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AN OVERVIEW OF CLOUD COMPUTING FOR THE ADVANCEMENT OF THE E-LEARNING PROCESS

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ABSTRACT

As an aid in the teaching-learning process, online communications systems are used to facilitate e-learning, a form of virtualized computing and distant learning. The rise of E-learning platforms emerged drastically in the past two years. Data mining for education information processing uses facts generated from internet databases to enhance the educational learning paradigm for educational purposes when the learning process is computerized. Cloud computing is a suitable platform for supporting e-learning solutions. It can be automatically altered by providing a scalable solution for transforming computer resource consumption in the long run. It also makes things simpler to use data mining techniques in a distributed environment when interacting with massive e-learning datasets. A summary of the current state of cloud computing is provided in the study and examples of infrastructure explicitly designed for such a system. In addition, it also discusses examples of cloud computing and e-learning methodologies.

Keywords: *E-Learning, Cloud Computing, Virtual Learning, SaaS, PaaS, IaaS*

1. INTRODUCTION

E-Learning emerged due to the widespread use of the internet and other digital communication systems and distance education [11]. It makes use of multiple formats and functions that might best aid classroom instruction. These include Virtual instruction, emails and web links, discussion boards, and other learning platforms, among other things. As a result of the online integration of students, content producers, and professionals, the learning experience is better handled. Learning with web-based tools has many benefits, the most prominent of which are the tasks' consistency and recurrence, adaptability, accessibility, and easier access [16]. E-learning or virtual teaching platforms are becoming increasingly popular in information technology (IT), particularly after the outbreak of Covid-19 and digital advancement. Different educational levels have associated efforts, such as Massive Open Online Courses (MOOCs), Blackboard, Desire to Learn (D2L), and the Virtual Learning Center at various universities, implemented as E-learning format globally [21,22]. Compared to the conventional attendance class, virtual programs, fully endorsed by the e-learning paradigm, have an obvious optimal learning environment, a notably greater frequency for those who can acquire their material online [6, 13,20]. These proportions have a lot of consequences; for example, the infrastructure requirements to provide a concurrent service for that many learners far surpass the capability of traditional web application users. Moreover, the need for instructional resources often fluctuates rapidly and dynamically, with significant activity spikes. To respond to requests without affecting other system services, a much more advanced infrastructure will be needed than what is normally required for the learning institution to function normally during these periods. Providing services based on usage and only paying as the pay-per-use policy for resources that are used is an option. Cloud computing technology provides the solution to these problems. Cloud computing was first proposed to reduce computational costs while enhancing system reliability and availability [1, 30]. These goals have since evolved into those of cloud computing. Nevertheless, there is a distinction between the two regarding how the tasks are calculated in each setting [40]. In terms of technical resources, a computing grid is more stable, and it is primarily designed to maximize the performance of a computer system. On the other side, Cloud computing aims to provide transparent mobility while allowing users to acquire various services rather than familiar with the basic infrastructure. It does not have a limited range of services, including hosting services and word processing [37]. It's important to note that one of the foundations of

