A Survey on Applications of Cloud Computing in Education Sector Considering COVID-19 Perspective

BY

PRITY LATA CHOWDHURY

ID: 213-17-502

This Report Presented in Partial Fulfillment of the Requirements for the Degree of Masters of Science in Management Information System

Supervised By

Professor Dr. Md. Ismail Jabiullah

Professor

Department of CSE

Daffodil International University

DAFFODIL INTERNATIONAL UNIVERSITY

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APPROVAL

This Thesis/Project titled "**A Survey on applications of cloud computing in education covid 19 perspective**", submitted by Prity Lata Chowdhury to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of MS in Management Information System and approved as to its style and contents. The presentation has been held on 24 January 2023.

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Jahangirnagar University

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Supervised by:

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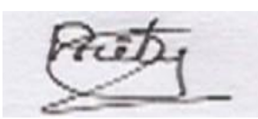
Professor Dr. Md. Ismail Jabiullah
Professor
Department of CSE
Daffodil International University

Submitted by:



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(Prity Lata Chowdhury)
ID: 213-17-502
Department of MIS
Daffodil International University

ABSTRACT

The current coronavirus (COVID-19) has had a profound effect on the delivery method of education around the world, affecting the majority of countries in a very aggressive approach. Many educational institutions are either operating under a state of emergency or are being compelled to produce online courses. Academic institutions must become much more cost-effective in the online delivery of high-quality educational activities if they are to meet the pressing difficulties brought on by COVID-19. If you're a teacher looking to improve your teaching methods and classroom output, the cloud is a great place to start. Cloud computing provides a fantastic opportunity. This study serves as a quick overview of cloud computing's intermittent usefulness in the realm of higher education. It also discusses some practical uses, such as cloud computing, combustion, & collaborative e-learning platforms. After all was said and done, a few further obstacles were issued.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

Almost every country has been impacted by the COVID 19 (Coronavirus) global epidemic, which has had a profound effect on the healthcare infrastructures available to treat the disease. There is a need to implement a wide range of cutting-edge systems to address the myriad problems caused by the global spread of infectious agents.
Industry 4.0 uses various cutting-edge development and computing infrastructures in multiple domains. These developments provide manufacturing and maintenance facilities with wifi access to assets that can be used to increase the efficiency of automated processes. When Industry 4.0 is fully implemented, all of these technologies will be linked together, and medical stakeholders will be able to communicate with one another regarding the creation and use of immunogenic, care instrumentality & supply, checkup, police work detection, and trying to decide required action with little physical human participation. That which has the legal Information supplied by cutting-edge technology gives for frequent updates on the group of people in question.

Machines are present in the factories of the Fourth Industrial Revolution. That are enabled by wireless infrastructure and sensors. The data from these sensors is fed into a system that keeps tabs on the production line as a whole and even makes decisions on its own. Due to the epic COVID-19 rampant, there has been a severe shortage of many commonly used disposable items, but Industry 4.0 has been able to produce these items more efficiently than ever. During this crisis, it ensures that patients have access to the necessary medical supplies and disposables by establishing a strategic supply chain.

Data derived from different sources such as Artificial Neurons, the Internet of Things (IoT), etc the new 4.0 industrial revolution will become a smart ecosystem. Rapid prototyping and development of medical components are possible due to the development of technologies. Through this in-depth review, we aimed to confirm the usefulness and apps of industry four.0 technologies for handling the COVID-19 global epidemic.

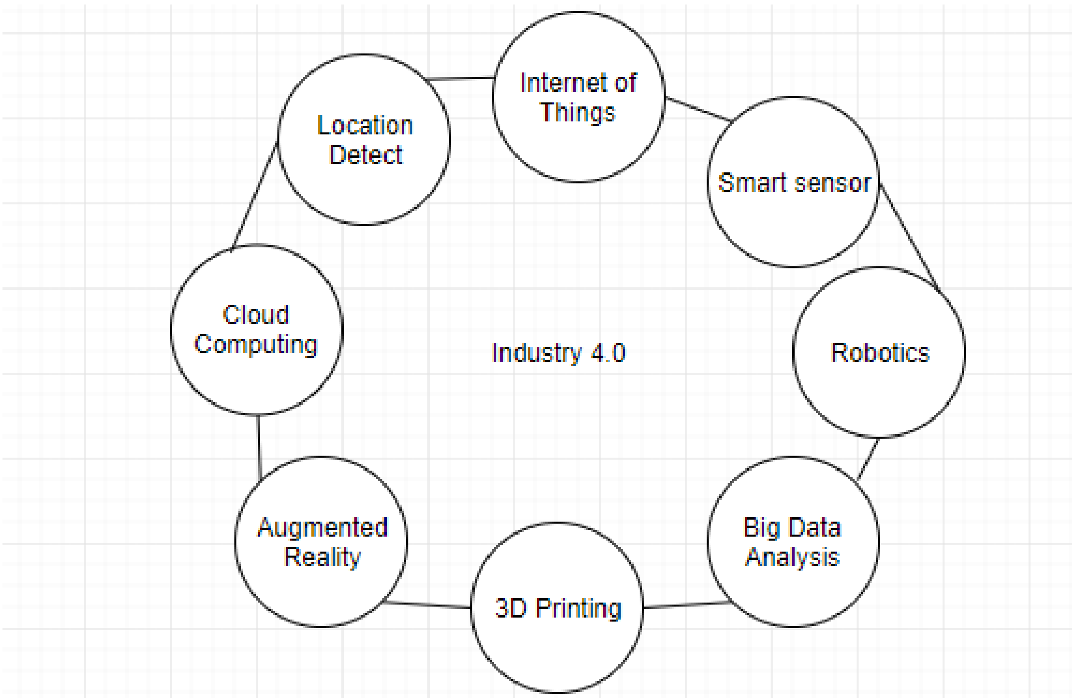

Fig1.1: Industry 4.0 & Cloud Computing

CHAPTER 2
REVIEW WORKS

2.1 Concept of Cloud Computing:

There is no generally agreed-upon definition of the CC construct because the topic is still very much up for debate. This may be due to the fact that CC is similar to other forms of high-end computing, such as P2P, group, market/service based, and system components [1]. Discovering the current literature will expose some similar characteristics of CC all across various available definitions, and this controversy will likely continue as technology advances. In order to provide ubiquitous, on-demand network access to shared, configurable computing resources like services, storage, applications, and networks, the National Institute of Standards and Technology (NIST) proposes that such a model be implemented.. Both the provider and the client can save time and energy by taking advantage of these tools, as they are simply new ways of integrating established technologies that help businesses make simple but meaningful adjustments to their procedures. In order to accomplish this, it is necessary to integrate preexisting technologies and to bundle a service. , Utility Computing, and Grid Computing. The use of cloud technology aimed to create next-generation data centers that integrated virtual services like information hardware, application logic, and computer programmer across a network. The new data centers' key benefit is that they enable users to access their applications not just from a central location, but from anywhere.

