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Cloud Computing in Education: a COVID-19 Perspective

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Abstract: In light of the complete closure that the world has witnessed as a result of the outbreak of the Corona virus (Covid-19) and the great impact on various areas of life and everywhere in the world. The trend towards virtual reality is becoming inevitable. Cloud computing has provided an excellent platform with full services to educational institutions all over the world, as it provides services that help reduce material pressure in light of the economic crises of countries due to the closure of all life facilities, as well as it provides the opportunity to focus more on teaching and scientific research operations instead of focusing on infrastructure Information technology hardware and software. In this research, the stages of cloud computing development and the services and benefits it provides in the field of education were clarified, and it sheds light on the most important advantages and applications provided by service providers that are available to all employees in educational institutions, in addition to shedding some light on the challenges and fears of using computing and its impact on data and its privacy. which prevents organizations from using them and outlines some of the measures service companies have taken to address these concerns.

Keywords: Cloud Computing, Computing Applications in Education, Cloud Computing Challenges.

1 Introduction

In light of the Corona pandemic (Covid-19) , and the restrictions curfew have against the risk of this virus it was started to adopt the remote working in everything. As a result of these changes in life, specifically in education, Activities were carried out on online platforms by the core technology of cloud computing is virtual technology, which virtualizes various components in cloud computing into a resource pool, unified deployment, flexible use, universal virtual platform to extend, migrate and back up various application data.[1] Where virtual classrooms and virtual scientific conferences were implemented. educational institutions are under great pressure in order to continue their humanitarian mission in providing science and knowledge, and they need to find ways to deliver that mission. Cloud computing is the best way to provide services around the world with the tools available and reasonable prices.

Cloud computing plays an ideal role here in reducing IT costs for higher education institutions and cloud computing also provides an excellent platform for educators to improve their teaching practices . The cloud is known as a huge multifaceted system which is made up of numerous end users, cloud service providers, physical hardware machines, internet latency, service brokers, bandwidth, scheduling algorithms, and storage capabilities etc. [2]

History of Cloud Computing

During the 1960s, the initial concepts of time-sharing became popularized via RJE (Remote Job Entry);[3] this terminology was mostly associated with large vendors such as IBM and DEC. Full-time-sharing solutions were available by the early 1970s on such platforms as Multics (on GE hardware), Cambridge CTSS, and the earliest UNIX ports (on DEC hardware). Yet, the "data center" model where users submitted jobs to operators to run on IBM's mainframes was overwhelmingly predominant. in the 1990s, telecommunications companies, who previously offered primarily dedicated point-to-point data circuits, began offering virtual private network (VPN) services with comparable quality of service, but at a lower cost.

In July 2002, Amazon created subsidiary Amazon Web Services, with the goal to "enable developers to build innovative and entrepreneurial applications on their own." In March 2006 Amazon introduced its Simple Storage Service (S3), followed by Elastic Compute Cloud (EC2) in August of the same year.

In April 2008, Google released the beta version of Google App Engine. The App Engine was a PaaS which provided fully maintained infrastructure and a deployment platform for users to create web applications using common languages/technologies

such as Python, Node.js and PHP. The goal was to eliminate the need for some administrative tasks typical of an IaaS model.

In February 2010, Microsoft released Microsoft Azure, which was announced in October 2008. On March 1, 2011, IBM announced the IBM SmartCloud framework to support Smarter Planet and In 2011, Apple announced its own cloud, iCloud. In May 2012, Google Compute Engine was released in preview, before being rolled out into General Availability in December 2013.

In 2019, Linux was the most common OS used on Microsoft Azure. In December 2019, Amazon announced AWS Outposts, which is a fully managed service that extends AWS infrastructure, AWS services, APIs.(Wikipedia-source).

The NIST Definition of Cloud Computing: Cloud computing is 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 released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models. [4] This cloud model promotes availability and is composed of five essential characteristics (On-demand self-service, Broad network access, Resource pooling, Rapid elasticity, Measured Service). [5]

a. On-demand self-service means that a consumer can request and receive access to a service offering, without an administrator or some sort of support staff having to fulfill the request manually.
b. Broad network access : Cloud services hinge on the Internet's infrastructure, and as such provide a ubiquitous availability of services as long as there is an Internet connection.
c. Resource pooling: The combined computational power of large amounts of physical and virtual servers provides a cost-effective pooling of resources.
d. Rapid elasticity: Cloud services leverage on technologies such as server and storage virtualization to rapidly meet the rise and fall of user load and service demand.
e. Measured service is reference to services where the cloud provider measures or monitors the provision of services for various reasons, including billing, effective use of resources.

