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Research Article

A Systematic review of Mobile cloud computing Applications and its impact on Learning and Big data

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Abstract: Mobile devices play a necessary role in our daily life, which are increasingly being used in different fields. Because of the high usage rate of mobile devices, the user needs safe technology to connect to big data exchange. That is presented by Mobile Cloud Computing (MCC), which happens by integrating mobile and cloud computing. This study shows the role of MCC and big data investigation in education. This holds extraordinary guarantee for the future because it has benefits like Cost less, Easily accessed, Huge Storage, Sharing, Collaborative interactions, resources availability, and Flexibility. Also, it has challenges regarding Mobile network conditions, Control of applications Security, and privacy. We did a reference review of several studies related to mobile Education and its Potentials and Challenges. Also, we study the effect of MCC in boosting teaching and learning activities by 250 questionnaires for 150 teachers and 100 students and conducted a statistical study of using MCC for employee's online courses in a year at El- Kenouz Training Centre in Qena, Egypt.

Keywords: Mobile Cloud Computing, Distance Education, E-Learning, Mobile Learning, Cloud In Education, Zoom Application, Big Data

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1. Introduction

Advanced technology and cloud computing have resulted in a remarkable change in education and the way students' study during the last several years. Student accessibility services aim to confirm that each one of a student's desires is necessary met. Some students may experience mobility issues outside of educational institutions making it difficult for them to attend inside it. Accessibility for all students is shifting in their favor as e-learning grows in popularity. It's never been easier to interchange remarking with teachers. Previously, notes were handwritten and then duplicated physically or photocopied by students. However, using cloud computing in education, students may exchange notes with their peers from any location that has an internet connection. Not only that, but professors may also provide learners with useful information and extra resources. Cloud computing eliminates the need to be physically present at the right place and right time; instead, it permits the dispersal of resources for everyone **(Farzai, S. et al.,2020)**.

Aside from the many advantages of adopting mobile cloud computing, there are also drawbacks, such as the delays experienced when mobile devices access cloud services from long distances, which are mostly due to/from the mobile devices. On the other hand, there are several problems connected with keeping data in the cloud, the most important of which is protecting the privacy of users' data against unauthorized access and harmful assaults. Also, problematic is the availability of the owners' data at any moment of the request. The integrity of the data is also a problem since it should not be altered or manipulated by intruders. Many cryptographic approaches may be employed to address these concerns about information security **(Psychas, A. et al., 2020)**.

Learning applications, as is widely understood, need a huge number of computing and communication resources, as well as dynamic access to enormous amounts of data within and outside the education organization, resulting in using a networked learning system. Mobile cloud computing might deliver computational resources at the correct time and location. Big data and associated technologies might provide the data management and analytics solutions required to decrease learning system expenses and enhance system and learning process inefficiencies. Big data includes developing technologies that extract value from data with four Vs: volume, variety, velocity, and veracity. Big data is expected to affect future network traffic, and as a result, network designs. This survey attempts to clarify Mobile Cloud Computing Applications potentials and challenges in education and Big Data **(Sun, P. 2020)**.

This research is a qualitative study. It tries to show the importance of using Mobile Cloud Computing applications in enhancing the education process. It also attempts to indicate the challenges and obstacles that face the education process in using Mobile Cloud Computing technology. To prevent security concerns, the research

proposed that a version of mobile cloud computing application be compiled and implemented in educational systems.

2. Research Hypothesis

The present study hypothesized the following: The main hypothesis.

In the research, Mobile Cloud Computing technology has a main effect on the educational process.

The following sub hypotheses are classified:

1- Mobile Cloud Computing technology has a tremendous impact on the beneficiary in educational and works training institutions.
2- The presence of a substantial impact of Mobile Cloud Computing technology on the used student, trainee and teacher.

3. The Research's Objectives

The researcher looked at distant education, which may be regarded as a novel topic in education because several nations, including Western, Southeast Asia, North America, Europe, and Africa, have pursued this road.

Cloud computing aspires to:

1. Shifting the computer's processing and storage space. As a result, informational and technical programs are being changed from products to services.
2. Offering a business strategy that allows for the use of infinite computer resources and open space and time.
3. Delivering educational services to the beneficiary of the educational process so that they can profit from development or study in the e-learning (distance) sector, as in other nations across the world.

4. The Significance of the Research

On the theoretical side, the research is critical because it may give a study for the educational library that academics have not before and realistically addressed. Second, via the use of Mobile cloud computing, this research aims to provide all service capabilities for utilizing mobile devices and equipment that are not otherwise available to benefit the beneficiary of the educational process and academics. As a result, it contributes to the enrichment of the educational process and the utilization of Internet services in the following ways:

1. Mobile Cloud computing technology has a lot of storage space.

2. The capacity to protect and keep users' data secure and secret.

3. It also offers extensive coverage for a speedy internet connection.

4. The necessity to persuade policymakers and decision-makers of the viability of mobile cloud computing.

5. Research Delimitations:

The basic research's limitations are:

1- Knowledge limitations, as the study encompassed both cloud computing and e-learning.
2- Spatial limitations, the investigation was finished in four schools in Cairo, Egypt and El- Kenouz Training Centre in Qena, Egypt Water and Wastewater Company.
3- Temporal limitations, the investigation was carried out 1/10/2021.
4- Human limitations in this study, a survey was used based on students' and instructors' perspectives regarding the formations of Egyptian schools as human boundaries for the present study and statistics for the training year from July 2020 to June 2021 for trainers and trainees to study the impact of e-learning.

6. Mobile devices:

Mobile devices are becoming an essential part of our everyday lives, and they are being utilized at an alarmingly high pace in a variety of sectors. Because of the increased usage rate of mobile devices, the user needs safety technology to connect to massive data exchange offered by mobile cloud computing, which occurs through integrating mobile and cloud computing. Much advancement in information and communication technology has recently occurred, changing the globe; the world is fast becoming a tiny neighborhood. Cloud computing, wireless communications (3G/4G/5G), and the competitive mobile device market are examples of these technologies **(Tawalbeh, L. et al., 2016)**.

Mobile devices can provide a set of services that create a more comfortable life and are easy for people. They are incorporated into everyday routines to assist people in a range of activities like determining their location, managing their time, processing images, booking hotels, selling and purchasing online, and keeping linked with

others. Other mobile applications can assist people in learning and improving their education **(Ali Ahmed, H. et al., 2018)**.