2.2 Models for Deployment, and Cloud Platforms:

There is no agreed-upon definition of the CC framework because its very nature is still up for debate. Some superior computing models, such as peer-to-peer computing, cluster computing, market- and service-oriented computing, and grid computing, have similarities to CC, which may explain this [1]. As technology evolves, the debate over CC persists, but a review of the current literature reveals that there are some consistent features shared by the various definitions. The National Institute of Standards and

Technology (NIST) suggests that this model could provide ubiquitous, as-needed network access to shared, configurable computing resources like services, storage, applications, and networks. Since these solutions largely involve repurposing or repurposing the use of preexisting technologies, they can be delivered rapidly and with minimal overhead by either the provider or the client. To accomplish this, it is necessary to integrate preexisting technologies and utilize packages as a service. (Software as a Service), "utility" computing, and "grid" computing. The use of cloud technology was intended to facilitate the development of next-generation data centers that centralized and distributed virtual services such as information hardware, application logic, and software over a network. One of the most important benefits of the new data centers is that users can access all of their applications from a single point of access from anywhere.

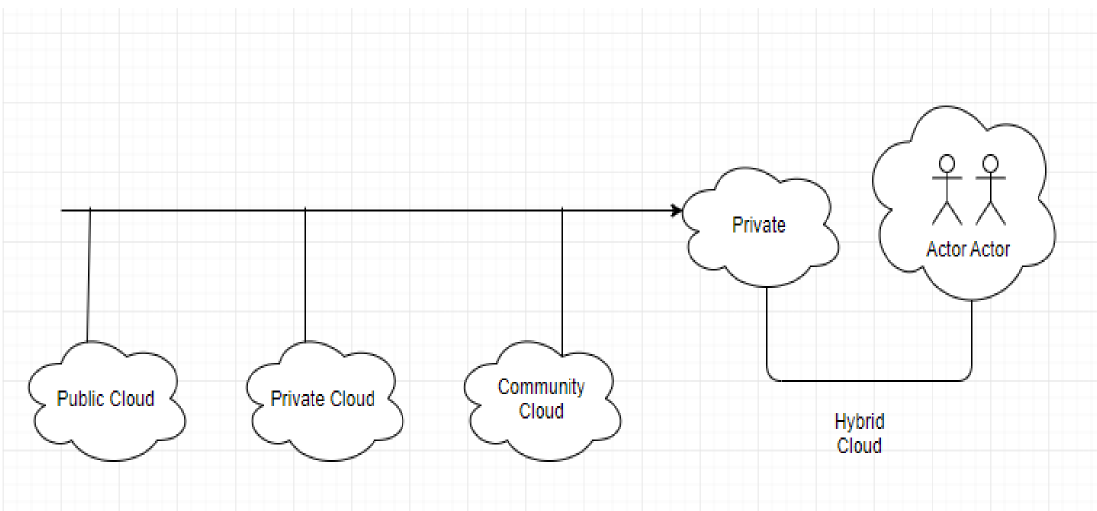

Fig2.1: Deployment Models & Cloud Computing Services

2.3. The Use of Cloud Computing in Academic Institutions:

When it comes to the classroom setting, CC will have many positive effects for both teachers and students. The ability to store massive data, to collaborate on projects, and to share materials is an attractive proposition in both education and research. In addition, because CC are frequently used remotely, users will appreciate the convenience of being able to access these resources whenever and from wherever they please, using any device they choose. High education institutions (HEIs) have opted to use CC instead of traditional IT infrastructure and computer code systems due to its efficiency and rapid deployment. Cooperative methods of education Because of this, many educational institutions that are looking for computer-based technologies to support more socially-oriented and cooperative learning designs have begun to adopt CC technology. Since users of a cloud platform have access to features like information access, observation, and storage, as well as to the platform's infrastructure, cloud computing greatly simplifies e-learning in human-computer interaction. While cloud computing is still in its infancy in the business and government sectors, it is widening the income gap in higher education institutions. However, due to rising competition in the teaching market and the accompanying pressures on performance, student successes, and financial gain, it is rapidly transitioning from an elective to an obligatory component of the academic supply. As a result of the capabilities offered by CC, HEIs will be able to go beyond its current constraints. Therefore the active academic community has easy access to CC services. The first table shows how researchers have discussed and attempted to capture the benefits of CC from a variety of perspectives. In the context of the academic community. Several of the current Studies lack empirical findings, despite this evidence gap in analysis being artfully clear at the structure level with regards to CC's implementation in universities. Due to the paucity of research into adoption in HEIs, it is important to investigate the factors that influence this process in greater depth. Previous literature on CC adoption in HEIs is summarized in Table 1; this study is built on the structure level theories (i.e., TOE and DOI) that are in line with the objectives of the study.

Table1 1.1: Cloud computing Higher Education Institutions.

Study	Title	Theory	Methodology	Country
[2]	Behrend, T.S.; Wiebe, E.N.; London, J.E.; Johnson, E.C. Cloud computing adoption and usage in community colleges. Behav. Inf. Technol. 2011, 30, 231–240. [CrossRef]	Diffusion of Innovation, Technology acceptance model theory.	Data collected via Survey. 335 valid responses were gained. Quantitative approach followed.	HEIs in sub-Saharan Africa
[3]	"Conceptualizing a model for adoption of CC in education"	Diffusion of Innovation, Technology acceptance model theory.	Model-based on the concept.	HEIs in sub-Saharan Africa
[4]	"The Effectiveness of Cloud-Based E-Learning towards Quality of Academic Services: An Omanis' Expert View"	N/A	Data was collected through Semi Structured Interviews. Qualitative approach.	HEIs in Oman.
[5]	"An exploratory study for investigating the critical success factors for cloud migration in the	N/A Success factors based on literature	Structured online questionnaire	HEIs in Saudi Arabia

	Saudi Arabian higher education context”			
[6]	“Using CC for E-learning systems”	Literature review		HEIs in Saudi
[7]	“Student perceptions of cloud applications effectiveness in higher education”	N/A	Data was collected via Survey	University in Southeast Michigan USA
[8]	“A conceptual model of e-learning based on CC adoption in higher education institutions”	Diffusion of Innovation; Finite Volume Method	Conceptual Model	HEIs in Oman
[9]	“Examining CC Adoption Intention in Higher Education: Exploratory Study”	Technology acceptance model theory	Questionnaire-based survey.	Politehnica University of Bucharest, Romania.
[10]	“Investigating the structural relationship for the determinants of CC adoption in education”	Technology acceptance model theory	Administering survey. The quantitative method was followed in the paper.	Universities in Thailand
[11]	“Cloud for e-Learning: Determinants of Its Adoption by University Students in a Developing Country”	Technology acceptance model theory 3	An empirical method and survey were conducted. Questionnaires were formed.	Saudi Arabia
[12]	“Determinants and their causal relationships	Diffusion of Innovation	Focus group discussion and DEMATEL	Science and technology

	affecting the adoption of CC in science and technology institutions”			institutions, Taiwan
[13]	“CC adoption by HEIs in Saudi Arabia: an exploratory study”	Theory of every thing	Researchers conducted survey.	HEIs in Saudi
[14]	“CC adoption and usage in community colleges”	Technology acceptance model theory 3	Interviews were performed. IT support staff and college administrators were the target group	Rural and urban community colleges, USA

