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A Review of Cloud Computing Potential to Improve Online Education

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ABSTRACT : E-learning, or virtualized computing and remote learning, makes use of internet communication tools to help in the teaching-learning process. The last two years have seen a meteoric growth in the popularity of online learning platforms. When it comes to formal education, data mining for IT purposes leverages information gleaned from online databases to improve the educational learning paradigm. Supporting e-learning solutions on a cloud computing infrastructure makes sense. Long-term changes in computer resource use may be made automatically with the help of a scalable solution. Using data mining methods in a decentralized setting simplifies interfacing with large e-learning datasets. The research provides a brief overview of cloud computing at the present time as well as some instances of cloud-specific infrastructure. E-learning and cloud-based computing are only two of the topics covered.

1. INTRODUCTION

The advent of the internet and other digital communication methods, as well as remote learning, paved the way for what is now known as e-learning [11]. It employs a number of forms and features that have the potential to be useful in the classroom. Virtual classes, emails with relevant links, online message boards, and other media all fall under this category. The learning process is better managed thanks to the online collaboration of students, content creators, and experts. The most notable advantages of learning using web-based tools are the activities' regularity and repetition, flexibility, portability, and convenience [16]. Since the spread of Covid-19 and the development of digital technology, e-learning or virtual teaching platforms have been more popular in the field of information technology (IT). Implemented as an E-learning format all over the world [21,22], Massive Open Online Courses (MOOCs), Blackboard, Desire to Learn (D2L), and the Virtual Learning Center at different institutions are all part of the same ecosystem of related initiatives.

There is a clear ideal learning environment for individuals who can get their material online, and the

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number of people who participate in virtual programs that are completely approved by the e-learning paradigm is far higher than in traditional attendance classes [6, 13, 20]. The infrastructure needed to support so many students all at once is beyond the capabilities of most standard web application users, for example. In addition, there are often abrupt and dramatic increases in demand for classroom supplies. A more sophisticated infrastructure than is typically necessary for the educational institution to operate regularly will be required during certain times in order to react to demands without compromising other system functions. In a pay-as-you-go model, users only need to cover the costs of the resources they actually employ. The advent of cloud computing has made it possible to address these issues. To lower computational costs and improve system availability and dependability, cloud computing was initially suggested [1, 30]. The cloud computing movement has advanced these aims.

However, there is a difference between the two with respect to the calculation of the jobs [40]. A computing grid is more reliable in terms of hardware since it is built to improve the efficiency of a computer network. Cloud computing, on the other hand, is designed to make mobility visible while enabling consumers to buy a wide range of services without needing to be experts in the underlying infrastructure. It offers a wide variety of tools, such as word processing and hosting [37]. Keep in mind that Service Oriented Architecture (SOA) is a key component of cloud computing. Application integration, concurrency control, and security protocols are just a few of the obstacles to distributed organizational computing that this technology is meant to help programmers overcome [24, 39]. There are also many other systems and protocols, the use of hardware and software, and the existence of preexisting data systems that we may be directly exposed to. A cloud platform makes all of its features available to users while concealing the physical location and other technical details of the underlying computer infrastructure [45]. The benefits of this new computer paradigm are easily discernible when compared to other technology. If an application can be run successfully on the cloud, there's no need for the user to upgrade their hardware [28]. Because it instantly intends the business needs by interactively assigning IT assets (servers) based on the computation complexity in virtual environments, this storage capacity and computing initiative helps corporations get their software fully operational faster, with a lesser provision of services from the IT division [14]. Big online classrooms, like the ones we've been talking about, also generate plenty of records of students interacting with each other and their instructors.

These systems conceal a great deal of information that is important to society. Data mining methods are required [25]. In this context, educational data mining (EDM) is a method that benefits teachers and students alike.

