS [13] applications can be run directly from a web browser without any downloads or installations required, although some require plugins. Today SaaS is offered by companies such as Google [14], Salesforce [15], Microsoft [16], etc.

**Platform as a Service (Paas):** In this type of category, a layer of software or development environment is summed up & a service is offered upon which other higher levels of service can be built. They were used for applications, and other development, while providing cloud components to software. PaaS is a framework they can build upon to develop or customize applications. PaaS makes the development, testing, and deployment of applications quick, simple, and cost-effective. PaaS providers offer a predefined combination of OS and application servers, such as LAMP platform [17] (Linux, Apache, MySQL and PHP), restricted J2EE, Ruby [18] etc. Google’s App Engine [19], Force.com [20], etc are some of the popular PaaS examples.

**Infrastructure as a Service (IaaS):** In this category, basic storage and computing capabilities as standardized services over the network is provided. They are self-service models for accessing, monitoring, and managing remote datacenter infrastructures, such as compute (virtualized or bare metal), storage, networking, and networking services (e.g. firewalls). Some common examples are Amazon [21], GoGrid [22], 3 Tera [23], etc.

**C. Cloud Architecture of educational sector**

The services are provided to consumers through Internet by the cloud providers with the help of huge database or physical data centers. The cloud provider’s regularly check the authentication for providing the data. The Figure 2 below represents the cloud scenario in an educational system. The public and private clouds are connected through cloud management system to provide the required data from database. Virtualization plays an important role in the cloud scenario [24]. The database provides the data from the residing virtual machines. The end users in cloud computing in education may be the students, teachers, researchers or the administrators using the cloud. User potentially can use any OS supported by the virtual machines used.



**Figure 2: Cloud computing Architecture**

The basic characters of cloud computing are infrastructure, scaling and virtualization which are supported by the hardware and software architectures. The main focus is on providing a large amount of computing power and computing resources in an aggregated fashion through virtualization technique. This unique virtualization concept is able to fulfill some standardized requirements [25].

- On-demand self-service must be there by which a customer can self-provision computer, storage, etc., without human interaction.
- Broad network access must be present with reachability and platform options (including thin and thick clients, phones, tablets etc.).
- It must be a multi-tenant (pooled resources) environment fostering location-independence.
- It must support rapid elasticity with the ability to grow and shrink based on policy, with no impact to applications or users.
- It must be a measured service, metered by performance with a pay-as-you-go pricing model.

**D. Benefits of cloud computing in education**

As we all know in this era of internet where consumption of data has been increased to an extreme level, so we need to store those data too. In order to save those data takes huge amount of expense. As we have to store a huge amount of data cloud computing comes into handy. Following are the some of the benefit of cloud computing:

•Less costs – Cloud computing has led to a great benefit as we do have to spend upon huge capital for storing data instead our data is stored at various place and can be accessed by the user without giving extra cost and enjoy all types of data mostly for free.

•Flexibility in Capacity – We don't have to save huge amount of data at one place as with the help of cloud computing we can save the data at different place which helps in reducing the capacity to store huge amount of data. This gives flexibility to save to users as well to the service providers.

•Automated Updates on Software – We need to regularly update our software's so that they are efficient and in a position to meet the new demands of the consumer but manually updating every machine takes time and man power to complete the task. Therefore cloud computing helps in saving time by automatically updating the systems from time to time.

•Security – Data are the most valuable thing in this era where internet is an inevitable part of our lives. We can save our data in our computer and cell phones but it is not save as it can hacked by any person in our absence and loss of data is something no user wants due to any technical failure of machine. Cloud computing overcomes the issues of security and also helps in having the back of data if data is wiped out accidentally.

• Mobile Accessible – Due to the emergence of smart phones and portable devices in this fast moving generation where everything can be approached on a click anywhere and anytime. It is all possible due to cloud computing that we can access our data at any point of time.

### E. Challenges of Cloud computing

Some of the notable challenges associated with cloud computing are discussed with some of these may cause a slowdown when delivering more services in the cloud. Most of them provide opportunities, if resolved with due care and attention in the planning stages.

#### • Cost

Cloud computing itself is affordable, but changing the platform according to the company's needs can be expensive.

#### .Downtime

Downtime is a significant shortcoming of cloud technology. No seller can promise a platform that is free of possible downtime.

#### .Reliability

The capacity and capability of a technical service provider are as important as price. The service provider must be available when you need them. The main concern should be the service provider's sustainability and reputation.

#### .Password Security

Industrious password supervision plays a important role in cloud security. However, the more people are accessing your cloud account, the less secure it is. Anybody aware of your passwords will be able to access the information you store there and the Data theft can be done.

#### . Privacy

Sensitive and personal information that is kept in the cloud should be defined as being for internal use only, not to be shared with third parties. Businesses must have a plan to securely and efficiently manage the data they gather.

#### • Lack of Standards

Clouds have documented interfaces; however, no standards are associated with these, and thus it is unlikely that most clouds will be interoperable. The Open Grid Forum is developing an Open Cloud Computing Interface to resolve this issue and the Open Cloud Consortium is working on cloud computing standards and practices. The findings of these groups will need to mature, but it is not known whether they will address the needs of the people deploying the services and the specific interfaces these services need.