2.4 Theories of Technology Adoption:

When we talk about "adoption," we're talking about a decision-maker (the "adopter") or a group of decision-makers considering a new product, service, or plan. There are a number of steps in this process, the culmination of which is the determination of whether or not the new product should be considered premium. An entity makes the decision to adopt an object or set of objects in a given situation. Many outside factors are also at play here, but the gift study specifically positions HEI as the subject and CC adoptions as the subject. Several studies considered constructs influencing CC adoption at the individual level, but little material was found on this topic at the structural level. We have already established that the TOE framework and the Interior Department model are the two most prominent hypotheses used when taking into account technology acceptance area related to asset.

2.4.1. TOE Schematic:

The Theory of Everything (TOE) framework will provide an outline of the innovation procedure within a business setting. Technology, organization, and environment are the three facets of an associate business that are taken into account by TOE because of their impact on the uptake of new technologies. In this context, "technology" can mean either the internal or external technical data of a company, but, due to the mechanization that will affect the adoption rate, it is more likely to be the latter. External forces like competition and regulatory and market conditions sit between the setting and the organizational sides, while the characteristics of the company and its explicit communications channels and resources fall under the organizational sides.

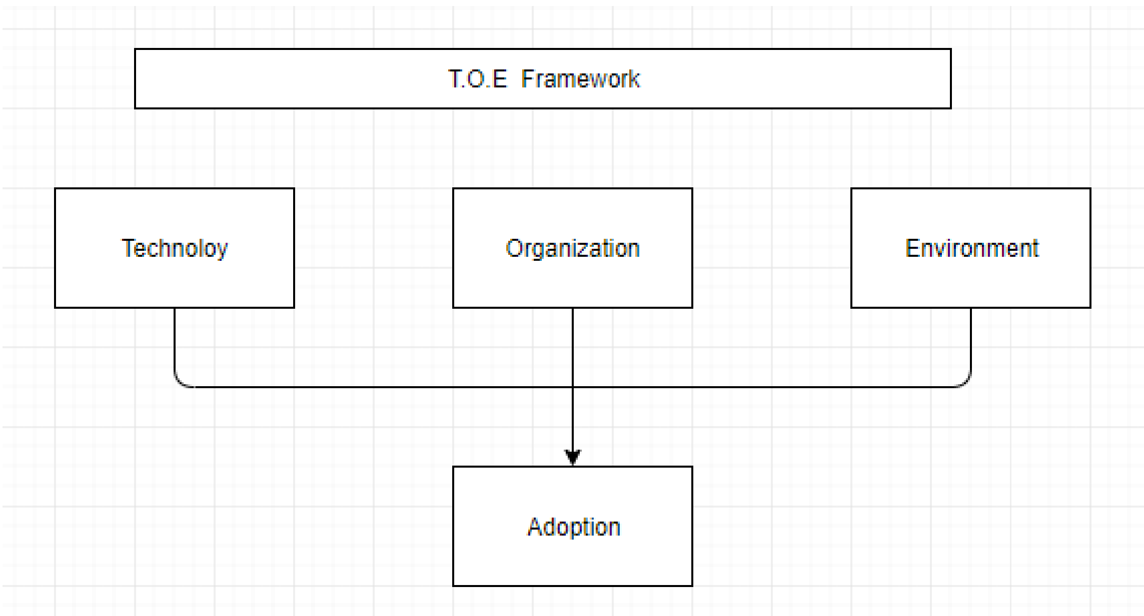

Fig2.2: TOE Framework.

2.4.2. Model of DOI:

DOI theory employs five stages to describe a company's internal innovation process. The five stages include gathering data, making a choice, putting a plan into action, and checking in to see how things are going. This theory covers a wide range of situations and offers compelling clarification for how any company can successfully adopt innovation. DoI the theory provides a unique angle by focusing solely on this approach. Given its emphasis on the technical aspects of the TOE framework, combining the two sets of principles yields synergistic benefits for all parties involved. Both the TOE framework and the DoI model are widely used to analyze enterprise-wide tech adoption.

We have on hand undergraduate-level reviews of published adoption-theory discussions Table 2 demonstrates that authors draw from a wide variety of theoretical frameworks when developing their research models. Yet no single theory can adequately account for the wide variety of innovations that exist. As a result, the theoretical model that is incorporated is fascinating and can be used to determine the adoption strategy for limited innovations.

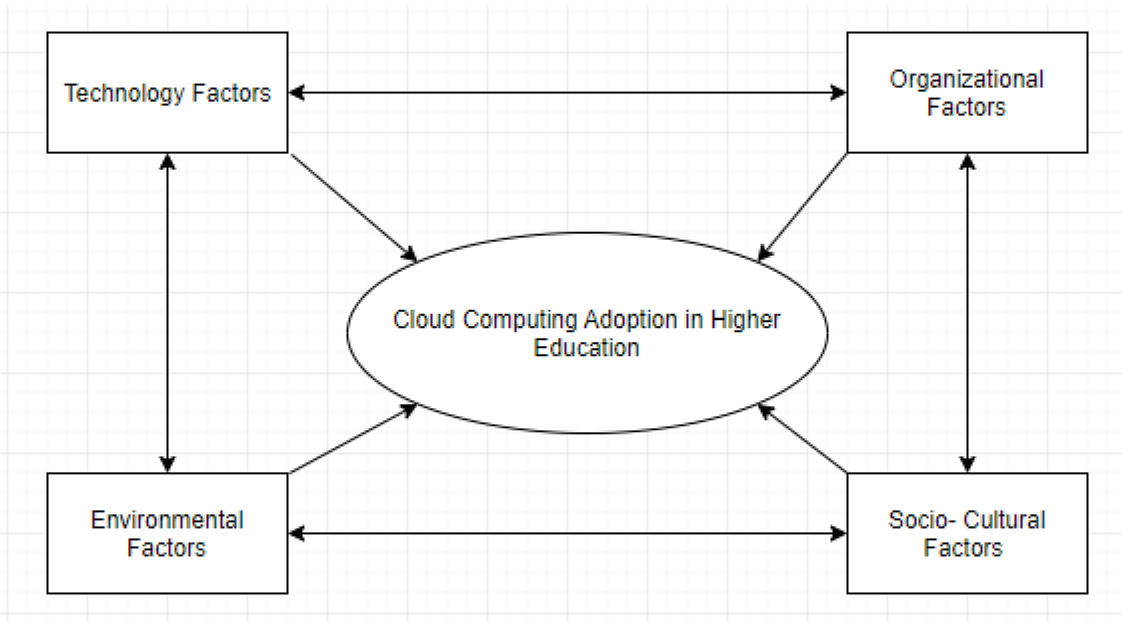

Fig2.3: DOI Model

2.5. Methodologies of Analysis:

Researchers have relied on statistical analysis to improve their ability to create, explore, and verify analysis findings for over a century. Since the advent of computer technologies, the scope of use for applied mathematics techniques has broadened. In this section, we argue for the necessity of using two distinct methods of analysis and explain the goals of this research.

