A Comprehensive Study on the Application of Cloud Computing in Enhancing Learning

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Abstract-

Education is crucial for a nation's economic progress and is becoming more significant in today's digital environment. In India., the government has implemented measures to improve the education system, but students still face challenges like limited access to resources, insufficient lab facilities, and a shortage of qualified teachers. "Cloud computing" provides a solution by offering flexible, scalable, and easily accessible digital resources. This allows students and teachers to get learning materials anytime and anywhere, and on various devices, supporting personalized and collaborative learning. This paper examines how "cloud computing" is transformed the "education sector", focusing on infrastructure, tools used in academic environments, and cloud-based services adopted in "higher education". Cloud computing can help bridge gaps in the education system by delivering inclusive and innovative digital solutions, ultimately improving the reach and quality of education.

Keywords-cloud Computiing, Education, Paas, Universities , higher Education, parent

1.Introduction

Cloud computing describes a shared repository of flexible computer assets., including servers, networks, storage, software, and utilities. Service providers or managers may quickly provision and decommission these resources with the least amount of work. [1,2] Cloud computing can assist in offering those remedies. It's a network of shareable computer resources that can be found almost anyplace. Therefore, we can overcome all these shortcomings by putting cloud computing technology into place and maintaining a centralized system that allows all authorities to continuously monitor and lead the education system while also checking it from every angle. Besides looking at what the institutions need, they make sure every student gets a good education. They also ensure that things like attendance and how well students do in school are not affected by problems with the school's facilities. [1],[3],[5] The Indian government has been offering numerous incentives to encourage education and is pushing parents to send their children to school and institutions. Students are drawn to schools and universities by a variety of schemes, but their performance is severely impacted by a lack of resources, including modern literature, lab equipment, and excellent professors. As a result, they are discouraged from continuing their education. The absence of infrastructure, or the difficulty of maintaining What is there is one of the most fundamental issues the government has in providing education. A large quantity of continuous funding is required. as well as the expertise

to support it, to acquire and maintain a broad variety of hardware and software.[06] Cloud designs may help governments worldwide by decreasing duplication of effort and increasing resource usage. This aids with the government's environmental initiatives, lowering pollutants and improving waste management. [7,9]. Higher education is cantered on the process of knowledge discovery and its distribution, whether it takes place in person, digitally, or through a combination of both. The IT framework should be designed with perfect consistency, scalability, and In order to accomplish the previously stated objective, ease of use was taken into consideration. Purchasing third-party "platforms Platform-as-a-Service (PaaS)" and "infrastructure (IaaS) "are permitted., in contrast to what is necessary for services rendered by regional IT service providers. This transforms the paradigm in e-Learning for Higher Education. this shifts the risk of issues like broken hardware, programming designs, and patching to the cloud provider, guaranteeing that it is suitable for the intended use and within suitably formatted Service Level Agreements (SLAs). [10], [12]. "Louise Upton", the principal and "higher education" lead, indicated in a study. [13, 20] that higher education institutions were trapped in a perfect storm. This is brought on by a loss in private support, a drop in endowment value because of market circumstances, a reduction in government assistance, and an increase in expenditures. This report is strengthened by the Gartner Group outline. A publication [14,20] states that two of the most important problems chief information officers in higher education are now dealing with are reducing enterprise costs and enhancing technological infrastructure. Two of the most often cited advantages and characteristics provided by cloud computing service providers are reduced costs and flexible adaptive design. demonstrate the potential for cloud computing to progress in these crucial areas. [15],[20]. Further evidence that "CIOs" in higher education are interested in cutting expenses and modernizing infrastructure can be seen in an Educause report [16], where financing for IT concerns and administrative/ERP frameworks rank first and second, respectively. It seems that many CIOs in higher education are taking on the responsibility of institutionalizing resources and structures through shared administration operations to save costs. It is quite difficult to do both using Many websites still employ outdated technology.in use on many sites today [14, 17]. Web 2.0 and mobile technologies are evolving at a rapid pace, making it necessary for institutions to have more adaptable innovation programs. Higher education institutions are rapidly adopting "cloud computing" to cut costs and take advantage of the latest innovations [17].

Cloud apps provide several benefits for the educational sector. The cloud reorganizes and modernizes IT, gives IT the freedom to delegate little tasks, and lets IT shift its attention to advancing the core goals and objectives of higher education institutions. With cloud computing, a business may pay for just the IT services they really utilize and enjoy far greater IT flexibility.