Cloud Computing Services

- Software as a Service (SaaS): Anytime Anywhere apps. This is currently of most interest in education. [6]. it is delivery model where applications are delivered through the Internet without the need to install or maintain those applications.For example (Google Apps for Education and MicrosoftLive@edu)
- Platform as a Service (PaaS): is a complete development and deployment environment in the cloud. Paas provides application development tools as well as ap-

plication deployment and maintenance services. Examples of PaaS include Microsoft's Azure Services Platform.

- Infrastructure as a Service (IaaS): It helps you avoid the expense and complexity of purchasing and managing servers and other infrastructure for an enterprise data center. It provides basic IT services such as virtual machines, Servers, Storage, Load Balancer, Network and Security.

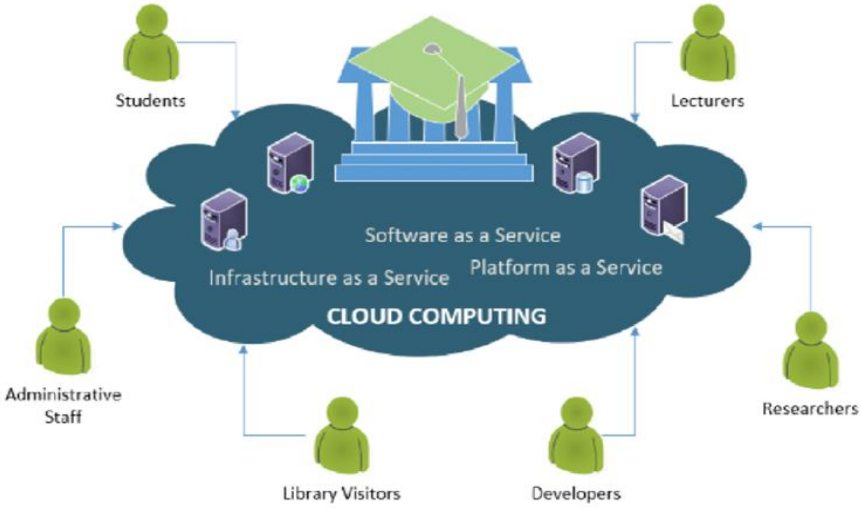

Fig. 1. Cloud Computing Services

Cloud Deployment Models

- Public cloud: The great advantage of a public cloud is its versatility and "pay-as-you-go" structure, which makes the system scalable and low-cost. [7] The complete server infrastructure in Public cloud belongs to Cloud service providers who manage and administer the pool of resources. [8]
- Private cloud: When computing operates within the data center of a corporation, it is private cloud. The business units of the organization are given have exclusive rights to access the infrastructure only within that organization. [2] private clouds offers better control over the customization of infrastructure and can better to address the security and privacy concerns of organizations. [8]
- Hybrid cloud: refers to a mixed computing, storage, and services environment made up of on-premises infrastructure, private cloud services, and a public cloud—such as Amazon Web Services (AWS) [9]
- Community cloud: Community cloud deployment model refers to a cloud infrastructure shared between multiple organizations belonging to a particular community like universities, banks, government organizations, etc. and working on a joint

research or projects. Access to a community cloud infrastructure is restricted to the members of the community who generally have uniform performance, privacy, and security requirements. .[8]

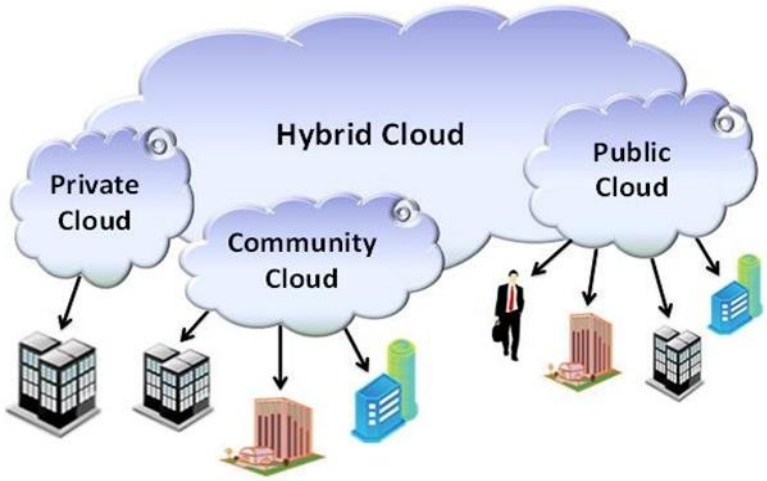

Fig. 2. Cloud Deployment Models

2 Education in cloud Computing

The cloud in education has many advantages. Most educational institutes are not financially strong. Therefore, cloud is a useful option for them to reduce the cost of IT infrastructure. Zheng 2016 study aims to explore the application of cloud computing technology in digital libraries and concludes that cloud computing technology is worth promoting in digital libraries due to its multiple advantages and benefits for the learner, educator and one of the great advantages of the cloud is that the end user does not need any specific knowledge about installing the application in the cloud or the hardware and technology used and its intricacies.[10]