2.5.1. Modeling using Structural Equations:

Structural equation modeling (SEM) is a type of multivariate data analysis that has been around since the 1980s and can be used for either theoretical discovery or confirmation.

One kind of SEM relies on the concept of covariance, while the other relies on the concept of variance. CBSEM is used to test hypotheses and confirm (or disprove) them. PLS-SEM, or partial least squares structural equation modeling, is commonly used for both exploratory data analysis and theory creation. Using Smart PLS 3.0, we performed variance-based structural Equation modeling (PLS-SEM) on the gathered data, which supported the measure and structural model.

2.5.2. Neuronal System:

You can think of a neural network as a massive parallel distributed processor made up of simple processing units that have a built-in propensity toward storing and making accessible knowledge gained through experimentation. In addition, a neural network can acquire new knowledge from its surroundings by implementing the learning process, making it similar to the human brain in many respects. The synaptic weights then act as a memory for the information learned. The learning algorithm then makes methodical adjustments to the neural network's synaptic weights in order to meet the original goal. Even more, the neural network has many advantages. Non-linear and linear neural networks provide this benefit by facilitating the evaluation of non-compensatory decision processes, and they also aid in achieving input-output mapping without requiring distributional assumptions about the inputs or outputs. In addition, the neural network's adaptability suggests it can deal with how data is generated. Furthermore, it has been observed that neural networks excel over more conventional forms of compensation. Multiple, discriminant, and logistic regression models, amongst others. Though neural networks have been used in research across disciplines, including those dealing with economics, customer loyalty, wearable healthcare devices, and consumer choice, relatively few studies have examined its potential uses in information systems. As a result, the present research will first use partial least squares structural equation modeling (PLS-SEM) to identify the constructs that have robust relationships with CC adoption in HEIs, and then employ the quasi neural network model for forecasting CC adoption in HEIs in light of the essential adoption variations.

CHAPTER 3
HOW IT WORKS

The widespread adoption of cloud computing facilitates societal progress, and its unique qualities are in demand across all sectors of the economy. Cloud computing is characterized by its low overhead, practical stability and dependability, analytical computing power, data storage capability, and scalability. The resource utilization will be maximized as a result of several features that enhance the user experience and make it easier to access resource services.

3.1 Cloud computing's benefits in institutional administration:

3.1.1 A classroom can be set up anywhere, at any time:

If you plan to use the terminal. With the help of internet-connected instruments, professors can now conduct class lectures from the comfort of their own homes. Users will make use of these resources whenever and wherever they are needed. Anyplace. Because everything is stored in the cloud, students can access their teachers' video lectures and electronic lesson plans from any location at any time using their laptops, personal digital assistants (PDAs), or mobile devices.

3.1.2. The development of software and hardware for classroom use can be considerably lowered in price thanks to this development method:

With cloud computing, all you need is a goat terminal device with a browser to access the internet, and you'll be able to do whatever you want once you connect it to the internet and start using the service.

3.1.3. It's easier to collaborate on educational materials and share knowledge:

Cloud computing is being applied to the field of higher education, which has a significant impact on the sharing of academic information resources because of the data being stored there. At present, a plethora of academic info resources have been developed or are in the process of being developed by academic institutions, academic enterprises, and schools of all levels. The "cloud" will supplement the existing academic information resources of various universities. Cloud computing's robust measurable nature, along with the fact that its resources will be shared in a meaningful way, will result in fewer resources being dedicated to any given enterprise overall, saving both time and money. Information resource developers and various educational institutions will use cloud computing's powerful cooperative operating ability to better understand the co-construction of academic information resources.

3.1.4. Safeguard the privacy of academics:

Providers of cloud-based computing services offer reliable, low-cost, and expert data storage, and the data itself is kept in the cloud. Therefore, the use of cloud computing in educational institutions will significantly guarantee the safety and dependability of instructors' and students' data, and instructors and students will no longer need to worry about viruses, hackers, and data loss due to hardware damage.

3.2 Integrating Cloud Computing into the Process of Building Management Information Systems for Educational Institutions:

3.2.1 Schools can take use of cloud computing's affordable and flexible software application customization services thanks to the technology's scalability:

In addition to vast amounts of data and robust computing resources, users of cloud computing platforms also have access to low-cost application code services like Google Apps and Zoho Workplace. Colleges typically need to spend a lot of money on the purchase of business code, and it costs a lot to keep operating system and application code up to date and maintained. When the university joins the cloud computing service project, however, it will be able to provide low-cost or even free industrial applications like the office suite. Regular updates in the cloud ensure that users always have access to the most recent version of the software. Cloud services are only accessible via the Linux operating system's graphical user interface, which can be accessed via the free Firefox web browser. Cloud computing services like Google's allow for things like grid-based page processing and design. Open source applications are notoriously complex and tricky to master.

Users can access a variety of free tools, including a presentation creator and a data table maker, on Google Apps, but it falls short of the functionality of cloud computing services like Google Apps.

3.2.2. Schools can benefit from cloud computing because it offers a secure and trustworthy location to store data:

Today, keeping data secure and private is a priority. Antivirus programs from a variety of developers, like 360 and Jinshan, are popular today. However, new viruses are constantly being released, and it will take some time for antivirus software to be updated to keep up. The virus can use this to its advantage by erasing data. When a school stores data in the cloud, it is protected from both natural disasters and unauthorized access.

3.2.3. With cloud computing, classrooms may more efficiently share and access digital materials:

Teachers and students participating in SIMtone's "Universal Cloud Computing Service" initiative will all have access to the same virtual desktop, software suite, services, and shared resources from any device with an internet connection. You won't have to lug anything back, and you can get everything taken care of with the professors. Ports for connecting to various gadgets vary.

To access the "General Cloud Computing Service" platform, users with computers "that will," "which will," or "that may" run WinXp would use the virtual machine computer code "SoftSNAP." The "WebSNAP" service allowed even computers with less powerful hardware to use cloud-based applications. A group of people working from different locations and at different times will be able to collaborate on a single project using the cloud computing service.