2. FUNDAMENTAL NOTIONS OF CLOUD COMPUTING

All the research presented up to this point is a review of cloud computing. Researchers are able to offer the concept in more depth because to the qualitative review's foundation in in-depth investigation. In order to address a research topic, one must first investigate the relevant publications, academic papers, and other source materials to offer an overview, summary, and analysis of the topic. Emerging in recent years, "cloud computing" refers to the practice of making various computer resources and services available through the internet, including data storage, servers, databases, networking, and software. That's why people came up with the idea for Service Oriented Architecture [36], a set of rules and tools for integrating different kinds of services. In the context of cloud computing, "service" refers to a function that has been "packaged" in such a manner that it may be "automated" and "delivered" to clients in a standardized and organized fashion. Services may be thought of as anything from hardware-related components (like memory or CPU cycles) to software-related tasks (such user authentication, email management, database management, or operating system controls). Reduced demand necessitates reallocating currently used resources.

The customer's needs are always put first.

Most notably, cloud computing requires just a minimum network connection, is highly interoperable, and uses protocols to isolate the provider's code from its environment [41]. Instead of strict divisions, a SOA will often use hierarchical layers to organize its components.

Some parts use the services provided by lower levels to enable features in higher tiers. In addition, each sub-

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division may use a different set of corporate guidelines, building plans, etc. The term "according to the kind of arrangement being offered" refers to the fact that there are often three distinct kinds of layers present in every given setup. There are three main classes of coatings, one of which is a cloud-based storage system that organizes your data into "files" or "blocks." Complete execution services are made accessible via a compute cloud, which is a collection of registers, columns, or entities that deliver these services. The cloud computing concept is useful for large-scale projects [35]. It's common knowledge that many scientific and commercial applications are weighed down by excessive computing needs. When dealing with massive volumes of data stored in reliable systems, as is the case with a continual data flow, a more robust communication connection is required.

There are several categories into which service-oriented architectures might be placed. These systems are often categorized based on the level of complexity they provide to the user. In most cases, as shown in Figure 1, there are three tiers that may be distinguished using this approach.

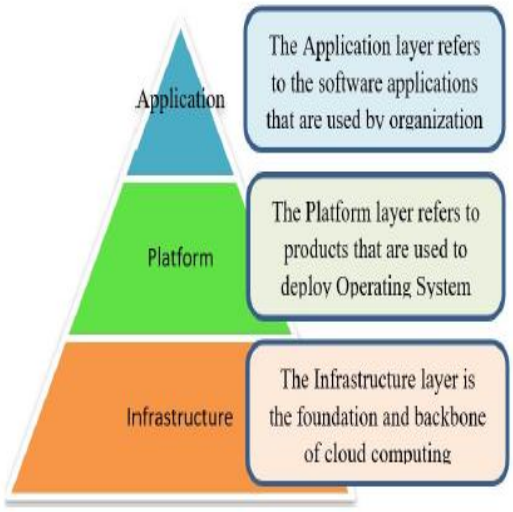

Figure 1: The Stacks That Make Up Cloud Computing [7]

Platform as a service (PaaS), the second tier, is a provider-provided infrastructure that contains an integrated software package with everything a development hub needs to generate applications at the design and delivery phases [27, 31]. Although PaaS providers don't often supply infrastructure itself, by using IaaS services, developers are able to establish a link to the necessary architecture [31]. The PaaS may be thought of as a software layer since it enables the development of app components and whole applications.

Engineers can fix software problems more effectively across the board using an integrated development environment or a set of standalone tools. Everything from identifying the problem and modeling it to creating a solution and putting it through testing and deployment falls under this category.

The same is true for computer languages that support several operating system compilers and modules, allowing for the deployment of the same program across many platforms without the need for code rewrites. Google App Engine, Amazon Web Services, Heroku, OpenShift- Red Hat, etc. are all major participants in the market for PaaS-cloud computing services. When internet use first began to gain popularity, the most advanced form of cloud computing was Software as a Service (SaaS) [32].

Some companies gave to all users the programs that manifested as customer contact managements from the Platform as a service [28].