### III. APPLICATIONS OF CLOUD COMPUTING IN EDUCATIONAL SECTOR

In instruction divisions there are different utilizations of distributed computing, a portion of the well known application fields are talked about underneath:

#### A. The EduCloud@Home paradigm

The educational project EduCloud@Home [26] paradigm could be applied to a variety of commercial clouds. An open computing-utility market can be established, in which both the users is able to buy and sell the various services of their education. As the calculating power can be expressed by a "long-tailed" distribution, where a high-amplitude population is tracked by a low-amplitude population which regularly "tails off" asymptotically, if we supply parallel or higher computing capabilities than commercial suppliers data centers in education state then EduCloud@Home can also acquire the Long Tail effect, by assembling small education computing resources from many lecturers and scholars.

For better understanding EduCloud@Home can provide several possible applications can be imagine which are as follows:

• Modernization and scientific research centers, communities – EduCloud@Home offers the home volunteers computing that is inspired by the means for the construction of open, interoperable Clouds for supporting scientific ideas, overcoming the portability and compatibility problems stressed by the @home projects.

• Education resource planning discussion center- In business/commercial locations can bring considerable benefits by planting an EduCloud@Home computing infrastructure, especially in small, medium as well as in big enterprises. With local, existing, off the shelf, resources it is also possible to implement our own data centers. Generally in any venture, there exists a capital of impartial computing resources for office automation, examining, designing.

• Social networks, wireless sensor networks, home automation – In Cloud computing perception, both the software and the computing resources which is possessed and supervised by the service providers, which relieves the programmers'

efforts in facing the device heterogeneity and also avoids application downloads. The designer's of Mobile applications should start to consider their applications, which should be usable on a small device, and also need to interact with the Cloud. Service discovery, brokering, and reliability are important, and services are usually designed to interoperate.

### Challenges and issues

The accompanying issues ought to be contemplated, in the use of home instruction so as to actualize such a type of processing:

- Education Resources and Services the executives – For overseeing assets and services offered by Clouds a system is required. This must be able to enlist, find, record, allot and reassign, monitor and arrange assets and administrations. Compatibility among assets, administrations and their compactness are the significant issues which can be looked at this dimension.
- Home part frontend – To furnish clients with an abnormal state service oriented perspective of the registering framework, a deliberation is needed. The frontend gives an extremely special and uniform access point to the Cloud. A client must be permitted to submit a utilitarian processing demand which just provides requirements and determinations, without any knowledge of the framework assets arrangement.
- Private Security – The powerful instruments are required to give: verification, assets and data insurance, information classification and trustworthiness.
- Education asset and administration accessibility, reliability and information consistency – As it is important to implement repetition of asset administrations and hosts' recuperation arrangements since clients voluntarily contribute to the registering. Along these lines they can log out or disconnect from the Cloud at any quantum of time.
- Semantic Interoperability structures among Clouds – Cloud ought to be conceivable to interoperate with one another.
- QoS and SLA the board – The applications ought to be run, so as to separate among both the commercial and open volunteer Clouds (generally best effort).

### B. The strategy used in cloud-computing which is based on informatization construction in health vocational education

The benefits of this sort of distributed computing technique are as per the following:

1. Using Cloud registering to incorporate Hardware and Software Resources on the public service stage for Health Vocational Education Informatization. Because of the deficiency of store and the limit of scale, it is troublesome for some wellbeing professional universities to utilize top of the line exploratory contraption or purchase particular application software. The existing assets of social insurance businesses and wellbeing professional schools [27] can coordinate with public benefit stage for the informatization in wellbeing professional education. On

general society benefit stage for cloud computing, to give increasingly effective equipment bolster a solitary hub that has lower computing force can shape a joint power. Rich resources of programming administration can likewise meet different necessities of various clients.

2. Building Extensive, Affordable, High execution Network of Health Vocational Education Utilizing virtualization, dispersion and bunching, it tends to be consolidated wellbeing professional schools with health care enterprises to share the existing low-end servers, arrange gear, laboratory equipment, PC assets and datum. We can develop an infrastructure layer and construct an uncommon network of wellbeing professional training that covers health vocational universities, off-school practice bases and therapeutic administration showcase, to guarantee the normal development of the video arrange learning, telemedicine [28] (educating, gatherings).

3. Realizing Application Mode of "Utilization Support layer" The application support layer is one of the vital parts of Cloud computing based on the stage for wellbeing vocational education informatization. Based on virtualization and computerization of cloud computing, we can give administrations, for example, information exchange, system joining, application running environment, information get to, moment messaging, information sharing, database, network management focus, observing focus to keep away from the expense and intricacy of purchasing and dealing with the underlying hardware and programming, and facilitating for health vocational universities.

4. Creating of the Network Platform for Health Vocational Education So as to Construct the system instructing, social education (deep rooted training) and management platform, can virtualizes proficient datum, for example, educating resources, case assets, applications, clinical datum, health care records, and give these to users in the application layer. The client can get required programming and administrations basically through the browser and applications will be conveyed in the unified servers, disposing of consumption on hardware, network security gadgets and updating, maintenance of programming. As, cloud computing provides the most solid, secure data storage place for expert datum and teaching assets with other datum. The centralized stockpiling of datum saves storage space enhances the reliability and security of system datum all the while.

