



Identifying the role of cloud computing technology in management of educational institutions

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ABSTRACT

Cloud computing refers to a computer architecture that offers universal on-demand network access to a shared pool of configurable resources. Educational institutions are essential because they play a vital role in policy formulation and contribute to cultural, political, and social growth. Cloud computing is highly popular throughout the IT sector worldwide, and its importance and excitement is also expanding in educational institutions' IT demands. There is currently little information available on the use of cloud computing in educational institutions. Organizations can use cloud computing to decrease IT costs while also gaining more flexibility and scalability; nevertheless, the sustainability of many cloud computing services remains to be seen. Measures to address security, privacy, and legal concerns, as well as the standardization of cloud technology, are still in the works. This article discusses the importance of cloud computing technologies in educational institution management. This also presents a number of problems in terms of cloud computing adoption in educational institutions.

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1. Introduction

The notion of cloud computing [1] emerged in the 1950 s with the advent of mainframe computers. Multiple users were permitted to access a central computer through dumb terminals, the primary purpose of which was to give access to the mainframe. It was not possible for a business to give mainframe computers to every employee due to the large cost needed. Neither did the requirement for such great capacity storage and high speed processing for a typical user, which mainframe computers provide. The most cost-effective approach for this advanced technology was to provide shared access to a single resource. The concept of virtual machines (VMs) emerged in the 1970 s with the advent of virtualization software such as VMware, which allowed one or more operating systems to run concurrently in an isolated environment. A virtual computer can run within one piece of actual hardware, which can then run an entirely other operating system.

Amazon.com proved that it would overcome the collapse of the dot-com bubble in the first few years of the 2000 s, shortly after Salesforce.com introduced this unique notion to the attention of

the world. Amazon was the first big company to upgrade its data centres, which only operated at around 10 percent at any one time. Amazon understood that it could use its current capacity far more effectively with the new cloud computing infrastructure design [2].

In the meanwhile, Google had become a key participant in the Internet trade industry by the late 2000 s. Google Docs offered directly to end users the capability of cloud and document sharing in 2006. The 2008 'Emerging Technologies Conference' of Gartner Inc. reports that 80% of Fortune 1000 companies is currently planning for cloud computing and 30% will pay for cloud computing infrastructure [3].

KPMG's 2010 poll also indicated in favor of this. "While cloud computing allows organizations to decrease IT costs while increasing flexibility and scalability, the sustainability of many cloud computing services remains to be proven. Measures to address security, privacy, and legal concerns, as well as cloud technology standards, are still in the early stages." [4].

Gartner estimated cloud computing to be extremely popular in the IT sector throughout the world, while its relevance and excitement are also increasing in the field of IT requirements in educa-

tional institutions. Although higher and technical educational institutions have different priorities, aims, missions, and visions, the distinctions are minor. Institutions have begun to shift their infrastructure to the cloud, either entirely or partially. Universities are following suit and migrating to cloud computing.

Educational institutions are essential because they play a vital role in policy formulation and contribute to cultural, political, and social growth. Some universities have been hesitant to regulate and establish mechanisms for the use and mobility of information, whilst others have pushed for innovation in knowledge distribution in education. To take it a step further, organizations of all sizes are beginning to consider cloud technology and shared services.

Cloud computing is the technological sector that develops most fast and is also the most affordable for the educational system. A more efficient and cost efficient distribution model for administrative systems has shown the truth of cloud applications on all markets, and no hardware, software, middleware or database can be purchased, installed or maintained. By adopting cloud computing, organizations may reassign their IT resources to more important tasks from application management, maintenance and operation. The supplier oversees improvements, fixes, integrations, data security, backup, recovery from disasters and optimizing performance using the subscription model.

Although, cloud computing has a lot of benefits for educational institutes, but there are certain challenges and issues. These mainly include security and privacy, governance issues, compliance issues. Many researchers have provided solutions for issues related to cloud computing. Still, these are ongoing issues and further research and development is required to counter these issues. These issues and challenges are required to be addressed for improving the benefits of cloud computing in educational institutes as well as other areas.

2. Characteristics of cloud computing

NIST has given five essential services of cloud technology and depicted in Fig. 1 is as follows: [5]

A. On-demand self-service: Calculation of computational capability, for example network storage and server time, may be done by the customer automatically, without any human contact between them.