cloud computing is Service Oriented Architecture (SOA). There are many dispersed organizational computing barriers that this type of technology is intended to help programmers to transcend, such as application integration, concurrency control, and security protocols, as well as numerous different systems and protocols and the use of hardware and software to which we might have direct exposure, and existing data systems [24, 39]. All of a cloud platform's functions are made accessible in a way that hides the location and other technical aspects of the computing infrastructure from users [45]. In comparison to other competing technologies, the advantages of this new computing paradigm are plain to see. Users don't have to invest money on new hardware to use the application because cloud software vendors attempt to deliver comparable or better capabilities and functions than if the applications were loaded locally on end-user machines [28]. This storage capacity and computing initiatives help corporations to get their software fully operational faster, with a lesser provision of services from the IT division because it instantaneously intends the business needs by interactively assigning IT assets (servers) based on the computation complexity in virtual environments [14]. Massive e-learning environments, such as those discussed earlier, also produce large archives of student participation with peers and teachers. Significant data is stored in these systems that haven't been explicitly declared. You'll need to use data mining algorithms [25]. Educational data mining (EDM) is a technique that helps both instructors and learners enhance teaching and learning in this situation [2]. The creation of novel strategies for examining the data created by the aforementioned current education system activity is the focus of this discipline. This method's ultimate goal is to understand student performance better and create protocols and resources that will make learning more engaging and easier. There are computer-based tutoring systems that are specifically developed to assist in the teaching and learning process and directly link to this approach. These are sophisticated programs that support students learning by monitoring their performance and providing them with feedback. An instructional model interacts with the EDM process, which extends and refines the knowledge it has. Considering the size and capacity expansion of computer capabilities (solid space, ram, and CPUs), cloud hosting is a sequence for adopting data mining algorithms and implementing them towards every database [15, 42]. Several more data mining methods, on the other hand, aren't very scalable. This is a topic that is becoming extremely relevant, and scholars and businesses alike are taking notice.

Due to the Covid-19 pandemic educational institutions around the globe moving to either use blended learning or fully E-learning. The major challenge is to deliver secure and adequate resources to support the E-learning process. This research aims to review cloud computing services for E-learning to enable the educator to utilize the benefits of cloud services such as scalability, flexibility, and security to support and enhance the E-learning process. The remainder of this paper is organized as follows. Section 2 introduces the fundamental notions of cloud computing, section 3 discusses E-learning tasks and cloud computing, section 4 describes the perspective challenges of e-learning and cloud computing. Finally, section 5 concludes the paper.

2. FUNDAMENTAL NOTIONS OF CLOUD COMPUTING

All the analysis in the preceding sections are the review of the cloud computing. The review is based on the qualitative analysis, which allows researchers to present the notion in elaborative way. A literature review examines publications, academic papers, and any other source materials pertaining to a particular issue, area of investigation, or concept, and provides an overview, synopsis, and analysis of a research subject in order to address the research. Cloud computing is an emerging approach in which different resources and services such as data storage, servers, databases, networking, and software are delivered via the web. This brings us to the conception of SOA [36], a framework for integration consisting of a combination of a rational and technology framework to assist and incorporate all range of facilities. In essence, service in the context of cloud computing is a function that has been wrapped in a somewhat form that it could be mechanized and delivered to customers in a standardized and structured way. Any element, from those adjacent to equipment, such as storage capacity or processing time, to software elements targeted at verifying a user or handling mail, database administration, or regulating the use of the operating system, can be regarded as a service.

Essentially, the cloud computing philosophy suggests a shift in how challenges are tackled through technology [38]. Using and combining services is the basis for application

design. Instead of relying on the concept of processor algorithms, as with more conventional methods, such as distributed systems, the provision of functioning depends on the use and integration of services. In other words, this has benefits in terms of adaptability, dependability, scalability, and so on. For illustration, more instances of a specific service could be launched so that the application's response time stays appropriate for consumers during a spike of resource requirements due to a rise in customers or a rise in computational load.

As a consequence of a decline in demand, available resources should be made available. Everything is done sensibly to the customer. Among the most notable cloud computing are its minimal connection, high degree of interoperability, and protocols that separate the provider's execution and environment [41]. It's not uncommon for an SOA to divide its operations into levels or layers (rather than in precise boundaries). Some components make usage services rendered by lower tiers to allow other capabilities to higher ones. Aside from that, these divisions could have multiple corporate frameworks, architectural designs, and so on. According to the type of arrangement being offered, there are generally three basic types of layers together, which form what is described as According to the kind of arrangement being offered. There are generally three basic types of coatings together, which include what is described as a cloud-based storage system that provides data storage depending on "files" or "blocks." Cloud computing is a collection of registers, columns, or entities that offer services and complete execution services are available by a compute cloud. Mega projects benefiting from the cloud computing model [35]. Many scientific and business applications are well-known burdened by heavy computational requirements. A constant data flow necessitates an elevated communication link since it involves handling enormous amounts of data contained in stable systems, which indicates a high amount of storage space.