5. A Great selection of Client Clients can without much of a stretch utilize an assortment of assets and services in the application layer, through PC screen, TV screen, cell phone screen, and so on. All together to enable sharing assets, the client can likewise back up documents datum, for example, their own courseware, showing materials, and recordings to the cloud servers so as [2]. Instructing method of system application can change in the learning progress based on self-learning attributes of understudies and students make it vital on autonomic learning in professional colleges for understudies'; and it can also meet individual learning of various kinds, levels and demands for learners, to assuage logical inconsistency of working and learning in industry for experts.

**Key issues to be solved**

1. *Virtualization*

In cloud computing, virtualization is one of the most basic innovation. A single server can bolster numerous numbers of virtual machines so as to run different working framework and other application, for upgrading the use of the foundation, give increasingly productive datacenter, acknowledge business the board efficient agile through virtualization. Presently days Xen, KVM and VMware Infrastructure are the three sorts of virtual machine innovation normally utilized in distributed computing.

2. *Data capacity storage*

The highlights given by people in general administration stage, for well being occupation instruction data in information arrangement with stockpiling and distribution, and the attributes of the cloud engineering, stockpiling billow of wellbeing occupation training assets. There are two kinds of distributed storage layers: inside mists and outside mists and three distributed storage layers are likewise manufactured: open stockpiling cloud, private stockpiling cloud and cross breed stockpiling cloud.

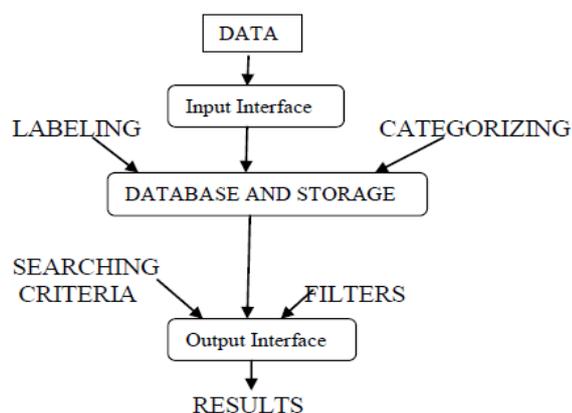
**C. Information management system and distance education system**

The advantages of this type of approach are as follows:

i. *Information Management System Implementation Algorithm*

Different quantities of info and yield forms in data the board frameworks are being administer. In this straightforward equipment structures and basic application models is being utilized. Data the executives' framework basically comprises of info yield forms, classification of this procedure, naming, seeking, and separating process as appeared in Figure 3.

So as to actualize these procedures, the information interface, yield interface, a PC that has the database and storage room will be adequate. For the most part information and yield interfaces are situated on a similar stage. We can likewise get to the yield interface from various stages through the online access interface.



**Figure 3: Architecture of Information management system**

Be that as it may, every one of these modules are situated on a similar PC, they are impacted from one another'

disappointments. At whatever point disappointment is knowledgeable about the database, it might prompt stop stockpiling administrations. At whatever point there is enhancement in execution [29] over the PC (reinforcement database, increment stockpiling limit, and increment in processor's speed) this may prompt respite the whole framework for a significant lot of time.

ii. *Algorithm for Distance Education Applications*

Distance education systems serve more complex processes. Some of the distant education system components are follows:

1. *Managerial components*

- Department-plan administration component
- Lessons administration component
- Scholar supervising component
- Customer supervising component

2. *Lecture components*

- Lessons supervising interface
- Material preparation interface
- Examination preparation interface

3. *Scholar components*

- Lessons checking interface
- Material checking interface
- Online exam interface

The above recorded modules utilize distinctive kinds of administrations by means of various interfaces and along these lines; diverse goals are served as needs be. These modules can't be made by means of standard work process. So as to set up individual frameworks for every module independently prompts increment in expense. Instead of utilizing standard work process, we can utilize it as an administration shaped by distributed computing for every module. It is simple and adaptable to deal with those administrations by distributed computing. The structure of the separation training framework is appeared in Figure 4. Information is sent autonomous and separate database and capacity units by means of director, instructional exercises and understudies through interfaces as per the Figure 4. The director, understudy instructional exercise, and understudy have distinctive individual interfaces that deliver to various clients for everyone. In this way, stages for these interfaces are independently found.

For instance, the administrator interface is on a PC and course instructional exercise interface is on the web stage by means of the Internet, understudy's interface can be both on the web and portable stage [30]. To maintain a strategic distance from disarray in such a structure interface, it will be proper to associate all interfaces autonomously and independently to database and stage units. The least demanding, least expensive, and the best way is utilize the cloud innovation.

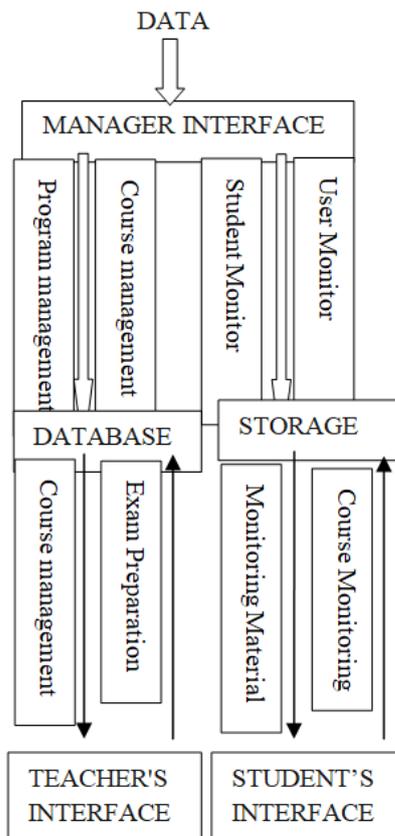


Figure 4: Distance education system application architecture.