3.2.4. Create an on-campus cloud computing service using open source software:

The concept of cloud computing is shared by all open-source software, but different open-source software will be used to create various cloud services. You can create a cloud service that functions similarly to Amazon's by using the EU-Eu-Calyptus open supply project; you can create a cloud service that functions similarly to Google's Apps by using the AppDrop or 10gen open supply projects; and you can create a cloud service that functions similarly to those offered by Amazon, Facebook, and Yahoo by using the Hadoop open supply project. The rapid growth of the IT industry has resulted in ever-faster laptop updates. Most educational institutions today have large quantities of outdated computers sitting around. Even though their hardware is still functional, computers that aren't compatible with modern software are considered obsolete. Not only do professors waste a lot of time and money, but they also spend more money on fancy new instruments. One way to deal with these issues is to launch a localized open supply cloud computing project. The goal of the so-called field open source cloud computing project is to network a large number of decommissioned or unused computers in the faculty to build the institution's own cloud computing service. Colleges and universities can take advantage of the field cloud computing service when they have a large computing workload. For instance, North Carolina State University and IBM's jointly developed cloud computing platform offers open supply regions free cloud computing services.

3.3 Importance of Cloud Computing for Organizations:

Companies today are making extensive use of cloud computing to advance their corporate strategies. Computing in the cloud and cloud computing on mobile devices are two forms of cloud technology. Cloud computing is a potential service delivery model for businesses and consumers alike. Cloud computing, as the most cutting-edge and widely recognized innovation in the IT industry, has the potential to completely alter the way in which wireless information systems function and where computers are used. It is a new IT paradigm that promises to change the way traditional IT services are delivered by allowing for greater convenience, lower costs, and new capabilities for all users. The term "cloud computing" has been used to describe a theoretical framework that allows for the continuous, hassle-free provision of a set of coordinated hardware and software services, such as network, server, and storage, on demand. According to NIST, cloud computing executes computing workloads in an associative, elastic, and multitenant environment where jobs will ferociously fluctuate, supporting demand for IT resources with the least service provider contact or management effort possible. According to IBM, a cloud is a network of shared, virtualized computing resources.

Both traditional batch-style back-end operations and real-time, user-facing applications can find a home in the cloud. Before it was called "cloud computing," the term "Active Server Page" appeared in the literature in 1990. (ASP). In 1999, Salesforce.com was an early adopter of cloud computing, when it began offering business solutions over the Internet.

After that, in 2002, Amazon introduced Amazon Internet Service (AIS), a cloud service. By 2006, however, Google Docs had become widely known and used. In the same year, Amazon also introduced a commercial web service called Elastic Compute Cloud (EC2), which provided users with the ability to rent computers on which to run software. Several American institutions, including IBM and Google, joined forces with one another and other institutions in 2007.

To facilitate the introduction of private clouds, Eucalyptus released the first open-supply Amazon Internet Services Application Programming Interfaces (AWS API) in 2008. This led to the development of Open Nebula, the first major open-source software for deploying private and mixed clouds. Microsoft's Windows Azure was released in 2009, marking the company's debut in the rapidly growing cloud computing market. Then came several other key figures. By allowing companies to outsource some or all of their IT operations, cloud computing creates a flexible and highly adaptable platform for running operations in the public cloud. It's possible that "cloud computing" is a service-based technology that combines hardware and software and makes it available on demand over a network, at any time and from any location.

Common examples of cloud services used by individuals include webmail, photo sharing sites like Flickr and YouTube, and document creation tools like Google Docs. Companies have begun pooling resources to implement cloud computing solutions for their information technology requirements. It offers services like data warehousing, application hosting, and data processing on remotely managed, web-accessible machines. Consumers can use cloud computing to access and store media and communication applications such as social networks, video games, and music. Cloud computing is replacing publicly owned businesses, privately owned knowledge centers, and IT groups. Businesses will use cloud computing for knowledge transactions, knowledge analysis, and value chain operations like supply chain management, finance, production, customer service, and collaboration with business partners. Services in the cloud can be had for less than the cost of a cup of coffee, thanks to a number of competitors. Researchers emphasized the potential for cloud computing to be used by a wide variety of companies due to its scalability and its ability to provide virtualized resources as a service accessible via the internet. A plethora of companies are now showcasing cutting-edge cloud computing innovations. Microsoft's cloud solutions are a suite of web-based services designed for enterprises of all sizes free-thinking experts and seasoned specialists. The public cloud provided by Windows Azure is highly filmable and climbable. IBM's cloud services are expanded by the IBM Smart Cloud Solutions, a more comprehensive suite of products for private, public, and hybrid cloud deployments. IBM's proposed Smart Cloud for Social Business is a potential suite of software as a service (SaaS) offerings for businesses that emphasizes teamwork and communication. As an adjunct to its IaaS offering, VMware provides vCloud Hybrid, which provides users with access to a combination of compute, storage, and network resources in the form of two distinct core computing services: Dedicated Cloud and Virtual Non-Public Cloud. Many businesses worldwide rely on Amazon's Internet Services because of the company's commitment to providing reliable, scalable, and cost-effective infrastructure. As part of its organization hosting services, Rackspace provides associate-level Open Cloud to businesses of all sizes and in all industries around the world. Salesforce.com is a well-known cloud computing company because of its on-demand, subscription-based CRM software deployment.

3.4 The Impact of Cloud-Based Technology on Learning:

In the latter part of the twentieth century and the first few years of the twenty-first, cloud computing had a profound impact on many facets of modern life. Over the past three decades, IT has expanded at an exponential rate, touching every facet of human activity and providing solutions in many fields that surpass human comprehension. Everything from banking and finance to trading and e-commerce to robotics and artificial intelligence to automobiles and aviation to rocket and space science. There is no aspect of human activity that has not been altered by the IT revolution.

Computer science and other areas of information technology have impacted nearly every facet of modern life. Without exception, businesses of all stripes now rely heavily on their IT systems and personnel as the very foundation of their operations. To sum up the twenty-first century in a nutshell: In the modern era, businesses can't function without the help of information technology services.

Provision of services, efficient management of day-to-day operations, achievement of strategic goals, and so on. It is now crucial for businesses to guarantee the continuous availability of their IT infrastructure. In the past three months alone, the higher education industry around the world has undergone a revolutionary transformation as a direct result of advances in information and communication technology. The use of technology in higher education has evolved due to the transition from conventional to "smart" classrooms and the widespread adoption of new forms of information and communication infrastructure. A look at today's classrooms. Another major problem is the mandated shift to Education 4.0 in higher education. A suitable technological solution is required.

How cloud computing is being used in educational settings, have grown steadily over the past few years, with many schools now making use of cloud computing in some capacity. It has also been noted that some universities and colleges have begun to implement private cloud infrastructure in recent years. Still, schools can't just implement cloud services without approving of them first. Tuition requirements, considering the aforementioned information and developments and the likely demands of future colleges and universities.

3.5 Disadvantages of relying on the cloud:

There are many barriers to widespread adoption of cloud computing technology, despite its many benefits and assurances. Because of the importance of protecting private data when storing it in the cloud. Even in the cloud, safety concerns continue to be paramount. The fact that cloud computing TECHNOLOGY is only accessible via the internet presents another significant challenge.