2.1 Top Benefits Of Cloud Computing

Cloud computing is a major shift from the traditional way of educational institutions in light of the separation from the real world and dependence on the virtual world due to the Covid-19 pandemic. Cloud computing offers various advantages as follows:

- Scientific side

Reaching the maximum capacity of information technology, Cloud computing can allow teachers to access the highest efficiency of programs that may attract students to follow their daily lessons, especially for small educational institutions, The ability of cloud computing to create a spirit of collaboration among learners, educators, and others in academia.

- economic side

The institutions that use cloud computing do not need to add hardware and software with higher standards and competencies when growing teachers' numbers, Reduces pressure on the budget of educational institutions

- security side

Security is one of the most important advantages of cloud technology. In the cloud system, the data of each customer is fully partitioned, so that the data does not overlap with others, and therefore the level of data security is very high. The connection to the servers is secured with the highest standards, It is like owning a private server, without paying large amounts of money and protecting against distributed denial attacks. [11]

- Environmental side

It Reduces Greenhouse Gas Emissions. Cloud computing cuts the amount of Greenhouse Gas Emissions (GHG) produced from data centers. A survey conducted by Accenture recently revealed that cloud computing has a substantial effect on carbon emissions; companies can lessen their per-user carbon footprint from between 30% and 90% by switching to cloud computing, many cloud data centers are powered by renewable energy sources. [11]

3 Cloud Computing in Educational institutions

There are many free programs operating within the cloud computing umbrella, which greatly contribute to the continuation of education and learning under the restrictions of the COVID-19 pandemic. These programs make for students and teachers a qualitative shift from traditional education to faster, wider and more accessible e-learning, most notably Google Apps.

3.1 Using cloud computing in conferences

Today, the trend towards holding scientific and educational conferences via the Internet has become higher than expected, and a positive presence from scientific and educational bodies, including professors, researchers and students, with the presence of auxiliary applications, including Microsoft teams, Cisco Webex , Zoom.

- Microsoft teams:

Centralized virtual platform for online meeting and collaboration through Microsoft applications (Word, Excel, and PowerPoint). The number of daily active users in Microsoft Teams nearly doubled last year, increasing from 75 million users in April 2020 to 145 million as of April 2021. Due to the impact of the coronavirus (COVID-19) outbreak and increased practices of social distancing and working from home, Microsoft has seen Significant increases in the daily use of their communication and collaboration platform within a short period of time. Microsoft Teams is part of Microsoft 365, a family of collaboration apps and services launched in July 2017.[12]

- Cisco Webex:

Video conferencing platform for online meetings, screen sharing, and webinars Zoom: Video-communication tool with the ability to share the screen with audience, hold only meetings, and collaborate remotely. [13] Where this application is easy to use as a single application with More content and information in one place and The level of safety is very high.

- Zoom:

Zoom Cloud Meetings are one of the most powerful online meeting solutions available today.Zoom provides communications software that incorporates cloud video conferencing, online meetings, chat, and remote collaboration. by providing innovative communication and collaboration tools that bring people closer together. [14]

3.2 Using cloud computing in teaching

The impact of the Covid-19 epidemic underwent extraordinary changes related to learning media. Previously, almost all learning was done by the teacher through face-to-face in class. transforming face-to-face learning in class to online media is not an easy.

The governments and the private sector have prepared online learning media such as the Zoom, google meeting, Telegram, WhatsApp, YouTube, google drive. [15]

- Google Drive:

Google Drive is unlimited storage at no extra cost and very easy to use. Files can be pushed to Google Drive via command line scripting or through the use of the online GUI upload interface. Files include images, video, audio, and PDF documents. [16]
Google is making things easier for users who prefer saving their documents locally, and not necessarily on the cloud, by adding an offline storage feature to Google Drive.Since Drive launched back in 2012, it's stored trillions of files and has more than 800 million daily users, according to stats given at Google I/O Conference 2017. [17]

- Apple iCloud:

Apple's cloud service is primarily used for online storage, backup, and syncing of mail, contacts, calendar, and more. Offers a cloud-based word processor (Pages), spreadsheets (Numbers), and presentations (Keynote) for use by any iCloud subscriber. [18]

- Google Classroom:

Classroom is a free service for educational institutions, nonprofits, and any user with a personal Google account. Facilitates communication inside and outside the educational institution. And it helps you save time and dispense with traditional means of work, and is easy to set up in creating classrooms, assigning study tasks, communicating and maintaining organization and security, like other services Google Workspace for Education.