While Cloud registering frameworks are unpredictable, extensive scale, and heterogeneous disseminated frameworks the executives of their assets is a testing errand. It requires co-improvement at different layers (framework, stage and application) displaying autonomic properties. Autonomic frameworks display the capacity of self-checking, self-fixing, and self-streamlining by always detecting them and tuning their execution.

This adaptable structure has been isolated from one another yet it is conceivable to make utilizing distributed computing innovation. Distributed computing is all on account of innovation interfaces and different segments without being influenced by one another's inadequacies however will have the capacity to speak with one another works. For instance, a test instructional exercise interface made in the framework data, the understudies watched and can be replied with interface. Another client with administrator interface or instructional exercise can start to utilize interface. Also, a disappointment that may happen in the database, instructional exercise material planning and capacity process will stop. Or on the other hand in situations where understudies work interface instructional exercise will have the capacity to keep on playing out their tasks.

#### D. Quality of Service in Cloud Computing in Higher Education

The nature of administration is weakening with the expanding number of uses moving to cloud condition. This constrains the researcher to build up a Quality of Service Metrics Model [31] to suggest and fix the parameters of value in distributed computing particularly in the field of online advanced education so the relationship and responsibility between the specialist organization and the

end client gets improved. The accompanying model is utilized for estimating the QoS measurements of the framework.

Innovative model:

The fundamental goal of the examination is to build up an imaginative model in which some explicit quantifiable QoS factors will be distinguished and suitable worthy parameter range will be given for them which will go as an info and after that will furnish with the yield. This will be upgraded QoS and will act like a guide to the clients and give them certainty. Through this model we will have the capacity to identify desires, breaking down and upgrade QoS that would help specialist co-ops to act proactively and keep up their administration quality and increment trust in clients/clients mind. QoS parameters corruption can be distinguished and amended through the advancement of an adaptable, effective, and simple to utilize observing model shown in figure 5.

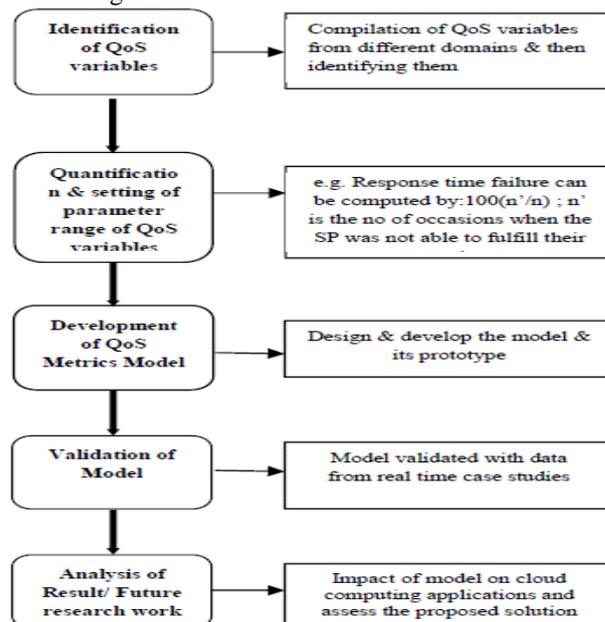


Figure 5: Flowchart for generating the QoS Novel model

The normal result and hugeness of advancement of this model is complex. Initially, the model will go about as a guide, which will help both the client and the supplier to know the QoS factors and their normal parameters to the administrations which they are giving and accepting. Besides, the model would help the specialist organizations to set up their administrations and keep up the nature of these administrations as indicated by the desires for the clients. Last yet not the minimum, the clients will have the capacity to know heretofore what they need to request regarding nature of administration from the specialist organizations and will have the capacity to screen it to enhance their administrations.

#### E. Cloud computing applications in Distance Education

The Important component of far off training is spilling of media server assets in the showing procedure which can be utilized for numerous clients' and everybody can access to information.

Voice and video-based spilling media learning assets are sought after at the present situation with the majority of the understudies' learning styles [32]. So understudies can have better customized learning, shared learning, and access to great learning results. This is an imperative motivation behind why removed instruction is growing quickly.

Albeit wealthy in sight and sound far off training in line and containing the vast majority of the understudies learning styles, and this aides in accomplishing better learning results, however we should likewise observe that there are still some inaccessible instruction issues to be tackled, for example, the uneven dissemination of assets, no genuine joining and sharing of assets, the low rate of multi-media showing assets, poor unique flexibility, etc.

The design is partitioned into three layers. To start with, Upper Layer is Cloud Software, Software as a Service (SaaS). The center layer is cloud stage, Platform as a Service (PaaS). Utilizing the cloud stage, any instructor can make far off training program improvement programming stage and working framework stages, with the goal that any educator can build up the encouraging procedure through the system and this will help in upgrading nature of instructing administrations. As the substances are uninhibitedly accessible then clients on the cloud stage can learn freely. The bring down is cloud gear which is likewise called Infrastructure as a Service (IaaS) and this fundamentally used to incorporate the far off instruction infrastructure (such as servers, databases, and so on.) for the lion's share of clients. Along these lines, as indicated by the above qualities of distributed computing, there are a few imperative application territories in inaccessible training.