It also makes resource tracking easier, expenditure more predictable, budget review better, and profitability faster [15]. Even with all of the benefits that cloud computing may offer to businesses such as flexibility, agility, simplicity, and proficiency a few components are still essential to its adoption [18]. These factors include the organization's current status, technological advancements, the possibility that the firm would use cloud computing, and how well the prospective adopting association will fit in with the

operational environment of the company. [19, 21].

2. Cloud Computing – The Concept

How consumers access cloud services

is explained by the cloud services model. The three most basic services architectures are "IAAS (Infrastructure as a Service)", "PaaS (Platform as a Service)", and "SaaS (Software As Service)". These service models are mutually dependent and can be improved. For example, because the application platform requires physical infrastructure, PAAS can access different infrastructure components from the idea of [1,2]

Infrastructure as a Service (IAAS). Firewalls, networks, memory, charging balancers, virtual machines, and other devices are examples of components. Load Compensation The software at the bottom of the stack, including the Admin Panel, Firewall, and Virtual Machine Operating System, provides immediate access to clients, infrastructure services (IAAS). One of IAAS's biggest providers is Amazon's web services.

Customers don't have to spend time. Based on application requirements, PaaS grows

2.1 Cloud Commercial Providers

2.1.1 Amazon Elastic Compute Cloud

When people and organizations need cloud services, Amazon Web Services, or AWS, is a set of services that offer apps and services at raw material rates. offers cloud-based memory, computers, and other services. HTTP can be used to access Amazon Web Services offers utilizing the other SOAP protocols. Amazon Elastic Compute Cloud (Amazon EC2) allows cloud users to serve and manage server instances in their data centers with the aid

automatically and the required infrastructure and backend components grow. PAAS Solutions

Provides a multi-feature API for managing programmatic platforms and developing solutions. Popular PAAS includes IAAS and Amazon Web Services that offer specific PAAS options.

The application software is below. Check your SaaS software provider.

SaaS applications include social network pages, online email, project management software, and CRMS. The main difference between SaaS and PaaS is that SaaS is already developed software, and PaaS provides a platform for software development.
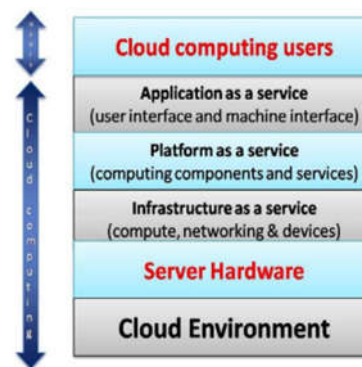

Figure 1 Cloud Computing Service

of easily accessible tools and service programs or APIs.

Amazon Web Services allows access to its products through HTTP using protocols like SOAP and others. Cloud users can utilize Amazon Elastic Compute Cloud (Amazon EC2) to set up and manage server instances within their data centers using available tools, rankings, or APIs. Operation through the Xen Virtualization Engine creates a virtual computer known as an EC2 instance [23, 24]. Once an instance is created and started, users can install and modify software on it. After making the necessary changes, they can create a new machine image. This image

can be launched again whenever needed. EC2 instances that are accessible to users, like physical hardware, offer nearly full control over the entire software stack. However, this level of control makes it more challenging for Amazon to automatically manage resources efficiently. It is also possible to configure instances in multiple locations within EC2. Regions and availability zones define these locations. A region is a geographical area that consists of one or more availability zones. An availability zone is a specific location within a region.

Amazon Simple Storage Service is a website that can be saved and accessed to images of EC2 machines (Amazon 68). They are placed in containers called "buckets." Each element contains up to 5 terabytes of data. The object name is the only URI [25.26] pathname. Before you can use them, the buckets must be specially designed. Buckets can be stored in multiple areas. Users can select their preferred region to reduce costs, improve performance, and comply with local regulations. Your existing IT setup and company's AWS cloud are already connected securely and smoothly to Amazon Virtual Private Cloud (VPC). With Amazon VPC, businesses can enhance their current management features, such as security tools, firewalls, intrusion detection systems, and other AWS services. This lets you link your current infrastructure to various isolated AWS computing resources, like Amazon CloudWatch, through a VPN connection. Examples of EC2 metrics include hard disk read and write operations, CPU usage, and network data coming in and going out.

2.1.2 Microsoft's cloud computing platform

Microsoft's Windows Azure platform is made up of three parts [26, 28], each providing a different kind of service. While Windows Azure offers a Windows-based environment for running applications and storing data on servers in a data center, SQL Azure provides cloud-based data services that are based on SQL servers. Also, distributed infrastructure services from .NET services are available for both cloud-based and local applications. Applications can use the Windows Azure platform whether they are running locally or in the cloud.