- Google Docs:

Students can write their documents for a single program, this service includes programs (Docs Editor-word, Spread Sheets- excel, PowerPoint Presentations).

- Chromebook:

The Chromebook is currently the most popular in the field of distance education and is the prime example of a fully cloud-focused device. These laptops have enough local storage and enough power to run Chrome OS, which essentially turns the Google Chrome web browser into an operating system. With a Chromebook, almost everything you do online: apps, media, and storage are all in the cloud. For this reason, they tend to be inexpensive and this is what has made them incredibly popular in education.[18]

- Gmail:

One of the services that google provides and With a Gmail account the communication between students and teachers by easier and faster. They can use Gmail to send and receive academic messages and they also have storage capabilities of 15GB on their account which is more than enough for keeping their files and documents.

- Google Forms:

Uses to create online quizzes as well as solve a questionnaire and survey simultaneously, using various tools to customize the form questions. Google Forms can be extended with add-ons that help teachers create new surveys or integrate form data with other Google Workspace applications (such as Google Sheets).[19]

Fig. 3. Applications of Cloud Computing

4 Challenges and Concerns

Cloud computing technology is developing day by day and its importance and benefits have emerged during the Corona pandemic, but despite this, there are still concerns and challenges for educational institutions in its application. These concerns and challenges can be divided into two parts, including those related to hardware and software.

- Infrastructure for educational institutions:
  The rate of change of ICT technologies is very large and this leads to Continuing pressure on the budget of institutions. It bears the material costs of hardware and software maintenance. [20]
- Network performance and bandwidth:
  The effectiveness of data access from the cloud depends on the performance of network and WAN bandwidth. [21] The continuity of the Internet service and its quality greatly affects and this is one of the problems that still exist, and this is what happened already in the middle of 2021 when cloud computing services were disrupted in America, which led to the disruption of important government sites, including the White House . [22]
- Maintenance of hardware resources:

Proactive or corrective maintenance is one of the preventive measures to ensure that data is not lost, but because maintenance costs are very expensive, it is considered one of the challenges facing education workers because of not ensuring the continuation of the educational process comfortably, so cloud computing companies worked on developing a strategy for improved maintenance management that is effective from Cost, operation and data preservation.

- Storage devices used in computing:
  Cloud storage is designed to be highly scalable and suitable for accommodating the huge amount of data, especially in this period when organizations and the entire world relied on cloud computing. However, according to recent studies, cloud storage technology still suffers from many problems and is still one of the most important challenges facing cloud users.
- Data management:
  Data protection from loss : Educational institutions continue to ask many questions About where their data is located, who manages their data, what is the fate of their data in the event of a cloud failure and how to protect it from loss, as well as the lack of unified standards between service providers in the event of data transfer from one service provider to another.
- Data separation:
  The data separation is one of the data security risks in cloud computing, and due to the fact that customer data in the cloud environment together, this is a big challenge, here the cloud service provider must Reassure customers of data separation. [23]
- Data security (Privacy, confidentiality, reliability, security):There are security concerns regarding the mechanisms of service providers that protect their confidential and sensitive information from potential breaches and attacks Service providers have provided fast and reliable mechanisms to ensure the confidentiality and security of information such as identification, authentication, encryption and privacy policies .[24] However, privacy remains one of the major issues delaying the growth of cloud computing and previous research has highlighted a number of privacy concerns due to the lack of clear and well-defined requirements to ensure personal privacy and the lack of clarity what educational institutions need to protect users' comprehensive. [25]

5 Conclusion

Adequate financial cost, quality of education and a comfortable atmosphere between student and teacher are one of the basic requirements in any educational method.As well as the continuous improvement of its information technology, but educational institutions is not able to allocate an appropriate budget for that, so the importance of cloud computing has emerged with the global crisis as a result of the outbreak of the Corona virus, Covid-19. Where cloud computing has played a major role in the continuity of education in universities and scientific communication between educational institutions through a set of appropriate free applications that provide a new type of

knowledge and high quality in addition to ease of use on all electronic devices available to the student and teacher. However, there are a number of concerns surrounding the use of cloud computing, and service providers are still working to avoid these concerns. Nevertheless, the user accepts a certain level of security breaches in exchange for the great benefits that the cloud provides.

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