Building a circulated administration arrangement of inaccessible instruction assets. Distributed computing can interface diverse land dissemination of assets including different computers (including armada), databases, and stockpiling gadgets, into a relatively straightforward to the client's elite virtual processing condition. Utilizing distributed computing for building circulated frameworks of separation instruction assets, combined with distributed computing assets sharing capacities, structure and reconciliation of instructing assets to get to the virtual interface [33].

Client can access to assets through instruction interface. They can likewise access to a current asset the board framework for all instructing assets database administrations. In the meantime, they can get new showing asset information from the store.

Building an administration situated design Application of distributed computing separation instruction framework is an administration driven engineering, as appeared in Figure 6. The bottom(Lr1) is made out of computers(or groups), switches, switches and programming assets, for example, databases and mixed media showing assets in a system framework.

Lr5: Scholar / Lecturer
Lr4: Application of Distance Education
Lr3: Interface between Cloud services
Lr2: Distance Education platform services
Lr1: Distance Education Resource Database

**Figure 6: Distance education infrastructure based on cloud computing services**

The second layer (Lr2) as shown above is distance education cloud computing platform service. It is critical to achieve services, because this layer is transparent to students or teachers. They needn't to know the details of the layer. They needn't to know how the cloud services are implemented. For the layer which services are implemented, and how to provide services outside, these are released by the third layer (Lr3), so called Cloud service interface. For students or teachers (Lr5), they need only enjoy the cloud services through distance education applications (Lr4).

Applications that distance education students or teachers communicate with the interface and interaction, whether it is based on the WEB page or the form of client software, are charged with the tasks of passing information to the cloud services, starting cloud service, conveying the results of the cloud service to the users. In fact distance education applications become the bridge between the cloud services and user communication.

**F. The Research on the Architecture of Open Education Based on Cloud Computing**

CSP (communicating sequential processes) depicts the activities and resulting correspondence; it is the essential unit of record to process [34]. CSP has the polynomial math administrator (Prefix, Deterministic Choice, Non deterministic Choice, Interleaving, Interface Parallel, and Hiding) and formal semantics [18] (Denotation semantics, Algebraic semantics, and Operational semantics.). What's more, it portrays the connection between process practices with the element: hypothesis solid, easy to comprehend, images clear idea, and so on.

To improve the CSP demonstrate, the model is preoccupied by Resource Set, Middleware Set, and Application Interface Set. Resource set quadruplicate is REUUID, Server, Storage, Network, and REUUID is the remarkable distinguishing proof of asset. Server tuple is (ID, IP, processing capability priority, isHA portrayal, comment), and registering capacity, need recognizable proof of figuring assets processing force and need. IsHA is a banner that used to help the High Availability. Capacity tuple is (ID, IP, Storage ability, need, depiction, comment). System set incorporates all the system assets in asset set. It comprise of (ID, Network topological, max data transfer capacity, Min bandwidth, time delay, need, portrayal, and comment). System topological demonstrates organize source hub to arrange goal hub of the course, and the property of bandwidth, time postponement, and need recognizes arrange QOS ability Middleware Set triple is (MSUUID, Resource instance UUID, Platform). MSUUID is the one of a kind distinguishing proof of middleware asset, and Resource case UUID is a case in which run instruction middleware. Stage tuple is (ID, IP, Interface type, Interface depiction, Input parameter, Output parameter, comment), through the instruction middleware, explicit occurrences give fundamental administration and management to the application interface layer.

Application Interface Set is (AISUUID, Middleware instance UUID, Authentication, Interface, Parameter, Result), middleware case UUID is one of a kind ID of an occurrence which gives the administration in middleware asset. Administration utilizes WSDL or XML to depict the sent interface, and gives data of the application interface.



Validation gives the confirmation to guest. Parameter, Result is interface's parameter.

**Working process of model**

Through this model, Cloud Education could be portrayed as CE=(Define, Configuration, Management), Define component incorporates the meaning of Resource Set, Middleware Set, Application Interface Set, Configuration segment is the design of the model, the executives segment is the administration procedure depiction [35].

Demonstrate mostly gives SaaS benefit in the application program interface layer, and gives PaaS benefit in virtualization layer. SaaS benefit for the most part give general business stage, open API administrations, for example, the learning stage, instructive stage, and personality confirmation benefit, scores question benefit, assets sharing administration, news benefit interface. PaaS administrations give the executives administration of virtual server, virtual capacity and virtual database dependent on APIs interface, which could be redone anytime of time. In the SaaS and PaaS benefit, API structure principles: simple capacities, execution of coding and interface, attention to the interests of the framework comprise of foundation, information, security and the board.

Regardless of whether to make new business, or unique data stage joining, the approval APIs given by instruction middleware, should make the best to understand the reuse of web benefit. The vast majority of the administrations distributed by application framework are having straightforward structure, single function, which can't fulfill the necessities of complex applications in the model. To offer help complex API benefit, some Web benefits needs be gathered, and shape blend benefit with inside rationale process. A few web benefit mixes conjured the essential mix application program. As indicated by the dynamic qualities level of administration arrangement, benefit structure can be isolated into static administration, synthesis administration and dynamic administration piece. What's more, static administration organization incorporates two different ways of arrangement and movement.