3. E-LEARNING TASKS AND CLOUD COMPUTING

As traditional classrooms close, more and more students sign up for online courses, and more and more resources are made available to them, the emergence of e-learning systems has grown exponentially [21,23]. Choosing a platform that can grow to meet demand while keeping costs down and making the most efficient use of processing, storage, and communication is crucial. What we see here is a manifestation of cloud computing in the form of content and information delivery and retrieval. To better understand the benefits of cloud computing, particularly on the technical and pedagogical levels, it may be useful to define the promise of SaaS applications for robust and complete remote learning. Providing the 'way' for facilitating the transition to such a paradigm is crucial if we are to realize the full potential of online tools and interactive services like lesson plans, audio/video recordings, course materials, peer tutoring, etc. The widespread use of cloud computing in academic settings demonstrates the sector's potential in [19]. Initiatives like JISC (2012) are in place in several countries, including the UK, to include an education cloud with the necessary technologies to handle data and store the data [33]. Education To get the most out of cloud computing, many people are turning to software as a service (SaaS) e-learning platforms. Its minimal hardware requirements mean it may be set up quickly by the end user. In addition, the manufacturer receives free,

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automated upgrades and access to vital resources via Web 2.0, while the supplier is freed from the burden of providing system care and maintenance.

From a technical perspective, e-learning system design and cloud computing platforms contribute to consistency, harmony, efficient resource utilization, and long-term stability in the e-learning ecosystem [10]. The implications of creating e-learning solutions in the cloud computing system are summed up by the authors in [29]. Because the program may be accessible from anywhere at any time, there is an initial higher need for web development skills. As a consequence, the subscriber has seen cost savings in areas such as software licensing, infrastructure setup, and administration. Because of this, the institution will save money, speed up deployment, and employ fewer information technology specialists. In time-sensitive scenarios like Coivd-19, this will be equally useful [16].

If hundreds of computers are not spread out over a wide area, then monitoring data access may be done from a single central point. Because of the cloud's centralized storage, updates to the system's cybersecurity may be tested and implemented quickly [8]. Therefore, from a scholarly perspective, one of the benefits of the cloud is its ease of access [16], as it is primarily designed to permit users to collaborate from anywhere at any given time, even though more efforts are required to determine how cloud-related pedagogies or assessments of learning purposes [11]. It's flexible enough to adapt to the needs of students both within and outside of the classroom. It has the potential to reach more students with more relevant information in more settings [10]. Dimensions of cloud computing in relation to electronic learning are shown in Figure 2.

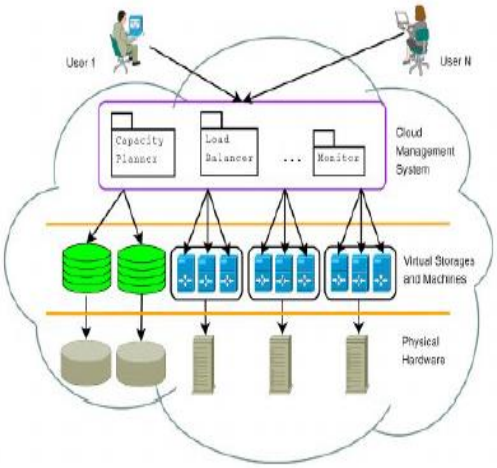

Figure 2 shows how the Cloud may be used for online education.

Information obtained from: [12]

Figure 2 shows the typical architecture of a cloud e-learning solution, which consists of three layers: a virtualized platform, a cloud management system, and a cloud services layer. The private cloud architecture is built using vSphere, and it consists of two computer pools used for instruction: a C pool with a thin client and a server pool running the hypervisor. All hosts and services in the virtual infrastructure may be monitored and controlled in real time using a web browser. Alarm data and permission settings may be saved, and performance and configuration can be tracked. A single hardware host hypervisor is required to support multiple OSes. By dynamically assigning system resources to each virtual computer, a hypervisor keeps them from interfering with one another. This situation calls for a hypervisor that can function natively on the hardware. The requirements of PaaS and SaaS cloud customers are met by this layer, which acts as an interface to the outside world. The virtual PCs are assembled by the educational coordinators, who choose the baseline images and then install the selected software [27]. As a result, students may connect to the appropriate VM through the internet and work on standardized web technologies created for their courses.

The E-Learning virtual model that may be customized is shown in Figure 3.