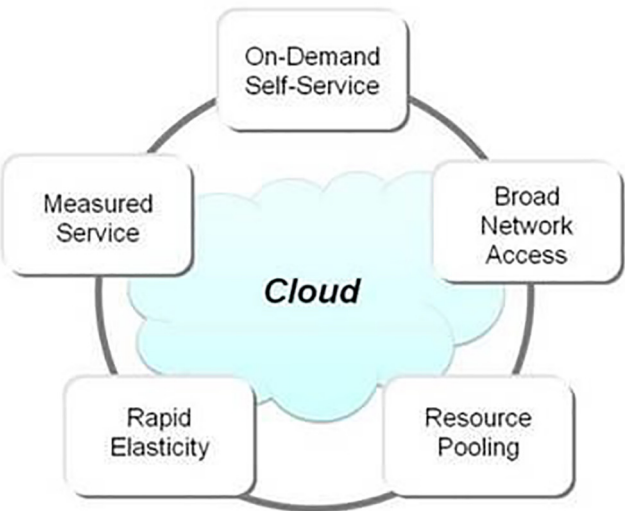


Fig. 1. Characteristics of Cloud Computing.

B. Broad network access: All services are network-wide, and may be accessed via various devices, such as PCs, PDAs and mobile phones.

C. Resource pooling: A multi-tenancy strategy serves multiple customers while pooling their resources and continually allocating a range of virtual and physical resources on a client's basis. These resources are agnostic locations, and the customer typically doesn't control or know the exact location of the resources concerned.

D. Rapid elasticity: Services may be delivered quickly and flexibly. Scaling and scaling in can be performed automatically in some instances. The resources available to provide the client are often uncontrolled and can be obtained as many as possible at any time.

E. Measured Service: The cloud system has the capacity to automatically monitor resource use. At some level of abstraction, it provides metering capabilities. Monitoring and reporting resource use can help to preserve transparency of used services.

3. Role of cloud computing technology in management of educational institutions

The cloud computing paradigm is an abstract, highly scalable computer infrastructure service that is made available to end users over the internet. It is shown below in Table 1.

• Personalized learning

Personalization of content is also possible. Content in different formats, administration of the learning experience, and an online community of learners, content, developers, and specialists are among the e-learning components. E-learning has several advantages such as ease of access, flexibility, consistency, convenience, and repetition. The cloud computing technology satisfies the e-learning requirements of simple accessibility, flexibility, consistency, ease, and repetition while maintaining a low cost structure. Cloud computing-based learning will be a key driving force in education [7].

• Virtual classroom environment with supportive tools

Cloud computing is an infrastructure that may provide additional value to the e-learning environment by allowing educational services to be delivered in an efficient and dependable manner [8]. Cloud computing has numerous advantages for e-learning, including low-cost infrastructure with high data security, centralized data storage, and data access monitoring. Cloud computing provides great performance at a low cost, as well as fast software upgrades [9]. It offers online classes and assignments, as well as feedback, discussion forums, and comprehensive resource management

• Reduced cost, flexibility, virtualization

The academic industry will have a beneficial influence on the cost structure of IT resources by decreasing the total cost of ownership by utilizing cloud computing technologies. Because of its

Table 1
Role of Cloud Computing in Education.

Role of Cloud Computing in Education	
1.	Personalized Learning
2.	Reduced Cost, Flexibility, Virtualization
3.	Virtual Classroom Environment with Supportive Tools
4.	Greater Reach for Teachers and Students
5.	Secure Data Storage for Examination
6.	Application Integration and Collaboration

flexibility and pay-per-use approach, cloud computing will greatly benefit and empower the academic industry. E-learning refers to learning that is accomplished via the use of technology. E-learning is defined as learning that is accessible over the internet [6].

• **Greater reach for teachers and students**

Cloud-based learning is a learner-centered paradigm that provides a comfortable and easy-to-understand environment [10]. Teachers can maintain their learning content up to date and assess students' common areas of knowledge. Researcher describes the advantages of a cloud computing-based e-learning environment as follows: cloud computing may be accessible over the web; no client-side software is required; and payment is based on usage. Cloud-based e-learning provides a data repository where the learner community may keep their massive amounts of data [11]. Through the internet, students may work from any location and with any computing device.

• **Secure data storage for examination**

Students can participate in discussions and forums, as well as take online quizzes and exams. Cloud computing infrastructure aids educational institutions and their students by allowing them to access the system from any place, at any time, and with any computer device at a reasonable price [12].

• **Application integration and collaboration**

Application integration was one of the most urgent IT problems for companies and the company model for integration was the only solution. It is an expensive and time-consuming procedure if integration exists at all. These programs are often divided into business divisions of the organization, making information difficult to communicate, report a single truth source, and avoid errors with the entry of redundant data. In addition, software has its own user interface and login needs. Interconnections for these many systems are extremely complicated and need to be upgraded and maintained with substantial IT resources [13].

Upgrades must be properly coordinated to maintain a continuous flow of data. While the best-of-breed approach gradually found its way into technical education, the main ERP providers were concurrently attempting to extend their solutions to address the previously identified shortcomings. Many businesses who used the best-of-breed strategy found it difficult to integrate new needs, business processes, or projects into their network of applications. Instead, they chose to install a fully integrated, single-source suite of apps for core functions, along with a few auxiliary best-of-breed solutions for specific requirements [14].