**G. Use for Learning Improvement in Higher Education**

For improving the methodology of learning a unique approach is adopted using this research.

**Research methodology**

*A. Population and Sampling Technique*

The target population in this research is high institution students who are living in Jakarta. The sample technique used in this paper is simple random sampling with no category of sample characteristic. The data is quantitative and will be processed using SPSS software to interpret the result.

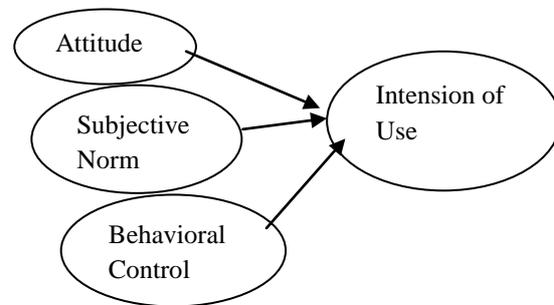
*B. Data Gathering Technique*

The data was collected by using questionnaire instrument which contain of various indicators based on variables in this research. Four variables were created in this research according to Theory of Planned Behavior, where each variable has ten indicators so total questions in the questionnaire are 40 questions. The questionnaires are

distributed to college students and lecturers in Jakarta, Indonesia. The variables will be formed into questions and at later stage this scale is used to measure each of the questions effectively.

**Research model**

This research model was adopted from Theory of Planned Behavior [36] from Ajzen [37] to investigate the factors that influence the intensity of students and lecturer while using cloud computing. This research contain of three independent variables (X), and they are Attitude (X1), Subjective Norm (X2),and Behavioral Control (X3) as well as one dependent variable which is Intention of Use (Y).The model is described in figure 7 which is as follow:



**Figure 7: Research Model**

The three hypotheses are provided as given below:

**H1: Attitude is positively influence the intention of use of cloud computing**

The measurement of the first variable is intended to see the user's view of cloud computing. Attitude could be one of the factors which impact users in using a technology especially cloud computing, attitude is basically referred as individual perception and evaluation of self performance. [38]. Attitude is measured with ten statements and respondent must fill it with scale it according with their opinion, the more high number of scale represent more agree with the statements.

- Q1 = for me, using cloud computing is a good idea.
- Q2 = for me, using cloud computing is very interesting
- Q3 = I feel comfortable using cloud computing
- Q4 = Cloud computing is suitable for me and my work
- Q5 = I like to use cloud computing services
- Q6 = Cloud computing is positive for me
- Q7 = Cloud computing help me in my job and learning process

**H2: Subjective Form is positively influence the intention of use of cloud computing**

Subjective Norm is the influence from people surrounding which encourages someone for doing something. Subjective norm is also defined as someone's perception of social perspective of something from friends, senior, or family that can influence the user of using cloud computing [20]. Subjective Norm is measured with ten statements and respondent must fill it with scale according with their opinion, the more higher number of scale represent more agree with the statements.



- Q1 = my senior suggest me to use cloud computing services
- Q2 = my colleagues suggest me to use cloud computing services
- Q3 = my friends suggest me to use cloud computing services
- Q4 = my teacher/lecturer suggest me to use cloud computing services
- Q5 = People around me influence me to use cloud computing services
- Q6 =my acquaintance influence me to use cloud computing services
- Q7 = Almost educated person use cloud computing service

**H3: Behavioral Control is positively influence the intention of use of cloud computing**

Behavioral Control is one the factor that influences the individual of using something because of the ability to control the thing [21]. Behavioral Control also gives impact toward intention of using cloud computing. Behavioral Control is measured with ten statements and respondent must fill it with scale according with their opinion, the more high number of scale [39]represent more agree with the statements.

- Q1 = I can use cloud computing service to finish my job
- Q2 = I have enough knowledge to use cloud computing service
- Q3 = I have enough resources to use cloud computing
- Q4 = I have enough time in using cloud computing service
- Q5 = I have capability to use cloud computing service
- Q6 = I have sufficient facilities to use cloud computing
- Q7 = I'll find opportunities to use cloud computing service
- Q8 = I save all of cloud computing in my gadget

**Result and discussion**

*i. Data Recapitulation*

The questionnaires were distributed by online media using Google docs. 117 questionnaires were sent back to researcher, and these data were observed and selected to get the valid one. Finally, researcher decided to use 109 questionnaires. The data was entered into SPSS software for statistic measurement. From this all data, 74.2% was student participation, while 25.8% was lecturers. 68.3% was male. They all familiar with internet and cloud computing, the most popular public cloud computing they used is drop box (88.3%) and Google docs (86.7%). These people that use cloud computing often access it through their smart phone and laptop.

We can see that, students and lecturers in this private university were already familiar with cloud computing, internet, and gadget. Next we want to know what are factors affect them to use cloud computing.