The mobility characteristic of mobile devices as Figure 1 has revolutionized the way people across the world use various technologies. There is no longer any requirement for them to remain at their workplace to complete their work or everyday routines. Users can move to a variety of places depending on a variety of criteria, including efficiency, a steady and fast internet connection, and data privacy issues, which mandate the need to safeguard users' data from unauthorized exposure, particularly via insecure wireless channels. All of these advantages of mobile devices, as well as their incorporation into people's lives, hasten the transition to greener and smarter cities. Mobile devices provide people with E-learning service which is a kind of distance learning that uses modern multimedia technologies and the Internet to enable one or more people to learn from their computers. Text, graphics, music, picture, animation, and even video can all be utilized in multimedia products **(Al-Adwan, A. et al., 2018)**.

Figure 1. Showing the mobility features.

7. Cloud Computing

Another new technology is cloud computing (CC) as shown in Figure 2, which provides access to stored information from anywhere and may be utilized in various companies or by people to improve productivity and performance while reducing cost and complexity. The concept of mobile cloud computing was coined shortly after the notion of cloud computing was established in mid-2007. The National Institute of Standards and Technology (NIST) describes cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and launched with minimal management effort or service provider interaction". It has three service levels. Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) are all examples of cloud computing (IaaS) **(Lee, C.et al., 2020)**. For users to compute on, the cloud provides a strong processing core and a vast storage area with adjustable computing resources. Could service is defined as on-demand, elastic, assured quality of service, and pay-per-use. Cloud computing is propelling a new class of apps known as MCC applications **(Ataie, E. et al., 2019)**.

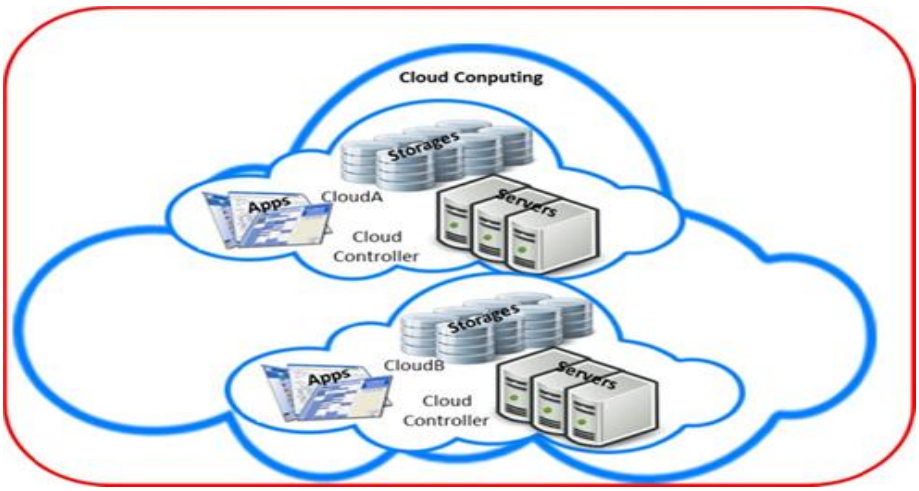

Figure 2. Showing the cloud computing concept.

7.1.Cloud Computing Features

According to **(Chaufournier, L. et al., 2019)** when compared to traditional computing paradigms, cloud computing introduces a slew of new capabilities. These features are as follow:

- Scalability and On-Demand Services - Cloud computing offers customers on-demand resources and services. The resources are scalable across many data Centres.
- Quality of Service (QoS) - Cloud computing may provide QoS in concepts of hardware or CPU performance, capability, and large memory to users.
- User-Centric Interface - Cloud interfaces are location agnostic and may be accessible using well-known interfaces such as Web services and Web browsers.
- Autonomous System - Cloud computing systems are self-contained systems that are openly maintained by users. However, based on the demands of the user, software and data within clouds can be automatically changed and condensed to a basic platform.
- Cost - Cloud computing does not necessitate an initial investment. There is no need for a capital outlay. Users can pay for and consume services and capacity as they require them.

7.2. Types of Cloud Computing Deployment Models in Education:

According to **(Sultana, J. 2019)** , there are four types of Cloud Computing Deployment Models in Education, which are:

1. Public Cloud

The term "public cloud" refers to a cloud that enables students/users to readily access the system and its services. IBM, Google, Amazon, Microsoft, and others are examples of firms that provide public cloud services. Any student can use this sort of cloud service freely and simply. Because public cloud suppliers often provide stronger access control methods for their beneficiary of the educational process, using a public cloud does not imply that the user's data is globally visible to other individuals. Although it has fewer privacy concerns, this sort of cloud is more important to educational corporations.

2. Private Cloud

Unlike the public cloud, which is open to the public, a private cloud can be held by a single corporation or organization. As a result, it is sometimes referred to as a corporate cloud or an internal cloud. The internal cloud means the ability to access systems and services within given limits or an educational organization. Only authorized students\users to have access to the private cloud, giving the company more control over data and security. Only educational enterprises with dynamic, essential, secure, management-demand-based requirements should possess private clouds.

3. Community Cloud

Various groups with similar backgrounds share their infrastructure and resources in the community cloud. Banks, government agencies, commercial businesses, and educational organizations are examples of such institutions. Students\Members of this community cloud enjoy the same level of privacy, performance, and security.

4. Hybrid Cloud

A hybrid cloud is a blend of public and private clouds. They can continue to exist as separate entities. This sort of cloud is utilized by large businesses where a single cloud deployment may not be adequate to fulfil their workload. Jobs that are not as essential, such as development and test workloads can be performed in the public cloud, whereas crucial and sensitive tasks, such as organization data processing, are performed in the private cloud. As a result, hybrid cloud hosting may reap the benefits of both deployment strategies and the community deployment approach.

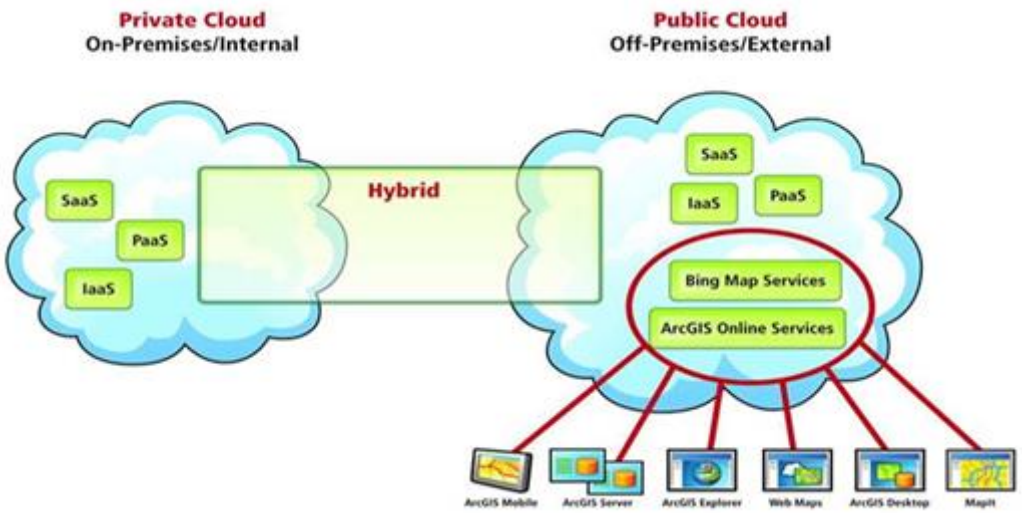

Figure 3. Showing the three types of Cloud Computing Deployment Models.