Truly successful ERP systems have a wide range of functional capabilities that are tightly integrated to facilitate data exchange, reporting, navigation, maintenance, and updates. The ideal system has fewer integration points to maintain consistency, adaptability, usability, and simplicity of maintenance, rather than an amalgam of acquired and afterthought capabilities.

Thus, educational institutions that employ cloud technology benefit from the most recent innovation, rapid deployment, and instant upgrades. Package integration, cheap operational costs, higher service levels, and complete security are further benefits of cloud computing.

Table 2
Benefits of Cloud Computing.

Benefits of Cloud Computing	
1.	Low Cost Infrastructure
2.	Increased Performance
3.	Instant Software Updates
4.	Advantages for Students
5.	Advantages for Teachers
6.	Security of Data

4. The benefits of cloud computing-based learning

Cloud computing-based learning provides a variety of benefits, including low-cost infrastructure, improved performance, rapid software upgrades, and benefits for students and teachers [15]. Benefits of cloud computing are shown below in Table 2.

• **Low cost infrastructure:**

There are no upfront costs for deploying gear or software in a cloud-based e-learning environment. The user can immediately access computer resources in the form of services over the internet. It saves money on software and hardware purchases and eliminates the need for software licensing.

• **Increased performance:**

Because the apps operate in the cloud, the machine's performance never suffers when the student load fluctuates. The underlying technology is capable of handling a wide range of loads at any time.

• **Instant software updates:**

Cloud-based learning environments automatically update the software in the clouds, so the user always has the most up-to-date software. The user is not required to purchase patches for updated software.

• **Advantages for students:**

Students may work in groups and from any location and at any time in a cloud-based learning environment. Students may actively participate in activities, take online quizzes and exams, and receive comments and evaluations from their professors. Students can use a cloud-based digital learning environment to submit their assignments and projects.

• **Advantages for teachers:**

Teachers can discover a comfortable setting to engage with students at any time and from any location. Teachers can create cloud-based document repositories. Teachers can post online exams, quizzes, and homework assignments. Teachers may analyze the test in a cloud-based setting and provide immediate feedback to pupils. Teachers can post the questions in forums for students to debate.

• **Security of data:**

The cloud-based learning environment ensures data security since both the program and the data are stored on remote servers. Cloud computing ensures data security for all stakeholders that use the cloud as a service.

Table 3
Challenges in Cloud Computing.

Challenges in Cloud Computing	
1.	Integration and Security
2.	Risk and Compliance Issues
3.	Governance Issues
4.	IT Staffing Implications
5.	Advantages for Teachers
6.	Security of Data

5. Challenges in use of cloud computing in educational institutions

Cloud computing addresses four main issues and concerns in education [16 17 18]. Challenges in cloud computing are shown below in Table 3.

A. Integration and security

The most difficult problem for IT departments at technical educational institutions is optimal and efficient service integration. The availability of new cloud computing services raises integration problems. Another significant problem is security, which includes the security of the facility where data is kept, the security of data transmission, and the provider's dependability.

B. Risk and compliance issues

With relation to shared storage, cloud computing poses a variety of concerns concerning privacy protection, data security, and privacy problems. In a shared service environment, for example, an institution cannot control where its information is held or how or by whom it is accessible. This is a significant risk factor. How can one deal with such dangers? How can you guard against threats to data security, integrity, and availability, as well as vendor lock-in and security flaws?

C. Governance questions

Universities should regard cloud computing as a new technology and phenomena that will need careful consideration from campus decision-makers and stakeholders, and they must be persuaded and embrace cloud computing as an essential feasible alternative for running the institute. Certain corporate operations might be outsourced to cloud computing, necessitating a more complicated decision-making process.

D. IT Staffing implications

Changes and the usage of cloud computing might have a direct influence on IT staff. IT staffing levels should also evaluate the benefits of cloud computing for the skills and expertise needed by IT professionals in the future. IT departments in technical educational institutions needed to have a distinct set of skill sets and training, as well as a better grasp of outsourcing and contractual concerns and procedures. Despite the fact that there are too many difficulties to embrace technology, it is a dependable and popular technology.

6. Conclusion

Educational institutions are crucial because they play a vital role and contribute to cultural, political and social development in political formation. In the IT sector the importance and excitement of Cloud Computing is extremely popular worldwide, also increasing in education IT needs. Little information on the usage of cloud computing in education institutions is presently accessible. Organization, nevertheless, still shows the sustainability of a number of cloud computing services, are able to utilize cloud computing to save costs while increasing flexibility and scalability. Security, privacy and legal issues are still being addressed and

cloud technology standardization is ongoing. The relevance of cloud computing technology for educational institution management is discussed in this article. This also raises a variety of cloud adoption challenges in educational institutions.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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