*ii. Validity and Reliability Analysis*

After all data were collected through questionnaires, it is important for us to determine the validity of the indicators to make sure that the instrument is valid to be used in the research model. We used Pearson Correlation, and the result shows that the data pass the validity check. To conduct reliability test, we test the items by looking at the alpha level. If the level of alpha is higher than 0.7, the questionnaire is reliable for this research and accepted. The result shows the alpha level of all variables above 0.7 which

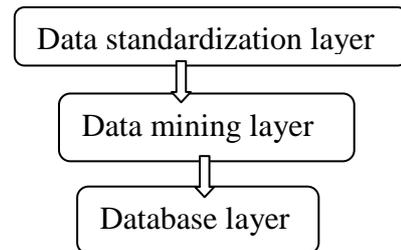
means the items of questionnaires are reliable to be used in this research.

*iii. Result*

In this research, we performed multiple linear regression to identify factors influence the intention of use in cloud computing. The R value 0.796 indicates the independent variables (Attitude, Subjective Norm [40] and Behavioral Control) supported 79% influence toward dependent variable (Intention of Use). While R Square is 0.633 which indicates the variables in this research contribute 63% and the rest of it 37% is influenced by another factor that is not discussed in this research.

**H. Research on Interactive Application of Online Education Based on Cloud Computing**

Application of cloud computing and large data technology online education interactive platform is divided into user Database layer, Data mining layer and Data standardization layer.



*i. Database layer*

The clients of the intelligent stage incorporate instructors and students. The administrations gave incorporate web based showing substance, showing the executives, connection, and learning the board. Diverse clients have distinctive approval and access diverse UIs and administrations. Administration application layer is a window of asset collaboration. It is a scaffold of clients' to utilize assets. It specifically impacts the client encounter. In this manner, application benefits layer remakes the data asset ask for concurring pant's needs, and furnishes clients with customized benefit assets, and clients don't have to know foundation data. Resource reconciliation process is finished by the stage's information handling layer. Here it breaks down the circumstance of the students progressively, particularly learning styles and inclinations, following the entire procedure of taking in, the conduct of understudies on the stage, and learning records of wise records examination. It tends to be utilized as a learning method of self-coordinated learning, customized moment notes, directed educational modules audit and evaluation, and multi-way online intuitive learning.

*ii. Information mining Layer*

This layer is partitioned into three sections which are: the lower layer is the database, the center layer is the combination of information mining investigation, and the upper layer is institutionalized. The center of this layer is a piece of information mining; online instruction is the center of intuitive stage.

With regards to distributed computing and vast information, the estimation of data keeps on developing from the most essential record to an anticipated future along the information examination and mining-disclosure and determining process, where the information are resources, and mining is the way to identify and foresee patterns is the objective. Utilizing the information to gather understudy conduct information, we build up the relationship between's instruction intelligent data to anticipate the future pattern of training.

### iii. Data Mining Layer

The base layer is the equipment offices layer, including capacity gadgets, organizes hardware, security gear, and reinforcement gear. The utilization of distributed computing can tackle the issue of equipment storehouses, incorporated administration of equipment assets, lessen unpredictability and vitality utilization, enhance equipment utilization, specifically, to enhance framework dependability and accessibility. Servers and other equipment assets shape a dynamic asset assignment, dynamic on-request appropriation to the application framework. In the application framework in the pinnacle time frame, the dynamic distribution of more equipment assets; through the pinnacle, programmed recuperation of abundance assets, booking to different applications or naturally closed down to broaden the equipment life.

### Results

For the exploration of online training cooperation, the development of distributed computing and substantial information innovation not just influences the type of online instruction collaboration, yet in addition gives another plan to intelligent data investigation. From one perspective, the new innovation makes the intuitive conduct to the ongoing and discontinuity heading; then again, the new innovation to get access to countless information, particularly social information for Web based learning examination and instructing choices to provide data support.

### I. Mobile Cloud Computing Techniques for Extending Computation and Resources

Using the existing research we determine that Mobile Cloud Computing is a useful model for extending computation and resources in mobile devices. We identify that the discrepancy between our test results and existing research is due to the research approach, which evaluates results on a limited set of criteria and does not expand to other factors.

The test plan revolves around a prototype application that is deployed on a mobile device.

A set of benchmark tests which monitor different criteria while running different scenarios were executed. The test plan was constructed in a multi-dimensional manner, and was used to test different factors across different dimensions. The following is a description of each dimension:

- Execution Scenarios: Four execution scenarios were modeled; Local (SQL), Local (NoSQL) [41], Server and Peer-To-Peer data stores.
- Success Criteria: Five success criteria were tested for; CPU, Memory, Battery usage, consumed Data and Time.
- Devices: Three heterogeneous devices were used for our tests. Device A is an Asus Memo Pad tablet, Device B is a

Google Nexus 5 phone while Device C is a Google Nexus [4] 10 tablet. Due to the limitations imposed by our Android-specific application, all devices were running on Android.

- File Sizes: Four files with different number of records were used to test different loads; 5 000, 25 000, 50 000 and 100 000 records.
- Test Runs: Each test was repeated for three times, such that averages could be calculated for more accurate results.

Data generated for the experiments was collected via device and application monitoring. Monitoring the device via the ADB tool generated large logs which needed to be analyzed manually and from which specific units of data were extracted.

### Results

We have researched the limitations of mobile devices, and identified five key limited resources as being CPU, memory, battery, data usage, and time. We explored existing solutions for these limitations, and identified offloading computation and storage from the device as a possible solution. Four different modes of execution were analyzed; localSQL database, local NoSQL database, cloud NoSQL database and NoSQL peer-to-peer database. We developed a prototype which showcases these execution scenarios.