8. Mobile Cloud Computing

Mobile Cloud Computing is the outcome of integrating mobile devices like smart phones, smart tablets, smart watches and portable computers with cloud computing to access the infinite services given by the cloud via the mobile device. Cloud computing is based on the sharing of a collection of network-connected resources to maximize usage, resulting in lower administration and capital expenses. Mobile Cloud Computing (MCC) will help a wide range of industries, including cloud-learning systems. At its most basic, mobile cloud computing (MCC) relates to an architecture in which both data storage and data processing occur outside the mobile device. Someone may also characterize MCC as a mix of mobile web and cloud computing, which is the most common tool for mobile users to connect to Internet apps and services **(Singh, J. et al., 2019)**.

MCC extends the capabilities and advantages of mobile devices while overcoming their restrictions, so users will no longer be concerned about memory capacity and necessary CPU power to execute heavy applications that cost a significant amount of energy and require greater memory. Multimedia apps, for example, which are among the most popular applications on today's mobile devices, include sharing and producing picture and video data. These applications need powerful processing capabilities, massive storage capacity, and perhaps enhanced security protection, all of which pose problems for mobile devices. Mobile cloud computing addresses these difficulties by storing big multimedia files in the cloud, which are then made available to mobile users as needed, which leads to improvement.Such as "Microsoft" and "Google," provide students and professors at educational organizations with free services such as email, contact lists, calendars, document storage, document creation and sharing, and the ability to build websites **(Jun, L. et al., 2019)**.

8.1. MCC Architecture

In Fig. 4, mobile devices are linked to mobile networks via base stations (e.g., base transceiver station (BTS), access point, or satellite), which create and regulate the connections (air links) and implementation between networks and mobile devices. Mobile users' demands and information (such as ID and location) are sent to central processors, which are linked to servers that introduce mobile network services.Based upon that home agent (HA) and subscriber data kept in databases, mobile network providers can introduce services to mobile users as AAA (for authentication, authorization, and accounting). Following that, the subscribers' queries are sent to a cloud through the Internet. Cloud controllers execute the requests in the cloud to offer the relevant cloud services to mobile users. These systems are designed using utility computing, virtualization, and service-oriented architecture ideas (e.g., web, application, and database servers) **(Suryono, R. et al., 2019)**.

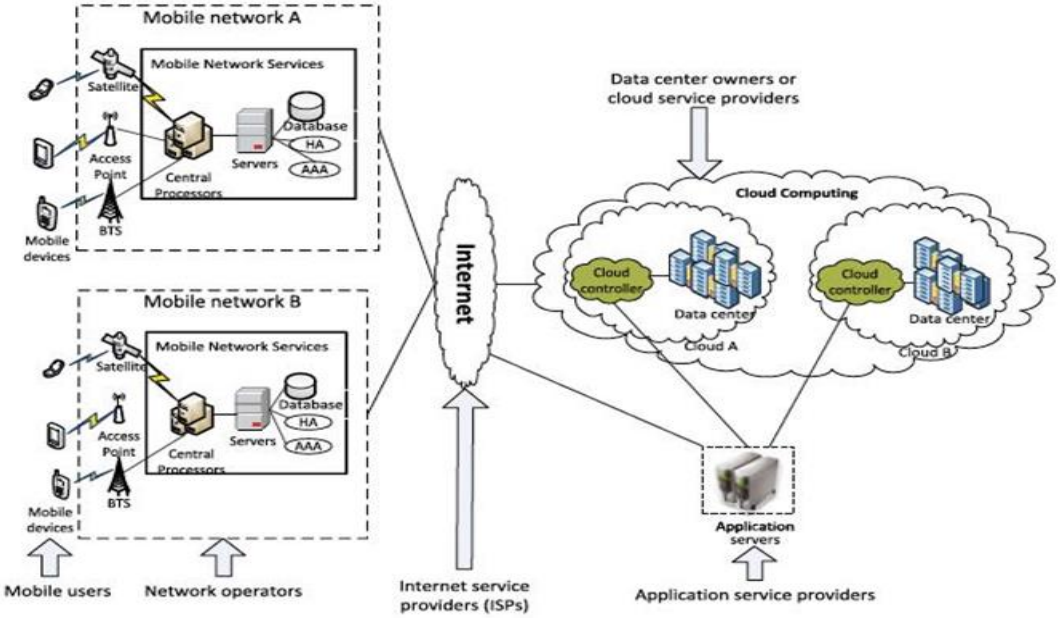

Figure 4. Showing the Mobile Cloud Computing (MCC) architecture.

9. The Concept of the Educational Process

Njenga, K., Garg, L., Bhardwaj, A., Prakash, V., &Bawa, S. (2019) stated that the educational process was described as the provision of education services to many beneficiary students, who are separated into several groups, by a group of expert experts and professors, using various means and instruments, all of which are unique in their character and components. It is established and scheduled in advance. When one examines the education process through the system input, one discovers that the education process inputs comprise various resources, which may be described in the outline given in Figure (5).

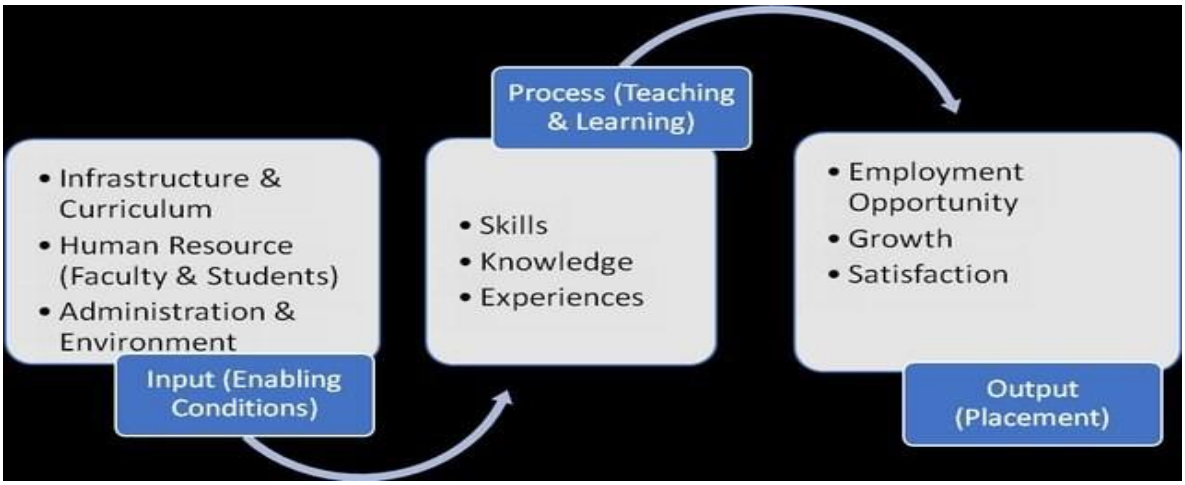

Figure 5. Showing the education processing

According to **(Rajabion, L. et al. 2019)** the uses of cloud computing, and its applications, which are used in distance education:

- **Software as a service application:** In this case, the instructor does not need to purchase equipment or software, download, update, or remove it because all that is necessary is to subscribe to the service and access it through an Internet browser.

- **Platform as a service (PaaS):** This is a collection of software and product development tools that are hosted on the "platform as a service" infrastructure.
- **Infrastructure as a service:** It broadens the computing environment by allowing the instructor to control more infrastructure components. Students get access to the Data Funding Service Centre's virtual server by supporting the infrastructure. The software, comprising operating systems and distribution, may be deployed and operated by the instructor.

10. Mobile Cloud Computing Infrastructure and Schooling Big Data

There are several mobile cloud computing infrastructures for various purposes, including learning apps. Traditional infrastructures comprise a collection of cloud resources that are accessed remotely by students using various devices over the Internet.The widespread use of mobile apps in virtually every aspect of people's lives has led to large volumes of data that must be processed and analyzed quickly in less time and with less power complexity, causing the development of new competitive MCC models.These models may be used in a variety of settings, including educational institutions, where massive volumes of data must be kept and analyzed **(Marozzo, F., &Bessi, A. 2017).**

Big Data is a relatively new term that refers to massive volumes of data that have been collected or stored as a result of revolutionary advancements in various technologies such as cloud computing, the growth of social media, and wireless communication technologies. It is characterized by the amount of the data (volume), the types of data based on the producing source (variety), and the time-frequency with which the data is generated (velocity); every, minute, day, month, or decade. Other of this massive quantity of data could be handled offline, but some applications, such as learning apps, require real-time processing of this data, since data analysis and making the appropriate judgments might be the difference between a student's success or failure **(Belcastro, L. et al. 2018)**.

10.1. Mobile Cloud Computing Potentials in Education System

Many technologies that were previously expensive or unavailable are now becoming free to anyone with a web browser. This is true for all websites, blogs, video sharing, music sharing, social sharing, collaboration software, editing/presentation and publishing, and computing platforms in the “cloud”. Students are already using many of these technologies in their personal lives. In the professional world, the trend of discovering and using technologies in our personal life is called “consumerization”. This means we should demand and consume the required services. Our education system should take advantage of this same trend, which will both enrich our student’s technology-enabled education, and importantly, reduce the budget impact in academic institutions. Educational organization management should identify and leverage emerging technologies that are cost-effective b, and strive for the broadest workable and fair access to technology for students and teaching staff. The need for hardware and software isn’t being eliminated, but it is shifting from being on-premises to being in the cloud. All that is needed is a cheap access device and a web browser, broadband in the schools, perhaps wireless hotspots **(Gurung, R. et al. 2016).**

(Rogers, K., & Michelle, P. 2017) indicated that there are several benefits of using MCC in education system. Most educational groups are not financially stable. MCC is a good option for them to reduce IT infrastructure expenditures. That the end-user does not need any special knowledge about app installation in the MCC or the hardware is a key advantage of the MCC. These things are maintained by the service provider; thus, the institute does not require any IT personnel to teach the basics of app usage. Because the future world will be technologically oriented, including technology in the learning session will enable a student to be completely prepared for the future world **(Al-Malah, D. et al. 2021).** The benefits are:

- Low-Cost and Free Technology: There has been a tremendous increase in low-cost and free technology for social interaction, publishing, collaborating, editing, content production, computing, and so on.
- Content Growth: The amount of content accessible to a wide audience is increasing at an exponential pace, and anybody may participate.
- Collaboration: As technology advances, people's capacity to communicate and work with others improves.
- Back-up: One of the most important functions of the Cloud is that it automatically saves content, making it impossible to lose or destroy any vital data. This implies that even if a user's machine fails, all data and documents will be stored, secure, and available.
- Storage: The Cloud system allows users to save any type of material or data, such as apps, music, e-books, papers, photographs, and so on.

- Accessibility: Any data saved in the Cloud may be quickly retrieved from any device, such as a mobile, smart phone, tablet, laptop or desktop.
- Collaboration: The Cloud allows several people to edit and work on a document at the same time, as well as simple sharing and transmission of ideas. This tool allows you to maximize group projects and collaborative lesson plans for both students and teachers.
- Resource and Time Conscious: With the availability of information online, instructors no longer need to spend time duplicating or printing lengthy papers or lesson plans. Students may now obtain assignments, homework, notes, and other components online.
- Assignments: Cloud enables professors to publish assignments online. These assignments can be accessed by students, completed, and saved in a folder to be reviewed later. This implies no spending time at the start of class turning in papers.
- No more pricey textbooks: Everyone understands how expensive textbooks are. Including tuition costs, the cost of books has surpassed the cost of almost everything else in education. As a consequence, most students are hesitant to purchase textbooks. Cloud-based books can alleviate this problem, and they are also less expensive than traditional books.
- No more out-of-date learning materials: The materials in textbooks are out-of-date, which is a major issue for pupils. Cloud-based resources, on the other hand, are always up-to-date and easy to upgrade, ensuring that students always have access to the most recent learning materials.
- No costly hardware required: Cloud-based software may be simply operated on Internet browsers, and most of them are also suitable with tablet or mobile devices. This implies that students and schools may access cloud-based services via mobile devices, eliminating the need to purchase an expensive laptop.
- No costly software necessary: The main benefit of cloud computing is the software as a service concept. Most software is either free or offered on a low-cost subscription basis, allowing students to readily utilize that program at a minimal cost.
- Reaching more and more diverse learners: Cloud computing is revealing a world of new possibilities for pupils, especially those who are underserved by conventional teaching techniques.