Windows Azure doesn't support specific types of computers.

Instead, it supports popular applications. Developers can use tools like ASP.NET and Windows Communication Foundation (WCF) to build web applications, background processing apps, and apps that combine both. In Windows Azure, data can be stored in queues, tables, and blobs, and all of these can be accessed using HTTP or HTTPS. SQL Azure has two main parts: the synchronization of SQL Azure databases and "Huron" data. SQL Azure Database is a cloud-based database management system (DBMS) built on Microsoft SQL Server. Data can be accessed through ADO.NET and other Windows Data Access APIs. Users can also use on-premises technology to access these cloud-based data services. Relational data is synchronized with "Huron" data across various local DBMSs.

2.1.3 "Google App Engine"

Google App Engine is a traditional web application platform that runs from Google's data centers. It currently supports Python and Java as programming languages. In addition to supporting popular web frameworks like Django, Cherrypy, Pylons, and Web2py, it also has its own web application framework that is

designed to compete with ASP.NET and JSP. Google takes care of tasks such as preparing code for clusters, monitoring performance, handling failover situations, and starting up application instances as needed. The latest APIs make it easy to perform tasks like caching, making HTTP requests, and storing and accessing data from different databases such as Bigtable. [28, 29]. App Engine developers are limited to accessing file systems that they read. Table 1 includes an overview of three common cloud solutions, including target application categories, supply classes, processing, storage, and autoscaling models. These cloud solutions seem to operate at various levels of abstraction and handle resources in different ways. [43, 49, 55]. To meet the needs of a particular company, users can choose from a set of cloud solutions or stick to only one method.

Table 1 A comparison of representative commercial products

Cloud Provider	Amazon EC2	Windows Azure
Classes of Utility Computing	Infrastructure service	Platform service
Target Applications	General-purpose applications	General-purpose Windows applications
Computation	OS Level on a Xen Virtual Machine	Microsoft Common Language Runtime (CLR) VM; Predefined roles of app. instances
Storage	Elastic Block Store; Amazon Simple Storage Service (S3); Amazon SimpleDB	Azure storage service and SQL Data Services
Auto Scaling	Automatically changing the number of instances based on parameters that users specify	Automatic scaling based on application roles and a configuration file specified by users

Table 1 Comparison of Cloud Commercial Products

2.2 Cloud System Architecture Computer

1) **Receiving layer:** Also known as the responsibility of control, received from the client service interface, service registration, and appropriate services. Uniforming all rules completes the registration process for the user or service. Mobile Cloud Computing

For services, the standard approach is Client-Cloud Copy [56-59]

2) **Basic management layer (BML):** The Cloud Computing Management Layer offers management tools and services for designing a mobile cloud computing system. It sits between the service level and the server cluster. Provides protocols for defined process surfaces and application services and regulates standardized operations of services, including announcements, verification s, addresses, security, and more. It manages all network resources and conceals the differences between the "operating system "and the hardware underneath.

Billing system, circumference structure, interactions management and mobile accounts management are all part of the device management. Assignment, Implementation, Life-cycle Management and Other Aspects are all included in task management. Load balancing, fault recovery, issue testing, and monitoring systems are all part of resource management. Identification of the customer, confirmation of receipt, security assurances, and defence are all included in security management [60 ,63].

3) The words "virtual layer" describes virtualized resources such as computer pools, networks, and storage. "Virtual functions" can be created using software tools such as "virtual environments", "virtual systems", and "virtual platforms" [64, 67].

4) "Physical Layer": The technologies and hardware that make mobile cloud services possible are mostly described in this layer.

Dumb phones and portable laptops could be ok. Distributed computers with the use of parallel computing, distribution strategy, and modern network technologies might provide an extremely reliable cloud. Instead of a large hard drive or powerful processing power, portable devices only require the most basic hardware at the mobile cloud computing stage, which comprises a network and simple
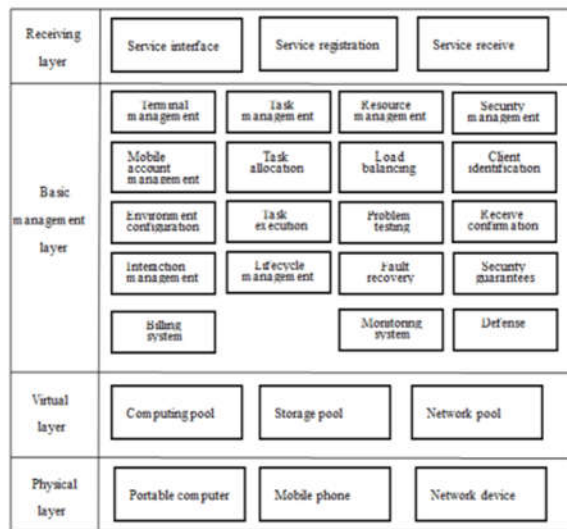
input and output devices.