Service-oriented systems can be grouped into a variety of areas. The complexity degree that these systems provide to the system user is a commonly used parameter for grouping them. As illustrated in Figure 1, this method frequently distinguishes between three distinct levels.

Infrastructure as a Service (IaaS) provides infrastructure, i.e., data centers, network technology, memory, or computing, and essential components like computer systems and abstraction of hardware elements [26]. If we compare the IaaS to a mono computer platform, the software and computer program together represent the IaaS. The operating system manages the system resources and makes them accessible. Rather than purchasing and establishing its entire computing infrastructure, the IaaS customer leases computational capabilities from the IaaS provider. Since services are typically priced based on actual usage, the customer only charges for whatever they consume. Because of cloud computing's dynamic scalability, they utilize (and spend for) fewer resources when the workload is light. Where there is a more critical requirement for help, IaaS can make them available to meet the demands of that specific customer. Most service agreements specify a maximum value that a customer may not go beyond. As an example, scholars and practitioners in the scientific community are prototypical IaaS customers. These clients can design experiments and interpret information to the degree that would not be feasible without the IaaS and the large amount of infrastructure it provides as a service. Amazon's Elastic Computer Cloud is one of the most popular IaaS suppliers today (EC2). Other notable IaaS providers include RackSpace, Google Compute Engine, and Windows Azure.

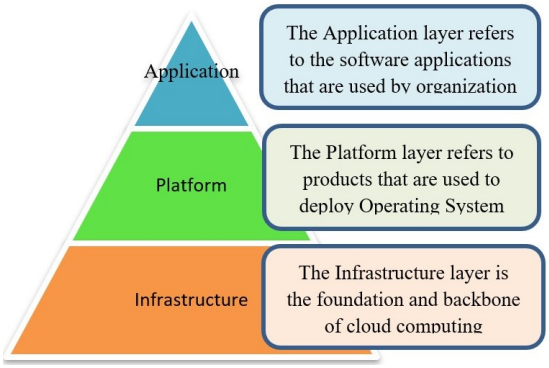

Figure 1: Layers of Cloud computing Source [7]

The second level, namely Platform as a service (PaaS), is a provider-provided infrastructure that includes an integrated software package with everything a development hub to construct apps at the design and delivery stages [27, 31]. PaaS providers don't offer infrastructure explicitly, but utilizing IaaS services provides developers with the tools they have to have an indirect connection to the IaaS infrastructure and, therefore, the architecture they require [31]. The PaaS could be regarded as a software layer,' allowing elements for apps and

apps altogether to be produced on top of the PaaS. An interconnected developer setup or a collection of stand-alone tools will help engineers work on software glitches throughout the entire software development lifecycle. This includes everything from analyzing and modeling a challenge to designing a remedy to testing and deploying it. Similar to this, a computer language that uses several operating mechanism compilers and modules makes it possible to deploy the same application on numerous systems without having to rewrite any code. Major examples of PaaS-cloud computing services market players include “Google App Engine”, “Amazon Web Services”, “Heroku”, “OpenShift- Red Hat” etc.

Software as a Service (SaaS) is the highest level in the pioneering use of cloud services when internet usage was growing in prominence [32]. Originating in the host functions of the Platform as a service, some organizations provided to everyone the applications appeared as customer interaction managements from these applications [28]. There are now numerous options available, both for businesses and private individuals as well as for education. Even though these services are delivered over the internet, which allows for geographic versatility, the direct sharing of data in this manner does not ensure its confidentiality. That's why VPNs are frequently used, as they enable data to be sent over the internet in an encoded file, keeping user and SaaS data safe and secure.