10. 2. Mobile Cloud Computing Applications Challenges in Education

According to **(Juma, M., &Tjahyanto, A. 2019)**, Mobile Cloud Computing Applications Challenges in Education are:

- **Performance**

The main performance issue maybe for some demanding transaction-oriented and other data-intensive applications, where cloud computing may not provide enough performance. Consumers that are far away from cloud providers may face significant latency and delays.

I.afety and Privacy

For cloud computing, businesses are still concerned about security. When information and key IT resources are beyond the firewall, users are concerned about their susceptibility to assaults.

II.Control

Because cloud computing allows for platform management, many IT wings or departments are worried. Platforms for individual organizations and their business operations are not generally designed by cloud computing providers.

III.Bandwidth Fees

Companies that use cloud computing can save money on hardware and software, but they may have to pay more for network bandwidth. Bandwidth costs may be modest for smaller Internet-based apps that are not data-intensive, but they may rise considerably for data-intensive applications.

IV.Reliability

Cloud computing is still not always reliable around the clock. There have been reports of cloud computing services being down for a few hours. Expect more cloud computing providers, greater services, defined standards, and best practices in the present and future.

Table 1: Challenges of Cloud Computing

Security	The key concern is data privacy: Users do not Know where their data is being stored and they have no control of it.
Interoperability	A universal standards about cloud have not yet been defined, resulting in a significant risk of vendor lock –in
Control	The quality of control that the cloud user has over the cloud environment varies

	greatly.
Performance	All access to the cloud is done via the internet, introducing latency into each communication between the environment and the user.
Reliability	Many existing cloud infrastructures leverage commodity hardware that is known to fail unexpectedly.
Platform or language Specificity	Some cloud environments provide support for specific platforms and languages only.

From above the researcher can summarize the benefits and challenges of using Mobile Cloud Computing in education.

Table 2. Benefits and Challenges of Using Cloud Computing in Education

BENEFITS	CHALLENGES
ACCESS TO APPLICATIONS FROM ANYWHERE	Not all applications run in cloud
SUPPORT FOR TEACHING AND LEARNING	Risks related to data protection and security and accounts management
CLOUD COMPUTING CAN BRING COST SAVINGS, BUT IT IS NOT FREE	Education support
24-HOUR ACCESS TO INFRASTRUCTURE AND CONTENT	Restricted by Education support policies, intellectual property
OPENING TO ADVANCED RESEARCH AND BUSINESS ENVIRONMENT	The key concerns are security and data privacy
INCREASED OPENNESS OF STUDENTS TO NEW TECHNOLOGIES	Distrust regarding new technologies
INCREASING FUNCTIONAL CAPABILITIES	Schools can determine how much and what gets served over the cloud
OPPORTUNITY TO CONCENTRATE MORE ON TEACHING AND RESEARCH ACTIVITIES	Lack of cooperative learning and socially oriented theories
HIGH PERFORMANCE	Speed/lack of Internet can affect work
IT CENTRALIZES AND CONTROLS INFRASTRUCTURE AND DATA, AND ENSURES BACKUP	Security needs to be managed with cloud, as with any other computing strategy

11. Related Studies

Mobile cloud learning, a hybrid of mobile learning and cloud computing, is a relatively new idea with significant potential for future growth and delivery in the education industry. Cloud computing assists mobile learning in overcoming mobile computing challenges. So, there are many studies focused on this area such as:

1- **(Islam, M., Abul Kasem, F., & Zaman Khan, S. 2017)**, explored how Bangladesh might profit from cloud computing in education, as well as the hurdles involved, and then provided several case studies and success storiesIn (2011-2012), National University Bangladesh made admission test result for more than 400,000 students on cloud computing, and successfully applied the cloud infrastructure by low cost. Bangladesh government made an expensive and long plan for distributing computers to schools. By using MCC a $100 laptop and internet is sufficient for the students.

2- (Wang, M., Chen, Y., & Khan, M. 2014), investigated the impact of cloud computing on traditional mobile learning. Khalifa University did a case study on the use of Moodle in the cloud via mobile learning. They found benefits to use Moodle in cloud were low cost, energy and off-campus users can access it via mobile devices. But, some users didn't accept this technology. Because it hadn't support their active communications and collaborations. A survey of students in a UAE university shows that about 80% of learners use laptops, mobile phones, or both regularly connected with internet for their learning purposes. Because they want free and comfortable learning environments.

3- **(Agrawal, S. 2021)**, investigates the usefulness of cloud computing in educational contexts. It also discusses a few applications, including cloud rendering, gamification, and collaborative e-learning tools. Finally, a few obstacles have been provided. She presented a study for 170 IT students in a private Malaysian university were tested for one trimester to assess their experience of using Cloud e-learning applications. When less restriction is placed on team discussions, they explore concepts and monitor their individual progress on their own. MCC applications break ice, build strong relations, collaborations, flexible and sharing information between them.

3- **(Sultana, J. 2019)** investigated the characteristics that influence the utilization of the Mobile Cloud Learning (MCL) platform Blackboard. Given MCL, the Unified Theory of Acceptance and Use of Technology (UTAUT) model was applied and changed with two additional factors, namely mobility and self-management learning, to better characterize user behavior. A structured questionnaire survey was used to get quantitative data for analysis. To evaluate the data and test the hypotheses of this study, structural equation modeling (SEM) was employed. Performance expectancy, effort expectancy, and self-management learning are demonstrated to be major variables in the result. By examining the major aspects and understanding the user, Blackboard platform providers and users may profit from the findings of this study.

4- **(Al-Hunaiyyan, A., Alhajri, R., &Bimba, A. 2021)** researched the Efficient Integrated Distance and Blended Learning Model and How to Minimize COVID-19's Impact on Education. Using a representative sample of 4,024 instructors and students from various Kuwaiti educational institutions. According to the findings, respondents were modestly supportive of e-learning adoption, with the majority recognizing its benefits. Respondents do, however, emphasize the need for continued improvement in the technological competencies necessary to manage the planned e-learning programs, as well as a variety of difficulties that may hinder e-learning.

5- **(Alfadda, H., & Mahdi, H. 2021)**, The study intends to investigate the relationship between TAM factors and the usage of the Zoom application in language learning, aswell as how gender and experience impact the use of technology. The technology acceptance model (TAM) is used in the study to get an insight into user attitudes to the technology used for language acquisition. This study's participants are 75 undergraduate English-as-a-foreign-language students who studied for their courses online during the COVID-19 epidemic. The study's findings show a considerable positive association between real Zoom use and students' views and behavioral intentions. There is also a favorable relationship between computer self-efficacy and other characteristics (i.e. PU, actual use, PEU, attitude, and behavioral intention).