Figure 2 Cloud Computing Architecture

3. Higher Education (Why and How):

Using cloud computing technologies appropriately can improve student, teacher, and researcher engagement in a way that is both economical and efficient. Although there are security issues, they do not outweigh the advantages.

"Educational institutions" can focus more on "teaching" and "research activities" by utilizing "cloud computing", as opposed to managing software systems and sophisticated IT configurations. Cloud computing has the potential to minimize complexity. By leveraging computer technologies to promote collaborative teaching approaches, cloud solutions can help socially conscious learning theories and cooperative learning. Cloud computing offers "e-learning solutions" several benefits through the direct provision of platforms, infrastructure, and educational services through "cloud providers", centralized data storage and access, and capabilities to monitor virtualization.

By working together and establishing a shared virtual environment using cloud computing, educational institutions can cut costs and labour requirements associated with setting up a fully functional computer lab.

Cloud computing is becoming a vital requirement for many educational institutions. due to factors like rising expenses, institutional performance, and competition.

3.1 Why higher education demands Cloud Computing:

It's getting more and harder for colleges, particularly in the Middle East and Asia, to make cloud computing technology available to their faculty, staff, and students for use in the classroom. Even if adopting cloud computing is more cost-effective, installing it still presents a barrier for businesses. An architectural model that includes installation phases has already been created in order to achieve this aim.

Furthermore, educational institutions don't always appear to know which CC model is best to utilize for video courses and in-class presentations. "Software as a service (SaaS)" is the most widely used model that has transformed the teaching profession.

For this reason, study on the feasibility of SaaS use in Middle Eastern institutions concluded that some problems still need to be fixed even if cloud computing technologies are becoming increasingly common in "higher education". Since the study aimed to assess how well educational institutions were performing, it made sense that both professors and students were keen on incorporating cloud services into their schools.

3.1.1 The Benefits of Cloud Computing in the Formation of University:

- ❖ Anywhere access to apps.
- ❖ Assistance with account administration and instruction.
- ❖ Constant access to information and infrastructure.
- ❖ Being open to cutting-edge research and the commercial world.

- ❖ Environmental protection through the application of green technology.
- ❖ A greater receptivity among pupils to novel technology.
- ❖ Boosting the ability to function.

3.1.2 Limitations in Higher Education without IT enabled Services:

No matter how well a student can study, they are all treated equally in the traditional educational system. Most professorial lectures are given by the same individuals. Each student progresses at a unique rate. The student's ability, interests, or dislikes are not taken into consideration by the teacher. The existing educational system is therefore fundamentally quite unfair. Traditional teaching methods are comparable to spoon-feeding since they lack any supplemental resources, such as instructional DVDs or other digital media, that may aid pupils in understanding the subject. Teachers observe each student's academic development in the classroom each day when they are together with pupils. Students' moral integrity and uniqueness are compromised by the prejudice of their professors.

Figure 3 Risks in cloud computing

3.2. How Cloud Computing Aids Higher Education:

In today's tech-friendly world, modern tools are helping schools and other learning places become better. Compared to before, things are different now, especially because of e-learning, which requires students to take classes that are available in many different places. One of the most basic and most frequently used skills in this new era, computer capabilities are everything you need. Everything else will fall into place after that. We are all aware of the significant effects that new technology has had on homes, businesses, and entertainment. However, consider how it affects schooling [61,62].

These days, cloud-based technologies are used in the classroom by all educators to improve student learning and prepare them for the creative economy. The internet, which has recently simplified and transformed education, is referred to as the "cloud" in this context. Using the internet to store and access data and different applications, instead of keeping them on a computer's hard drive, is called cloud-based technology. With this technology, educators and students can communicate, connect, and engage through internet-based portals while receiving the most recent information as it becomes available

online. Here are a few instances of classroom environments that make use of cloud-based technologies: [31]

Figure 3 The following illustrates how the School Education System may employ cloud computing:
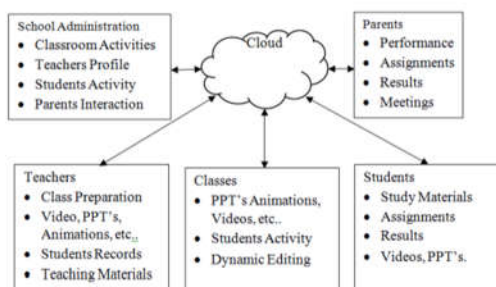

Figure 4 Cloud computing is being used in an educational system.