3. E-LEARNING TASKS AND CLOUD COMPUTING

E-learning systems advent expand at an exponential rate due to the suspension of on-campus classes, tremendous expansion in the number of students, instructional content, services available, and materials made accessible [21,23]. It's essential to select a platform that can scale to meet demand while still keeping expenses in check while optimizing resource processing, storing, and communication requirements. Cloud computing is what's happening here in the shape of delivery and retrieval of information and content. In contrast to previous 'traditional' learning environments, defining the promise of SaaS applications for resilient and comprehensive distance learning may help us comprehend the advantages of cloud computing mostly on a technological and pedagogical level. Throughout terms of achieving a beneficial system for online tools and interactive services, such as teaching materials, recordings, educational materials, peer instruction, and so on, we ought to offer the 'road' for supporting migration to such a model.

Many educational institutions are now using cloud technology, and it's evident that it has a promising future in [19]. In many countries, namely the UK, initiatives like JISC (2012) are in place to include an education cloud with the required tools to manage data and store the data [33]. Education SaaS refers to a cloud-based e-learning system that allows users to gain the benefit of cloud computing. Due to its modest hardware requirements, it can be swiftly deployed by the end-user. Moreover, it relieves the supplier of system service and maintenance responsibility, permitting the manufacturer to focus on the most critical business while receiving free automatic updates and providing essential resources via Web 2.0.

E-learning system architecture and cloud computing systems as part of consistency, harmony, effective resource use, and the long-term stability of the e-learning ecology from a technological standpoint in education [10]. In [29], the authors summarized the repercussions and ramifications of developing e-learning solutions in the cloud computing system. At the onset, there is a greater demand for web development abilities because the application may be accessed from anywhere, at any time. As a result, the subscriber has saved money by not paying for software, deployment, or server management. As a result, the institution will spend less money overall, have a faster deployment, and need fewer IT workers. This will be equally handy for the situations like Coivd-19 where the moment is restricted [16]. It is appropriate for the program type education sector to pay for content peruse, making it available to more sophisticated programs and required applications. Numerous educational establishments can use a SaaS server. Scalability is built-in to the system because it is hosted on a cloud server. The software's performance will not deteriorate as student usage increases. To acquire the confidence of consumers and a comprehensive providing users system software, the SaaS provider needs a sophisticated level of security. The consumer data is dispersed throughout various services and therefore must be consolidated in obtaining a comprehensive picture of the business, resulting in an increased need for platforms and data integrators for education. The advantages of a cloud-based curriculum have previously been studied from a technological standpoint by specific authors. While

affordability is the most frequently cited concern, other considerations include those highlighted for cloud use throughout the practice [33, 39, 40, 41]. It is not necessary to back up and move data between devices using a hard drive. Creating a reservoir of information means that students can keep it for as long as they desire, and it will continue to grow with them. Recovering after a crash seems to be almost entirely superfluous in this situation. There's essentially no information lost if the user machine fails. While working from numerous locations, students can access their files and modify them using virtualized programs that have also helped institutions implement E-Learning recently and notably during the lockdown. It offers academic organizations a minimal cost-effective alternative for their academics, staff, and students.

Data access monitoring is made simpler by the notion that just one location must be controlled rather than hundreds of computers dispersed across a larger region. Furthermore, because the cloud has a single database for all users, cybersecurity modifications can be efficiently evaluated and deployed [8]. Subsequently, even though more efforts are required to determine how cloud-related pedagogies or assessments of learning purposes [11], from a scholarly perspective, one of the advantages of the cloud is its ease of access [16], as it is mainly created to permit users to collaborate from anywhere at any given time. It can reach more learners outside the traditional teaching environment and meet their requirements. It can provide more meaningful information to a broader spectrum of students in a more comprehensive range of contexts [10]. Figure 2, shows the dimensions of cloud computing in its association to E-Learning.