### J. Mobile Education development based on 3G technique and Cloud Computing

The presence of 3G system and Cloud Computing communicates that present data procedure and Internet's improvement have just gone to another progression; this gives another opportunity to the advancement of portable instruction. The working of different kinds and high caliber of multi-media service framework by the comprehensiveness and speculation of 3G gives fundamental "equipment" for creating Mobile Education and M-learning [42]. Then, the accommodation of Cloud Computing idea and the constantly inquire about training with it have the application method, think about programming and different investigation assets all been set to the terminal hardware of Cloud, in this way the requiring "soft condition" for creating Mobile Education is given. The mix of 3G [43] and Cloud Computing gives solid system support to the acknowledgment of Mobile Education and additionally makes another condition for data sharing, data collaboration and study. The quickening activity of 3G and Cloud Computing for the Mobile Education improvement primarily encapsulate as following viewpoints:

- Providing a mobile Internet and constructing an education environment in Cloud
- Providing a great deal of resource library and constructing education resource in Cloud
- Establishing mobile network education stage, supporting M-learning
- Establishing virtual study community, setting up virtual M-learning environment

- Setting up "Cloud" and "Earth" platen, accelerating diversified developing of Education Information

Each time the happening to new strategy entry will get effect and change individuals' idea, work, study and way of life, versatile learning's landing is actually alongside the advancement of portable correspondence procedure and the

augmentation of portable correspondence traffic. For the significant impact of 3G strategy and distributed computing to Mobile Education, we should neither be at a stop in light of different stresses and neither vulnerabilities nor do only give Mobile Education a chance to grow normally.

#### IV. ANALYSIS AND DISCUSSION

The discussion on various approaches of cloud computing in educational sector is discussed below:

Work done in Cloud Computing (CC)	Area/Field	Pros	Cons
EduCloud@Home paradigm	Distance Education	It helps in launching an open computing-utility market where users can both buy and sell their services of education.	Education Resources and Services management with security issues
Information management system	Distance Education	Instead of using regular workflow, it can be used a service formed by cloud computing for each component. It is simple to manage those services by CC.	When a glitch is experienced in the database, it may cause to stop storage services.
Cloud computing applications in Distance Education	Distance Education	Voice and video-based streaming media learning resources is in line with most of the scholars' learning styles. So scholars can better implement personalized learning, collaborative learning, and access to good learning results.	The uneven distribution of resources, no real integration and sharing of resources, the low rate of multi-media teaching resources, poor dynamic adaptability.
Cloud Computing in Higher Education	Higher Education	Fix the parameters of quality in cloud computing especially in the field of online higher education so that the relationship and accountability between the service provider and the end user gets enhanced.	QoS parameters degradation can be detected and rectified using the model.
Learning Improvement in Higher Education	Higher Education	The model is used to investigate the factors that influencing the intensity of students and lecturer in using cloud computing. Students and lecturers in this private university already familiar with cloud computing, internet, and gadget.	The factors affect the model to use cloud computing need to be diagnosed.
Open Education Based on Cloud Computing	Open Education	Network of cloud computing indicates network source node to network destination node of the route, and the property of bandwidth, time delay, and priority identifies network QOS ability Middleware Set.	The management of the prioritization of network nodes is the biggest concern.
Interactive Application of Online Education Based on CloudComputing	Open Education	In the application system in the peak period, the dynamic allocation of more hardware resources; through the peak, automatic recovery of excess resources, may extend the hardware life and also it makes convenient for data analysis.	The new technology to obtain access to a large number of interactive data, especially behavioral data forOnline learning analysis is a tough task.
Cloud computing based informatization construction	Health vocational education	Public service platform for the informatization in health vocational education can integrate the existing resources of health care industries and health vocational colleges.	Virtualization and data storage issues

Mobile Cloud Computing Techniques for Extending Computation and Resources	Mobile Education	It finds the limitations of mobile devices, and identified five key limited resources as being CPU, memory, battery, data usage and time. Existing solutions for these limitations is explored and identified offloading computation and storage from the device as a possible solution.	Using existing research it determines that Mobile Cloud Computing may be a useful model for extending computation and resources in mobile devices with some limitations.
Mobile Education development based on 3G technique and Cloud Computing	Mobile Education	The combination of 3G and Cloud Computing provides strong technique backing for the realization of Mobile Education and also creates a new environment for information sharing, information cooperation and study.	For the profound effect of 3G technique and cloud computing to Mobile Education, we should neither be at a standstill because of various worries and uncertainties

The various types of education sectors have various advantages with its limitations. In distance education system, it can be used a service formed by cloud computing for each module. Students can better implement personalized learning, collaborative learning, and access to good learning results. In higher education, parameters of quality in cloud computing especially in the field of online higher education are suiting the learning system. In open education system, the dynamic allocation of more hardware resources; through the peak, automatic recovery of excess resources, may extend the hardware life. In mobile education, it determines that Mobile Cloud Computing may be a useful model for extending computation.

V. CONCLUSION

From the above discussed fields of application in educational sectors, it is found that cloud computing plays an important role in improving the interest of study atmosphere in different types of educational sectors. The uneven distribution of resources, no real integration and sharing of resources is the biggest concern for cloud computing in education. The cloud computing in educational sector has also some threats but can be handled by various new methodologies and researches with proper hypothetical data from different educational sectors.

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