Businesses may find it challenging to switch cloud providers due to the lack of standardization of application programming interfaces faces and platform technologies. Businesses may be hesitant to adopt cloud computing due to compatibility concerns. The five main categories of cloud computing are hazards. Governance failures and ability problems are examples of policy and structure risks. Information discharge and loss are examples of technological hazards that must be taken into account. The law presents challenges in the form of questions about software licenses and data security. The fourth category of risks includes problems with infrastructure such as networks. Lastly, there is a group of risks related to projects and businesses that prevent companies from using cloud computing.

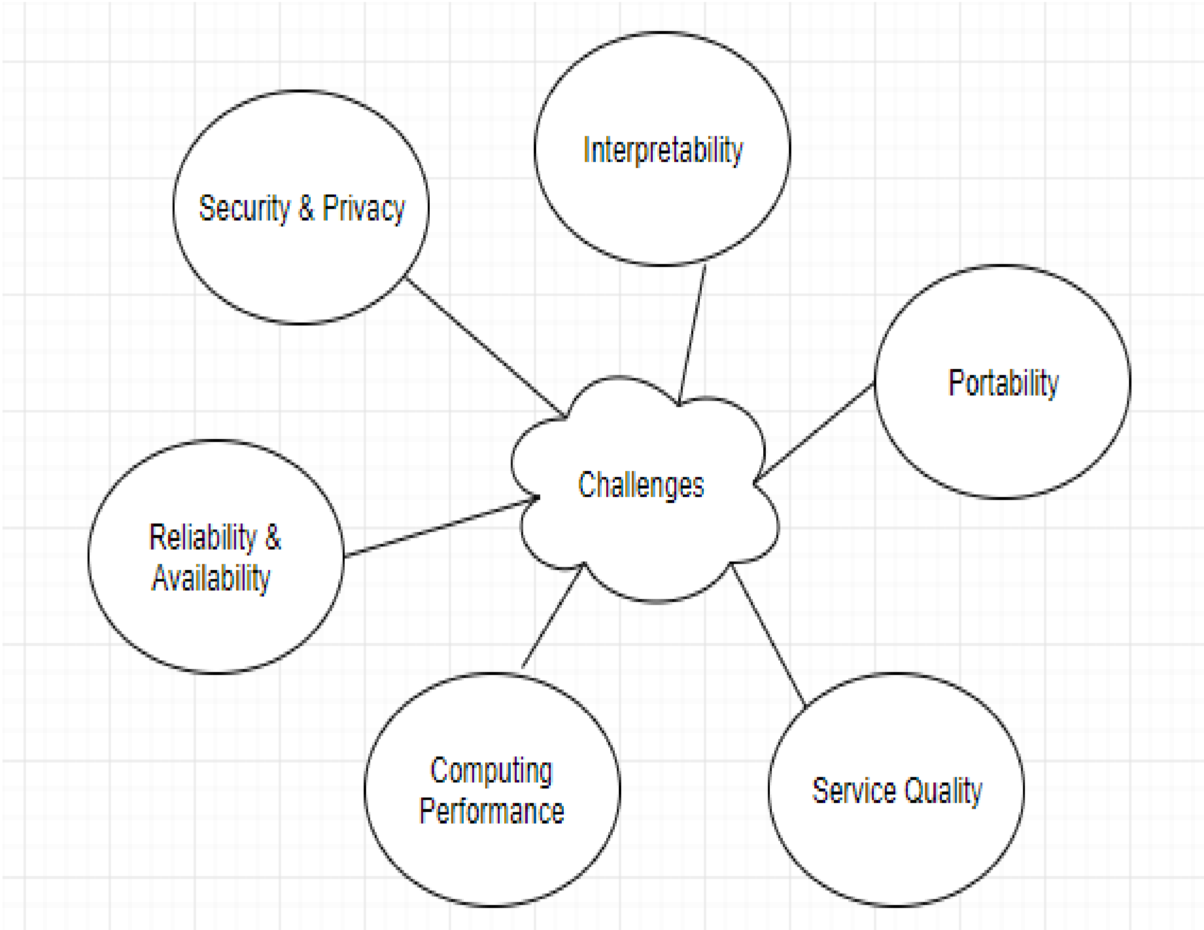

Fig3.1: Challenges

CHAPTER 4
IMPLEMENTATION

The concept of cloud computing consists of two words: computing and cloud. As it is known, computing is all that is related to the use of computer services, such as programming, management, use, and others. At the same time, the cloud is singular and means cloud: a piece of clouds, and the concept refers to the presence of computing near the user. It is available most of the time.

4.1 Cloud Computing items:

There are five components of cloud computing. Such as:

1.User 2. Platform 3. Infrastructure 4. Applications 5. Service

4.2. Types of Cloud:

In total we can divide clouds into 4 categories

1. Public Cloud: The resources are publicly available.
2. Collective Cloud: Cloud services that bring together a certain number of users.
3. Private Cloud: It is based on subscription.
4. Hybrid Cloud: Mixture of public and private cloud.

4.3. Cloud Services Uses:

1. Devices: Different types of computing devices
2. Operating System: The runs the overall program
3. Middleware: Link between cloud and the machines
4. Cloud service provider: From whom the cloud based service is being purchased

4.4. The advantages and possibilities of Cloud Computational Applications:

While the main education key stakeholders (students, teachers, colleges and universities, and IT staff) will all gain something from cloud computing, not everyone will reap the same rewards. While some of these affordances are in harmony with traditional modes of instruction, others stir up trouble in areas as diverse as the political economy of information technology and the administration of cutting-edge gadgets. In what follows, results from the analyzed literature are used to categorize advantages and benefits. One can see a summary of these in Table 1, ordered by the number of stakeholders who benefited.

4.4.1. An abundance of helpful educational tools available on the web:

Because these programs are typically web-based, students can access them from any location at any time [15]. The ease of use and low cost of cloud-based services like Google Apps, Dropbox, and others have led to their widespread adoption in the classroom. Plus, it's typically state-of-the-art software that gets regular updates and enhancements from industry experts. Other characteristics consist of high demand, quick feedback times, and scaling up factors.

Web application offer, which is why they're so desirable for classroom use. Sometimes though, performance and dependability have costs associated with them. Online versions of commonplace office suite programs like Google Apps for Education and Microsoft Office provide useful tools for teaching and learning [16]. Different teachers may assign them a wide range of uses. For good behavior in class, teachers can use a Google Spreadsheet to compile and distribute points to students [17]. Email accounts hosted by Google or Microsoft with a custom domain name [18]; YouTube channels to broadcast lectures [19]; SkyDrive21 or Dropbox storage for students and faculty [20, 21], In [22], the author describes a fascinating scenario in which chemical lab students use drop box as data and result sharing tools. Students have access to these records and can conduct their own analyses. Students are able to study for longer periods of time because they have easy access to data even when the professor is physically constrained to their home.