6- **(Handayani, D. 2021)** determined the impact of applying the Project Based Learning (PjBL) model with the help of WhatsApp Group (WAG) and Zoom sessions on student learning outcomes and student responses to the applications employed. The sample comprised 24 students from the State University of Bengkulu. The instruments utilized in this study include learning outcomes exams and response questionnaires to learning apps. The results revealed that using the PjBL approach, aided by the WhatsApp and Zoom apps, resulted in an improvement in student learning outcomes.

7- **(Bawanti, P., &Arifani, Y. 2021)** investigated the influence of utilizing the Zoom application on mobile phones on students' perceptions of speaking abilities and attitudes during online learning. This study approach employs a survey design and collects data by distributing 12 questionnaire items to students using Google form. The participants are primary school pupils from Thailand's Ban LoeiwangsaiSchool, who are divided into three categories: grade 4, grade 5, and grade 6. According to the findings of this study, the strategic design of online learning on the usage of the Zoom application influences students' performance in autonomous learning and time management. This has an influence on the competence and understanding of pupils studying English, particularly in terms of speaking abilities.

8- **(Gnana Gandhi, S., & . J, J. 2021)** highlights different distance teaching and learning programs such as Google classroom, Zoom, and Microsoft Teams. Those are helping students to overcome the lockdown during the Corona pandemic period. The study presented the experience of two groups of students, using these three programs, studying the effect of distance learning and their interaction, and doing assessments required of them via audio and video, as well as text files. The results of the study showed the students' interaction with distance teaching methods and their interest in learning and sharing with their colleagues and teachers.

The present study differs from these studies in investigating Mobile Cloud Computing Applications in Education, Its Potentials, Challenges, and Big Data**.**

12. Study Methodology

12.1. Research Design

This research applied the qualitative and descriptive approach where the data was analyzed which was collected from the prep and secondary students and teachers in four future Schools in Cairo, Egypt. Data were gathered using a qualitative technique, with 150 instructors and 100 students from the prospective schools taking part in data collecting. 250 questionnaires were delivered to instructors and students. According to the study's findings, mobile cloud computing plays a significant role in boosting teaching and learning activities. The research revealed that security issues make up a barrier to the successful deployment of mobile cloud computing applications. The survey discovered that respondents have a basic understanding of mobile cloud computing applications and that they are gaining acceptability in teaching and learning activities.

12.2. Research Sample and Instrument

The research sample was selected under the strong scientific foundations of the field of study in order to fulfil the study's objectives and directions. As a result, prospective schools in Egypt were picked, with three schools serving as study samples (because these schools have human resources capable of accomplishing the present study's field of application), and the questionnaire form was sent to fifteen students in each school. The sample size was forty-five people, divided equally between questioned students and professors, and all dispersed questionnaires were retrieved 100% of the time.

12.3. Data Collection Methods

To carry out this study, both theoretical and practical methods of gathering primary and secondary data were used. To build the theoretical frameworks, secondary data were taken from sources relevant to the research variables, while the field side was concentrated on the primary data obtained via the questionnaire form. It comprised mobile cloud computing components such as physical equipment and systems, operating activities, and services. The student and teacher dimensions were used to represent the distant education factors.

12.4. Data Analysis, Results and Discussion

The following scales were utilized to conduct the research: Y (Yes), N (No), SA (Strongly Agree), A (Agree), D (Disagree), and SD (Strongly Disagree). Two hundred and fifty (250) questionnaires were given to students and instructors at the prospective schools, with an average response rate of two hundred and twenty (220). The scales used to collect responses were coded: Y and SA = 4, N and A = 3, D = 2, and SD = 1. The table below represents the average coded from the replies received.

12.5. Basic Knowledge of Cloud Computing Application in Education

According to the replies in table 3, respondents are familiar with the application of mobile cloud computing in education, which facilitates teaching and learning activities by exchanging information over the internet. These findings were corroborated by **(A. M. Ibrahim, F., &Hemayed, E. 2019)** study, which found that education collaboration platforms facilitated knowledge exchange both asynchronously through email and in real-time and this leads to improving education. Also, the study's findings are summarized in **(Amron, M., Ibrahim, R., &Chuprat, S. 2017)**, who stress that knowledge exchange occurs amongst experts in various nations via an internet connection.

Table 3: Average of coded total for basic knowledge

Basic Knowledge of mobile Cloud Computing	Y	N	Coded Total	Total Frequency Observed	Averageof Coded Total
Online assessment and evaluation of learning activities is a mobile cloud computing application in education.	156	3	633	159	3.98

Mobile Cloud computing enables information exchange through the internet.	135	19	597	154	3.88
Using cloud computing in education improves teaching and learning activities.	150	3	609	153	3.98

12.6. Benefits of Mobile Cloud Computing Adoption in education System

According to the average coded total in table 4, the research showed that the replies of the respondents are significant. Using mobile cloud computing applications is critical in improving the education system. These findings are consistent with the findings of **(Lakshmi &Dhanalakshmi, G. 2016)** show that mobile cloud computing allows for daily backups of documents, which lowers (security challenge and catastrophe) and therefore saves operation costs. Mobile Cloud computing, according to their research, improves storage, increases productivity, and minimizes IT administration labor.

Discovered that mobile cloud computing technology allows for the sharing of tasks among many machines that may be dispersed across wide geographical areas **(Alshamrani, S. 2018)**. He found that mobile cloud computing services benefits such as easy maintenance of computing infrastructure, increased availability and integrity of data, applications, and research materials, improved data storage capacity, delivery of study materials, and the potential for departments to customize images independently.

Moreover, their research revealed that future schools is utilizing the benefits of mobile cloud computing to gain cost savings, energy efficiency, and dynamic scalability, which falls under the purview of **(Al-Samarraie, H., & Saeed, N. 2018)**. Similarly, **(He, J., & Zhang, D. 2017)** demonstrated that mobile cloud computing delivers a more genuine version of software at a lower cost. Hefound that mobile cloud computing allows educational organizations to save money while also taking advantage of developing technologies in research he performed. According to **(Hu, L. 2021)** mobile cloud computing provided a significant benefit due to its flexibility and pay-per-use pricing structure operation.Recent studies have clearly demonstrated that mobile cloud computing provides several benefits in education systems, despite the fact that the problems connected with it cannot be ignored.