Online learning environments Students in one school can establish a so-called "cloud classroom" by connecting with students in another classroom from a distant neighbourhood and communicating well without any difficulties. "Students" can share a type of ideas online with the use of webcams. For instance, many students have used the internet to study other foreign languages and cultures. [32] Are you aware that some students use the internet to take their exams? "Touch-sensitive" "smart-boards" with "stylus-style pens" intended exclusively for writing and sketching. them are placed in most mature and advanced schools that use cloud-based technology in the classroom.

The conventional white boards with marker pens and many rubbings and inscriptions have been replaced with these smart boards. [33 to 36] Technology has had a huge impact on education. For instance, it allows students to join in class discussions and add sound effects to their cheers. Using a smartphone like an iPhone, educators may personalize their lessons and project them onto these touch-sensitive whiteboards.

Lecturing: Teachers can now design interactive lessons thanks to technology. In addition to interacting with their lecturers from the comfort of their homes instead of having to go to class, Students can acquire their courses from the tailored website, which is usually free. [35,37,39]

Group projects:
Thanks to cloud-based technologies, students can now finish their group assignments faster and more conveniently. They can collaborate with their teammates online and submit their finished work from home. This contrasts with earlier times when students had to physically come together to complete the projects. Teachers and students can use cloud-based technology to access software and data from various devices. This allows them to take advantage of mostly free tools that help boost teamwork and participation in both physical classrooms, online classes, and mixed learning environments. This technology has many benefits that are beneficial to both teachers and pupils because it makes use of a network of different internet-connected servers. A few advantages of this technique are listed below.[39]

Keep in mind: To be honest, the internet, or more specifically, the cloud, is always a large storage where a person may save a variety of items, including documents, images, eBooks, and music, and then instantaneously retrieve them whenever they need them without experiencing any delays in traffic. [32,26,29]

Accessibility:
One thing you should know is that any type of data stored online may be simply got from any device if it has a "cloud connection". Using gadgets like laptops, tablets, and smartphones, you may quickly access your cloud-based data.

Safety backup: Typically, no one can remove information that's kept in the cloud. It usually keeps everything safe and can be retrieved when needed, even if the device stops working.

Saves time and resources: You can now access everything online, saving you from having to write lengthy assignments on books or bulletin boards. However, since

you might receive your homework online, this saves you time. [36,38,40]

4. Cloud services used by respective users with respect to higher education:

Table 2 Cloud services that each user uses in relation to higher education

Cloud Service Model	Google Cloud Platform	Amazon Web Services	Microsoft Azure	User's	
				Administration	Teacher Research
IaaS	Google Compute Engine	Amazon EC2	Azure Virtual Machines		Ye
	Google Cloud Bigtable	Amazon DynamoDB			Ye
	Google Cloud Datastore	Amazon DynamoDB	Cosmos DB		Ye
	Google Storage	Amazon S3	Azure Blob Storage	Yes	Ye
PaaS	Google App Engine	AWS Elastic Beanstalk	Azure Cloud Services		Ye
SaaS	Google BigQuery	Amazon Redshift	Microsoft Azure SQL Database		Ye
	Gmail		Hotmail	Yes	Ye
	Calendar		Calendar, Task	Yes	Ye
	Google Docs		Office 360	Yes	Ye
	Google Drive		One Drive	Yes	Ye
	YouTube				Ye
	Hangout			Yes	Ye
	Classroom		OneNote		Ye

5. Conclusion:

The teaching methods used by traditional educational institutions have a number of disadvantages. For example, a student's aptitude for the subject matter may not always align with a teacher's manner of education. Nothing else on it might aid pupils in their processes of learning and assessment. It is mandatory for students to buy their own pricey textbooks, notepads, and other educational supplies. The sole method accessible in a classroom is the conventional approach to instruction. As a result, the traditional educational system places limitations on student and instructor assessment as well as learning."Cloud computing" solutions are extremely beneficial to educational institutions, particularly higher education institutions. since they help them overcome the restrictions of traditional education systems. Students in education can access a multitude of materials thanks to cloud computing.

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