In addition, students use ready-made features to catch learning goals. Objectives. Other examples of general-purpose cloud applications in education include the use of video-on-demand (VoD) services for delivering lectures [23], the use of virtual worlds for exploring an art museum [24], and the use of a virtual learning environment (VLE) to integrate various generic cloud applications for language study [25].

Although educational apps dominate the cloud, there are many other types of apps available in the cloud that can be very useful in certain classroom settings. One such system [26] is the cloud-based Customer Relationship Management (CRM) system, which manages the interactions between the administrative staff and the students. Other examples include the use of a cloud-based civil engineering application (AutoCAD WS22) in the classroom [27], and the incorporation of scientific and statistical software such as Scilab23 and R24 into mathematics and statistics education [28]. 2010). [29] also mentions that students are using cloud services like GitHub and SourceForge, which are more commonly associated with professional software development, to manage the configurations of their projects' source code. In addition, there are cloud applications that were developed either particularly or generally with education in mind. In the first category, we find cloud-based VLEs. Students benefit from cloud-based e-learning systems provided by VLE providers like Blackboard and Lessons LAMS due to their widespread availability, scalability, and accessibility. In a similar vein, [30] illustrates a scenario in which students in a course on computer architecture use a cloud instance of Moodle that dynamically adjusts the delivery of course materials based on each individual's connection speed. In contrast, [31] introduces cloud software for targeted educational purposes through the use of NetLab+, a computing environment that gives students real-world experience with computer networks through projects and labs. The use of cloud-based dynamic visualization and simulation applications to teach subjects like geometry and algebra [32] and art appreciation [33] has also been studied. Some of the examined contributions take advantage of the cloud services' in-built collaboration and communication features, which are especially helpful for pedagogical approaches like constructivism and collaborative learning [34]. For instance, [34] surveyed future educators about their thoughts on the usefulness of Google Apps and other collaborative cloud-based tools for use in the classroom that are grounded in the constructivist approach to learning. Their responses indicated that they benefited from and approved of future implementations of these technologies in the classroom. The results were similar to those found by [35], who used Google Docs to facilitate group work and action research in a blended learning setting for a course on educational technology. Another study that emphasizes this benefit is [36], which suggests various cloud-based collaboration tools for educators. Technologies like Google Docs, blogs, or wikis are used in other submissions [37] from fields as varied as science and technology, an MBA, online learning courses, physics, computer science, and programming.

Table: 4.1 what the key players in education can gain from cloud computing and what they can do with it.

	Experts in the field of education	**Participants**	**Computer Engineers**	**Places of Learning**
Access to Online Forms	We can now create new learning scenarios. Facilitating cooperative pedagogies.	Options for extendin g learning outside of the institution. Easier resource sharing and communication.	Less work is required for installation and upkeep.	
Adaptabilit y in designing learning environmen ts	The resources required to run an environment are included in the package. Complex lab setups in the cloud for the study of computer science.	Making a unique classroom setting with little to no technological knowledge required. Make assignments a higher priority than configuration work.	Time and energy spent on setup and upkeep are both cut down.	Encourage educators, students, and other organizations to reuse pre-configured environments.

Assistance with mobile learning	There are fresh scenarios f or in-person or relocated learnin g.	Institutional learning made easier by simple synchronization or sharing across devices and platforms.		
Extensive computatio nal backing	The creation of complex simulation based learning environments (sciences, engineering), or the use of multimedia processing with timely learning analytics.			
Connectivit y		The impression of stable quality of service throughout time.	Managing expensive and overburdened infrastructure while meeting radically shifting service demands. Making apps	Managing expensive and overburdened infrastructure while meeting radically shifting service demands.

			without thinking about potential usage.	
Cost savings in hardware			Improved resource management and easier resource usage.	Less money is needed up front, and the expenditures are proportionate to how much is used. Federation potential in cloud storage for the public.
A decrease in software costs		Run the office suite on your home computer without paying for a license.		Alternative approaches to software licensing, such as the use of free or pay-per-use software (often not really used).

4.4.2. Adaptable design of study spaces:

Because of the cloud's flexibility, teachers and students now have more options than ever before for creating dynamic classroom settings. In many cases, the victimization rates of various cloud services and applications would be inconsistent. APIs into completely individualized learning environments (PLEs) that meet the needs and preferences of students [38]. For instance, [39] describes a test-bed for a course on e-learning that employs a PLE that incorporates several cloud resources including Google Apps, Facebook, and mind-mapping applications for future educators. It was acknowledged that while this medium was beneficial and inspiring for education, students can feel lost in its complexity without proper training. Some more cloud-based [41] PLE examples and contexts are geared toward facilitating lifetime learning in primary and secondary schools. Microlearning, or learning that takes place over brief periods of time, has also been suggested for use with cloud-based services [42].

Cloud computing also enables the rapid, elastic, and scalable supply of resources on demand. Educators will be able to create more robust computer environments, such as simulated development environments, bare virtual machines, or student PCs with pre-installed applications. While it may take some time to set up the desired environment, once professionals have designed and built one environment, it is simple to repeat the same environment as much as needed [43]. Save or package the preset environment for use in future courses or to share with coworkers [44]. Minutes is fast enough for various learning scenarios, and the infrastructure provisions the necessary resources so that they are available to the students [45]. By not having to worry about configuration concerns, a lot more time can be devoted to the task at hand [44].

4.4.3. Facilitation of mobile education:

Because of the device's limited processing and storage capabilities, mobile learning (m-learning) is now hindered [46]. The cloud can assist alleviate this problem. Because of the cloud's scalability and the ease with which additional computing resources may be added. This allows for learning programs to be run on students' mobile devices while the most intensive computing is done in [47]. Learning can be accessed, accumulated, shared, and synchronized by students using their mobile devices [48] 2011). with the nearly unlimited storage capacity that cloud computing enables, students can use m-learning services and apps that are rich and useful (multimedia, real-time, context-aware, etc.) and can be accessed from anywhere at any time [47], so long as they have access to a network.

Cloud computing has been shown to provide for mobile learning services in a number of studies. [49] Demonstrate live footage of students obtaining location-based e-learning content (such as historical information about nearby landmarks) on their mobile devices. In this case, achieving real-time reaction requires providing the right amount of cloud resources and enforcing QoS requirements at the infrastructure level. Other mobile-device-toting CS students tap into a cloud-based Moodle instance that tailors content delivery (e.g., file size) to each student's bandwidth [30]. Because today's students are accustomed to using a wide range of electronic devices, many of them turn to the cloud to synchronize their educational data across all of their various platforms.