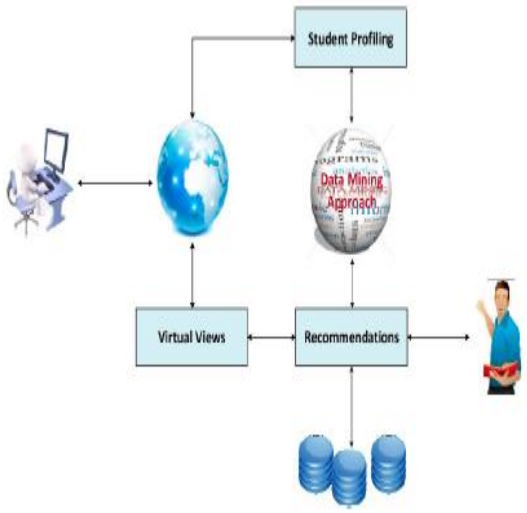

Figure 3: A System for Customized Online Instruction. Documentation [17]

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Higher education institutions are investing more in cloud computing and online education in response to rising student demand. Almost every educational system has adopted it as an effective and practical alternative to traditional e-Learning. However, the lack of studies may give a theoretical basis from which a technique might be developed. However, the advantages of the cloud strategy's inherent flexibility in developing an analytical framework and effective teaching methods may have been emphasized [34]. The lack of research providing a strategic or tactical overview of the topic is a major limitation of the discipline.

4. PERSPECTIVE CHALLENGES ELEARNING AND CLOUD COMPUTING

Cloud computing, applications, and capacities of the present may be rather beneficial to the growing field of e-learning [4,13]. The limitations of on-premises laboratories and computers may be greatly mitigated with the use of a cloud-based e-learning system. In order for the cloud to be extensively utilized and embraced to assist and promote e-learning, however, basic challenges and obstacles must be resolved. Using cloud computing effectively for e-learning and teaching requires a learning curve for both instructors and students, as well as IT assistance from educational institutions [18, 33]. Use whatever method you choose, whether it be a public or commercial cloud service, an external solution, or nothing at all. The teacher should be familiar with cloud capabilities and work with the university's IT department to determine the most appropriate cloud model for the needs of the course. The teacher needs guidance in establishing cloud resources, allocating those resources, and managing student accounts.

Students also need guidance and instruction on how to make the most of their time using cloud-based learning materials. The learning curve for both teachers and students might be high or mild, depending on the nature of the course and its prerequisites. It's possible that instructors in subjects like computer science and related courses will have an easier time adapting to and using cloud computing.

5. CONCLUSION

According to the analysis's overarching claims, using cloud services in E-learning is a great option because it enables educators to use cloud adaptability, flexibility, and security to model E-learning's central framework: instruction that can be accessed from anywhere at any time on any device. We can take use of the possibilities afforded by the current educational paradigm if we have access to an effective learning environment that includes specialized information. Integrating an e-learning system into the cloud has several benefits, including increased storage, compute, and network connection. It's important to focus on cost cutting in both software and hardware. Its licensing fee is lower, and its educational software selection is better. However, the extended machine life reduces the pace at which student computers need to be replaced. The decreased need for IT support staff to maintain and upgrade the lab's computers and software contributes to these cost reductions.

Currently available e-learning services and platforms do not allow for sufficient individualization of the learning experience. This method results in students receiving e-learning that is not tailored to their specific requirements. The use and improvement of cloud-based customized learning across numerous subject areas calls for new research and development. Interaction between teachers and students is essential in most contemporary systems since it improves the quality of education for everyone involved. Online and real-time training should be able to use cloud-based e-learning services like video conferencing or instant messaging. Email, voice over IP, and programs like Skype are used by modern cloud-based e-learning systems to make up for these deficiencies. This is still an issue for most cloud-hosted services. When trying to gauge how big an issue really is, several variables must be taken into account. Since customers are understandably wary about the cloud, service providers have made substantial investments in cloud infrastructure and platforms to reassure them. In addition, country constraints are critical since some nations mandate the local storage of data, making its distant or international storage a criminal violation. Researchers have found that there is a wealth of information available to them that may be used to better design and execute cloud-based e-learning systems. Future research should quantify the effects of moving to a cloud e-learning environment on a variety of factors such access time, impact on education quality, and financial return.

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