Table 4: Average of coded total benefits of mobile cloud computing application in education system

Benefitsof mobile CloudComputing Application in education System	**SA**	**A**	**D**	**SD**	**Coded Total**	**Total Observed Frequency**	**Average of Coded Total**
Mobile Cloud computing is inexpensive.	320	315	52	8	695	219	3.17
MobileCloudcomputinghas a large computational capacity (effective).	336	381	30	5	752	231	3.26
It has a worldwide scope (deliver the right amount of IT resources)	320	351	56	4	731	229	3.19
The use of cloud computing increases learning productivity.	316	345	26	8	695	215	3.23
It promotes high performance (it Reduces network latency for applications)	312	315	64	0	691	215	3.21

It promotes security tolerance (some cloud providers offer a good level of data protection)	292	396	52	4	744	235	3.17
It improves teamwork in learning.	300	333	36	11	680	215	3.16
Cloud computing facilitates data portability (users may access their data from any location with an internet connection).	448	255	42	3	748	221	3.38
Computing in the cloud keep data storage limitless	388	321	46	11	766	238	3.22
It encourages worldwide information exchange.	300	264	22	8	594	182	3.26
It allows for the effective monitoring and control of learning processes.	264	336	66	5	671	216	3.11

12.7. Challenges of Mobile Cloud Computing Application in Education System

The responses in table 5 demonstrate that the average coded total is substantial, and as a result, the mobile cloud computing application has several problems that must be solved for good acceptance. These issues include service delay/denial, compatibility issues, ICT infrastructure, a lack of trained staff, a breach of confidence, a weak policy, a managerial issue, confidentiality, integrity, and user access. These findings support **(V,S., & A L, S. 2015)** claim that there are insufficient IT resources to evaluate a new application before putting it into production.

According to **(Kaur, K., Payal, M., & Parihar, S. 2018)** finding, mobile cloud computing has five key challenges: security, interoperability, availability, performance, and data migration, as seen in the results above. They also showed that latency and networked throughout impact the education system, which is consistent with the findings above. This study discovered that while the problems of mobile cloud computing cannot be fully avoided, they may be efficiently handled.

Table 5: Average coded total of challenges of mobile cloud computing application in education system

Challenges of Mobile CloudComputing Application in Education System	**SA**	**A**	**D**	**SD**	**Coded Total**	**Total Observed Frequency**	**Average of Coded Total**
Insufficient ICT infrastructure (e.g. internet capacity and others).	404	159	14	0	577	161	3.58
Inadequate IT personnel training.	248	225	48	1	522	162	3.22
Inadequate policy for managing IT security concerns between cloud providers and their clients.	216	162	44	1	423	131	3.23
Breach of trust between the client and the cloud service providers.	156	228	60	4	448	149	3.01
Management's casual approach toward implementing an e-learning system.	204	225	50	0	479	151	3.17

Inadequate client information access	132	258	76	6	472	163	2.90
Uncertainty about the confidentiality and integrity of data	180	243	58	5	486	160	3.04
Inadequate policies to address security problems	204	192	64	5	465	152	3.06
Problems with cloud compatibility/upgrade (replacement of exist in IT infrastructure to make system compatible on cloud)	224	267	48	1	540	170	3.18
Delay or denial of service as a result of a technological bottleneck.	204	210	70	1	485	157	3.09

12.8. Trends towards Adopting of mobile Cloud Computing Application

The data in table 6 below revealed that there is a substantial trend toward cloud computing use. Many recent studies **(Hu, L. 2021)**, **(V,S., & A L, S. 2015), (Kaur, K., Payal, M., & Parihar, S. 2018)** & (**Atiewi, S., Abuhussein, A., & Saleh, M. 2018)** support the aforementioned conclusions. As a result, cloud computing applications are becoming increasingly popular in teaching and learning activities.

Table 6: Average of coded total trends towards adopting of mobile cloud computing

Trends towards Adopting of Mobile Cloud Computing	SA	A	D	SD	Coded Total	Total Observed Frequency	Average of Coded Total
Mobile cloud computing is becoming more popular in educational settings.	344	198	22	0	564	163	3.46
Educators and students are on board with mobile cloud computing.	148	255	56	1	460	151	3.05
Educators and students are particularly interested in mobile cloud computing.	128	282	42	1	453	148	3.06

This study looks into the uptake of mobile cloud computing in the educational setting. It was discovered that mobile cloud computing applications may significantly improve teaching and learning activities. Moreover, the study revealed that there are security problems that are impeding the successful deployment of mobile cloud computing applications. Furthermore, the survey discovered respondents had a basic understanding of cloud computing applications, and that the trends in teaching and learning activities are shifting toward cloud computing applications.

13. CASE STUDY AND SUCCESS STORY

Because of the flare-up of corona virus widespread (COVID-19) in later times, nearly all countries have been influenced extremely, affecting learning progress in the world everywhere. Many schools, colleges, and work institutions colleges are beneath lockdown or have been forced to give online learning. To face the challenges caused by COVD-19, it is necessary for the instructional must manage the capacity of producing high-quality in the virtual environment of teaching departments. Here, cloud computing gives an amazing stage for teachers to improve their instruction hones and efficiency. Cloud computing presents an ideal opportunity because it doesn't spare costs, but controls, Because of the synchronous utilization of infrastructure by a few

partners for educating, learning, and inquiries about. This is a brief study that investigates the pertinence of Mobile cloud computing for 464 trainee employees in El- Kenouz Training Centre in Qena Water and Wastewater Company, Egypt.

It, too, presents the effect of Zoom cloud meeting applications such as a Mobile cloud computing application on increasing the number of trainees by low cost and saving time in one of the work institutions.

13.1. Zoom Application

Recently, the Zoom application has developed as an elective application utilized by most individuals within the world of instruction. Data from the official site, https://zoom.us/about. Zoom is the pioneer in present-day enterprise video communications, with a simple, solid cloud stage for video and sound conferencing, collaboration, chat, and webinars over portable devices, desktops, phones, and room frameworks. Zoom Rooms are used for conferences, groups, and preparing rooms, official workplaces, and classrooms. Established by Eric S. Yuan in 2011, Zoom makes a difference business and organizations bring their groups together in a frictionless environment to induce more done. Zoom could be a freely exchanged company on Nasdaq (ticker: ZM) and headquartered in San Jose, California **(Zulherman, et al. 2021)**.