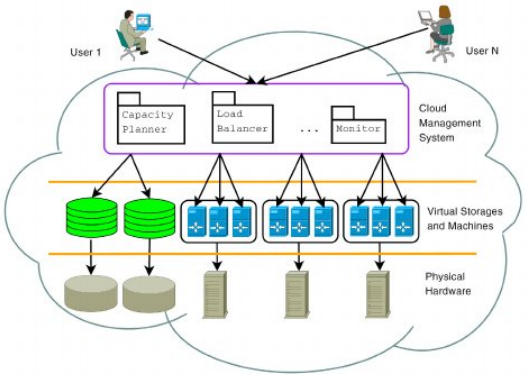

Figure 2: A glimpse of Cloud computing for E-Learning. Source [12]

It's easy to see in Figure 2 that most cloud e-learning techniques use three fundamental layers: a virtualized platform on top and a cloud management system and services layer underneath that. Two computer pools are used for teaching: a C pool with a thin client and a server pool running the hypervisor, with the private cloud architecture created using vSphere. It is possible to observe and manage all of the virtual infrastructure's hosts and services instantaneously using a web browser. Things like efficiency and configuration can be monitored along with saving alarm information and permission settings.

To allow multiple operating systems, a single hardware host hypervisor is essential. A hypervisor prevents virtual machines from interfering with one another by allocating resources to each element as they are required. In this case, a hypervisor that runs directly on the underlying hardware is the better option. This layer, which serves as an interface to the outside world, provides the PaaS and SaaS cloud users' needs. The instructional coordinators build the virtual PCs, choosing the baseline images and installing the software they've chosen afterward [27]. Thus, standardized web technologies are generated for specific course projects, and learners may connect to the respective VM using the remote network. Figure 3. shows the personalized virtual model for E-Learning.

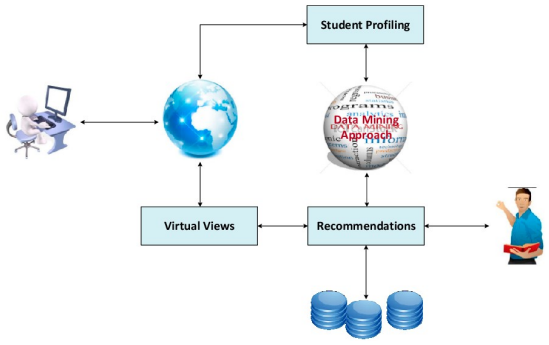

Figure 3: Personalized E-learning Architecture. Source [17]

The integration of cloud technology and e-learning has received more attention from the institutions due to its high demand to continue education. Almost all the institutions of schooling deemed it to be an operative and suitable alternative for e-Learning. Nevertheless, an absence of research may provide a theoretical foundation from which a methodology could be constructed. The

flexibility implicit in the cloud strategy, on the other hand, could've been highlighted as a considerable advantage in producing an analytical framework and creating successful teaching techniques [34]. The drawback in this field is that few studies provide a strategic or tactical of the subject.

Conversely, the overall characteristics of the cloud are associated with social engagement and collaboratively learning pursuit in the literature [28]. In [9], the authors investigate students' views of excellence and responsibility about various kinds of interaction within Google Docs. Instructional methods that use technology to alter and improve students' collective experience when producing a joint assignment. Additionally, various cloud-related studies may be found for measuring the results of online models to conventional approaches [43].

4. PERSPECTIVE CHALLENGES E-LEARNING AND CLOUD COMPUTING

E-learning may benefit greatly from today's cloud computing, applications, and capabilities as a lucrative industry [4,13]. A cloud-based e-learning system can provide significant assistance in overcoming the shortcomings of conventional local physical labs and computing platforms. Nevertheless, fundamental problems and barriers must be solved before the cloud can be widely used and adopted to facilitate and promote e-learning.