4.4.4. Help for schooling, assessing, and remarking that relies heavily on computers:

There are occasions when students need access to powerful computers in order to run instructional applications that would otherwise be too taxing on their personal devices or the institution's servers [50]. If a student is expected to design an experiment, perform certain computing tasks related to the experiment, review the results, and possibly restructure the experiment and perform new tasks, the computation work should be quick. Learning takes place during conceptualization and observation. Cloud computing infrastructures could be set up or rented to achieve on-demand capacity to execute these applications within the time constraints specified by the educational setting.

[28] One example, and it uses the AWS EC2 cloud to make available the mathematical and statistical software packages Scilab and R to students. The cloud provides the necessary computational power for these applications. In another example [50], students export their edited videos from the non-linear video editor Celera. Using Celera, students construct editing projects on their computers and then upload them to a virtual machine in the cloud, where they join a queue and are rendered in batches with other projects.

4.4.5. The ability to scale up learning systems and software:

Throughout the duration of a course, the demand for computer resources of educational applications varies (with peaks occurring around enrollment periods, assignment deadlines, prior to tests, posting of marks, and so on) [51]. If the demand for a service is higher than the available computing capabilities, the service may suffer severely in the old model [52]. In order to achieve the predicted QoS needs without over-provisioning computer infrastructure [53, 23], cloud computing's scalability qualities permit the adaptation of resources to the changing conditions. This is especially important in situations where a large number of students are accessing the same online course at the same time, as is the case with massive open online courses (MOOCs) [54]. Diverse scaling scenarios for providing consistent quality of service to a large number of users are presented in the reviewed literature. Students use virtual worlds for e-learning on a private cloud where QoS regulation is imposed at the infrastructure as a service (IaaS) level based on application measurements, as seen in [49]. (e.g., logged users). When the number of users grows, the platform reassesses its resource needs and negotiates with the underlying infrastructure and application provider to increase the maximum number of concurrent users.

4.4.6. Hardware expenses are reduced:

The pay-as-you-go concept of cloud computing, along with virtualization, on-demand provisioning, and scalability, helps schools save money on expensive hardware. Hardware purchases are the most straightforward opportunity to reduce costs. Since the cloud service provider rather than the institution owns these resources, they are typically underutilized and expensive, but the organization pays only for what it uses [55, 56]. Power used to operate hardware, cooling [44], fire suppression systems, or space, as well as maintenance and telecommunications services, provide further substantial savings. In addition, schools don't have to worry about maintaining the infrastructure [57, 58], which reduces the need for highly trained technical staff.

StarHPC was hosted on AWS EC2 Virtual Machines, which the company had to rent in order to use it. In this two-week session, ten participants learned how to build parallel applications on the cloud's virtual clusters. The school saved money by not having to buy brand-new, unnecessary equipment only for this one class. The cloud service provider was in charge of everything from hardware upkeep to licensing payments to service availability guarantees. This peak period was supported by the cloud's scalability, the ability to purchase and release virtual machines (VMs) on demand, and the policy of only charging the institution for actual usage. With dynamic resource reallocation (in the 70e80% range) and hardware consolidation via virtualization, hardware resources can be used more efficiently, resulting in lower power consumption. The managerial burden for routine IT maintenance tasks is also reduced.

4.4.7. Reducing software expenses:

Schools can save money by making use of the many cloud-based tools available for use in the classroom. When it comes to constructing their SISes, educational institutions need not deploy or pay for cloud tools (such Google Docs, Dropbox, or YouTube) [57]. Cloud computing's pay-as-you-go model prevents the unnecessary expenditure of resources on software that is only used by a small number of students, despite the fact that several licenses may have been purchased [59, 60]. Additionally, the pay-as-you-go model enables organizations to try out new products for a limited time [40]. The author states the cost was zero, although it was estimated that providing the same service on internal systems would have cost around one million pounds, without excluding the cost of buying and maintaining the necessary programs and infrastructure to run them.

The cloud, and specifically Google App Engine in its various flavors, also provides free software development kits that may be used in the classroom to teach subjects like computer science (e.g., Amazon SimpleDB for cloud database services). [40] is a good example of a mobile learning app that makes use of Amazon SimpleDB to disseminate supplemental question sets to students. They employ Amazon's scalability and cloud pricing plan because they don't know how the service will evolve in the future. The school paid for the service in installments as the mobile learning platform grew.

4.5 Challenges of Cloud Computing in Education Privacy and Confidentiality:

It is a greater concern and problem to collect, store, transfer, and share the data over the cloud without endangering the privacy of personal data.

4.6 Reliability:

The availability of the cloud service. How to deal with interruptions due to natural, technical, and other causes. Compatibility: It means whether cloud service systems are compatible with different platforms and operating systems, devices. Control: Is case of third party integration, a regulation of policy control is very important. It is closely related to privacy.

CHAPTER 5
CONCLUSION

5.1 Summary:

The thesis summary on the topic of "A Survey on Applications of Cloud Computing in Education: COVID-19 Perspective" would focus on the ways in which cloud computing has been utilized in the education sector during the COVID-19 pandemic. The summary would likely highlight the various benefits of using cloud computing in education, such as increased flexibility and accessibility for students and teachers, and how it has enabled remote learning and collaboration during the pandemic. Additionally, the summary may also discuss any challenges or limitations encountered in the use of cloud computing in education during the COVID-19 pandemic and provide recommendations for future research in the field.

5.2 Conclusion:

Modern telecommunication technologies are inseparably connected to deliver the quickest and most straightforward answers to business problems. One such issue is cloud computing, which has recently been the subject of heated debate and thorough investigation, but which still has a great deal of untapped potential, to do more study to improve. Different content management systems continuously used by the majority of the world school's to improve the educational experience for their students. Modern schools even resort to private clouds to better serve their students. Still some institutions fail to use the cloud-based technology.

5.3 Future Work:

There are several potential areas for future work related to the topic of "A Survey on Applications of Cloud Computing in Education: COVID-19 Perspective." Some possibilities include. Investigating the long-term impact of cloud computing on education: As the COVID-19 pandemic continues, it will be important to study how the increased use of cloud computing in education has affected student outcomes, teacher satisfaction, and overall educational quality. Examining the security and privacy concerns of using cloud computing in education: Cloud computing has the potential to store and transmit sensitive student data, so it is important to ensure that this data is protected and that privacy concerns are addressed. Developing new cloud-based educational tools and applications: As technology continues to evolve, new cloud-based tools and applications can be developed to enhance teaching and learning. Exploring the use of cloud computing in vocational education: Cloud computing can be used to provide students with access to remote labs, simulations, and other resources that can be used to enhance their vocational education and training. Investigate how to train teachers and educators on the use of cloud computing in education: As the use of cloud computing in education increases, it will be important to ensure that teachers and educators have the necessary knowledge and skills to effectively use these technologies in their classrooms. Study the cost-benefit analysis of using cloud computing in education: The cost of using cloud computing in education should be studied to see if it is cost-effective and feasible for schools and universities to adopt this technology.

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A Survey on Applications of Cloud Computing in Education: COVID-19 Perspective

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