Zoom Cloud Meeting (ZCM) is a web application that can use it for mobile or desktop based on cloud technology. Users can connect by visual video, voice, or both during live chats. Zoom Application has its Centre usefulness. You're one-to-one gatherings, video gathering conferences, and swapping of screens. Worldwide, teachers have started to use cloud technology-based programs or "just-in-time" directions approaches to a degree never of time recently seen. A lot of cloud applications can be used with mobile learning cases. There are two cloud capacity arrangements, a secluded stage for the great choice and sending of teachers portable learning applications and a flexible contextualization arrangement for portable learners to empower a customized learning environment. The system gives an adaptable approach which underpins instructors and speakers in planning and consequently sends portable applications to empower learners to create them have portable device-supporting m-learning activities.ZCM conveys online learning like real classes without space and time. Users are given feelings as in a real lesson. The shortcoming of ZCM lies within the diverse forms of the premium and non-premium forms. Clients that use the free version have a 40-minute chance at each session, at that point take off and re-enter the room and constrain 100 users to each assembly for complimentary adaptation.ZCM may be a friendly and easy-to-use application, making it less demanding for clients, too effortlessly. It also presents Guide to Educating to help users on how to use the application easily. Concurring to a few data, ZCM is a hazard in terms of client protection security, but the improvement team has reacted to and redressed it. ZCM has a good feature that users learn at the same time. Even though this application was designed sometime recently, the widespread circumstance the utilization of this instrument expanded amid this isolated period since this COVID-19 pandemic was widespread **(Alfadda, H., & Mahdi, H. 2021).**

13.2. Place, Time, and Subject Study

The study was conducted at El- Kenouz Training Centre in Qena Water and Wastewater Company, Egypt. In the training year (July 2020- June 2021), we study the impact of first applying online training courses for trainee employees during the closed of the Centre in the COVID-19 pandemic. The learning process was done using the Zoom cloud meeting application for mobile and desktop devices. With the subjects, as many as 464 trainee employees who took the online different courses to have experience in their job.

13.3. Data Analysis and results

The COVID-19 pandemic causes work institutions closures across the nation. By March 2020, many countries all over the world closed work institutions for some months. Although of closing, some Institutions struggled to ensure continuity in education for employees, by using online learning. We noticed a successful case by El- Kenouz Training Centre to train its employees in this hard period by using online courses for the first time. This study for beneficiaries was 464, with 186 men (40%) and 278 women (60%). Their age was between 30 and 50 years old. The study was applied to pay attention to the need to invest human resources as resources that can achieve an addition in the Mobile cloud computing for distance education.

The main goal was to implement 12 training programs to train approximately 240 remote employees from Qena and employees in drinking water companies in other governorates, in addition to the training plan, which includes the implementation of 119 training programs to train 1190 employees inside the El Kenouz training Centre after the closure period ends.

During the training year, the Zoom application was used for distance training and to benefit the largest number of employees inside and outside Qena during and after the closure period. The majority (90%) of employees used Zoom mobile applications, compared to a few of them (10%) used the desktop application. At

the end of the training year, the advantages and disadvantages of using e-learning to train employees were monitored. The positives were more important than the challenges. Most of the employees expressed their happiness with using the Zoom application. They also discovered that they can use the Zoom application to learn through online training courses easily.

We noted the results of this study and the effect of using online learning technology, which were as follows:

1- Increasing by 10% of the planned training courses.
2- Increasing by 11% of the planned training courses were done remotely.
3- Increase partnerships with other training Centers that effect of increasing unplanned remote training courses increased by 85%, but it meets the trainees' need.
4- Increasing the number of trainees from Qena Co. to 31% and from other co. to 33%.
5- Saving from the training budget.

The positives for this study were promising. A big number of these employees have internet connections and modern devices, and with the help of these, they can access online training courses. Online training saves time for employees and keeps them in their cities, without important moving to capital cities to attend more courses. They were able to easily communicate through writing or speaking using this application and collaborate effectively with mates. It makes sharing courses between employees more easily, and they can save backup for it. They can also meet individually with instructors to discuss. Also, sessions can be recorded for studying later.

There were some Challenges. Few employees had a problem finding a lack of quiet environment for participation. Some of them also couldn't have availability for connecting internet service. There were found difficulties of typical technical include low Internet bandwidth, outdated hardware that did not support install Zoom application and use it, or limited webcams and/or microphones.

Even though the fact that cloud computing offers benefits for progressing the effectiveness, taking a toll and comfort for educational institutions, it does not exist without a few impediments. The most challenging of cloud computing is the hazard related to information security, security, and holding its integrity.

14. Recommendations

1- The researcher proposes offering physical cloud devices since it eases certain maintenance responsibilities, a development that supports storing lectures and setting up sessions that contain all the capabilities accessible for the user to read the educational files.
2- The researcher stresses the introduction and activation of the cloud computing database system, which allows for collaborative work among users groups and the potential of deletion and change.
3- According to the study, activating the cloud operating system and cloud apps results in high flexibility in working with Internet browsers without issues.
4- The researcher shows that cloud computing facilitates structured cooperation in e-learning by both students and professors.
5- The researcher considers raising the cloud computing variables, since an increase of one unit leads to an increase in the proportion of e-learning via the influence of cloud computing dimensions.
6- The researcher underlines the need of creating a free software platform for cloud computing services to be employed in educational settings.
7- The researcher feels that the site should be designed to meet any future demands that may arise.
8- The researcher considers the need of researching the infrastructure required for cloud computing applications, as well as the prospect of combining it with e-learning to serve the technical education process.
9- The researcher sees the possibility of creating a paradigm for Internet-based application programs that enable cloud computing services.
a) The researcher sees the prospect of assigning particular storage space to each user and adjusting it as demand grows.
b) The researcher emphasizes the importance of providing a competent person authorized to examine and audit the site, the storage process, and the process of entering the educational site with the presence of a password in order to maintain the confidentiality of information, download lectures, and receive answers to users' questions.
10- Providing all the educational process's necessities via its Internet connection.
11- The usage of cloud computing alleviates the pain felt by educational institutions as a result of a lack of clear digital growth strategies.

12- Reducing the rate of development of a malfunctioning system as a result of not sustaining the strain caused by rising demand for infrastructure capabilities.
13- The desire of technical specialists and personnel at educational institutions to convert to virtual cloud services has grown by 50% in order to improve Internet presence and system confidence.
14- The construction of a specific facility for information systems necessitates large quantities of money and may be an impediment to the advancement of digital education since it reduces thermal emissions and energy consumption.

15. Suggestions

It is time for all educational institutions to include mobile cloud computing into their teaching and learning operations in order to improve information distribution. Because of the difficulties involved with mobile cloud computing applications, the research suggests adopting applications to be combined and implemented for the beneficiary of the educational process in educational systems. Further study in other different educational and work institutions should be conducted for comparison.

16. Conclusion and future work:

Mobile Cloud Computing is a new technology that has provided several benefits to students and teachers in recent years, which become crucial during the COVID-19 pandemic. Despite its difficulties and limits, Mobile Cloud Computing provides a variety of services to the beneficiary of the educational process and lecturers, making the teaching-learning process more efficient, engaging and positively influencing for all. Educational institutions may now reduce their spending on laboratory maintenance by utilizing cloud services. The major goal of this review paper highlights the importance to spread Mobile Cloud Computing technology in education sectors systems in different fields and how it can be both a boon and a challenge. The performance of MCC applications in all of the fields like healthcare, payment and entertainment systems need to improve user interface and usage techniques. These make us think about it as future work.

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