It is essential that instructors and students undergo a learning curve and that academic institutions give IT support to make good use of cloud computing for e-learning and teaching [18, 33]. Use third-party solutions or current public or commercial cloud resources or services however you like. Along with training, the instructor should be well-versed in cloud capabilities and consult with the university's IT department to establish the best cloud model for the class's requirements. The instructor must be taught how to set up and assign cloud resources and manage student accounts. Students must also be coached and instructed on how to access and use the cloud-based course resources. Depending on the course design and requirements, the learning curve for instructors and students might be steep or easy. Faculty in fields like computer science and related courses may have an easier time learning about and using the cloud than faculty in other areas.

A cloud-based system integrates the inherent advantages of cloud technology, such as cost savings, fault tolerance, and enhanced accessibility and remote connectivity into e-learning. Cloud technology benefits can be maximized with proper pre-implementation planning [3, 4, 5]. Businesses can utilize any options listed below to move from their present e-learning system to cloud-based e-learning. The process of converting an e-learning program involves several steps, including installing the operating system and middleware and implementing the server and client modules. A migration feasibility study must include user needs, existing IT infrastructure availability, and a cost/benefit analysis [44]. A system's monetary cost can be kept to a low by optimally mapping existing resources to the cloud tiered architecture using virtualization to reduce resource under-utilization.

Even though connectivity and speed have improved dramatically over the previous decade to an acceptable level worldwide, a slow internet connection can significantly impede cloud-based education and e-learning. The situation is exacerbated even further when data and services are accessed from non-regional cloud datacenters. Due to this problem, users and students of cloud-based e-learning systems may be subjected to excessive delays. The cloud may not be the appropriate Platform for teaching specific topics and disciplines if students need to use specialist software or equipment and resources in physical labs [33]. Digital forensics, mainboards, physical network devices, and robotics can be considered equipment if they require a hardware dongle. It is possible to use the cloud in part for this purpose, although it may not be possible in all cases. The use of cloud power must be thoroughly investigated and studied for such topics. Tools that closely imitate the hardware environment may hold the key to this problem's resolution. Using resources and software from both on- and off-cloud should be part of the hybrid cloud concept.

5. CONCLUSION

The overview presented in the analysis assert that using cloud services in E-learning is a nice alternative because it allows teachers to leverage cloud adaptability, flexibility, and security to represent the main framework of E-learning — instruction providing access anywhere, at any time, and from any gadget. When an efficient learning environment with specialized content is easily adaptable to today's educational paradigm, we can fully utilize the opportunities it presents. Increased

storage, computation, and network connectivity are a few advantages of integrating an e-learning system into the cloud. Software and hardware savings should be prioritized. In contrast, it has a more incredible selection of educational programs at a lesser license cost. However, the replacement rate for student computers is reduced due to the longer machine life. These savings are boosted by the decrease in IT personnel costs associated with computer lab maintenance and software updates.

Today's e-learning services and systems fall short when it comes to customizing and personalizing learning for each user. Students obtain generic e-learning that is not personalized to their needs as a result of this practice. New research and development are required for cloud-based personalized learning to be used and developed across many topic areas. In most modern systems, the interaction between professors and students is critical to increasing the quality of the learning experience for each individual. Integrating cloud-based e-learning services, such as video conferencing or instant messaging, should be possible with online and real-time training. Modern cloud-based e-learning systems make up for these shortcomings by using email, voice-over-IP, and apps like Skype. For the great majority of cloud-hosted services, this is still a concern. There are numerous factors to consider when estimating the size of a problem. Cloud service providers have made significant investments in cloud infrastructure and platforms in response to client concerns about security and privacy. Furthermore, country restrictions are essential since some countries demand that data be kept within their borders, making data storage remotely or outside the country a criminal offense. According to the current research, academics have an abundance of data at their disposal to aid in the development of cloud-based e-learning frameworks and implementations. a quantitative evaluation of the impact on numerous parameters such as access speed, influence on educational quality, and return of migrating to a cloud e-learning environment will be a future inquiry.

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