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A SUMMARY OF CLOUD COMPUTING FOR DEVELOPING THE PROCESS OF E-LEARNING

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ABSTRACT

Online communication platforms are used to support e-learning, a kind of virtualized computing, and remote learning as a tool in the teaching-learning process. In the last two years, e-learning platforms have grown significantly. When the learning process is digitized, data mining for education information processing leverages information produced from internet databases to improve the educational learning paradigm for educational purposes. A potential platform for enabling e-learning systems is cloud computing. By offering a scalable solution for long-term transformation of computer resource use, it may be automatically changed. When engaging with large e-learning datasets, it is also easier to employ data mining methods in a distributed setting. The research offers an overview of cloud computing's present condition as well as illustrations of infrastructure that has been specifically created for a system like this. It also talks about e-learning techniques and cloud computing demonstrations.

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

1. INTRODUCTION

Due to the extensive use of the internet, other digital communication technologies, and remote learning, e-learning has evolved [11]. It uses a variety of forms and features that could be most helpful for classroom education. These include, among other things, online courses, emails with links to websites, discussion forums, and other venues for learning. The learning process is better managed as a consequence of the online integration of students, content creators, and specialists. The most notable advantages of learning using web-based tools are the activities' regularity and recurrence, customization, accessibility, and simpler access [16]. In information technology (IT), e-learning or virtual education platforms are growing in popularity, especially in light of the Covid-19 epidemic and technological development. Numerous institutions throughout the world have incorporated Massive Open Online Courses (MOOCs), Blackboard, Desire to Learn (D2L), and the Virtual Learning Center as part of their worldwide E-learning initiatives [21,22]. Virtual programs, which are completely supported by the e-learning paradigm and provide a clear ideal learning environment in comparison to traditional attendance classes, are used much more often for students who may access their course materials online [6, 13, 20]. Numerous effects are a result of these ratios, including

For instance, the infrastructure needed to support that many students concurrently would be considerably beyond what users of standard online applications could handle. Additionally, the demand for educational

materials often changes quickly and dynamically, with notable activity surges. A far more sophisticated infrastructure will be needed than what is typically needed for the educational institution to operate regularly at certain times in order to react to requests without interfering with other system functions. One approach is to provide services based on consumption and charge only for resources that are really utilized under a pay-per-use model. Technology based on cloud computing offers a solution to these issues. The original goal of cloud computing was to lower computational expenses while boosting system availability and dependability [1, 30]. Since then, cloud computing has grown to achieve these objectives. However, there is a difference between the two in terms of how the tasks are determined in each environment [40]. A computing grid is more reliable in terms of technological resources and is mainly made to increase a computer system's performance. In contrast, cloud computing seeks to provide transparent mobility while letting consumers purchase a variety of services without having to get acquainted with the fundamental infrastructure. It offers a wide variety of services, such as hosting and word processing [37]. It's crucial to remember that one of the tenets of
Service Oriented Architecture (SOA) is cloud computing. This kind of technology is meant to assist programmers in overcoming a variety of dispersed organizational computing barriers, including application integration, concurrency control, and security protocols, as well as a wide range of other systems and protocols, the use of hardware and software to which we may be directly exposed, and existing data systems [24, 39]. A cloud platform's whole feature set is made available while keeping customers' access to the location and other technical details of the computing infrastructure hidden [45]. The benefits of this new computer paradigm are obvious when compared to competing technology. Because cloud software companies strive to give equivalent or greater capabilities and functionalities than if the applications were installed locally on end-user workstations, users don't have to spend money on new hardware to use the program [28]. Because it instantly intends the business needs by interactively assigning IT assets (servers) based on the computation complexity in virtual environments, these storage capacity and computing initiatives assist corporations to get their software fully operational faster, with a lesser provision of services from the IT division [14]. Large archives of student interaction with classmates and professors are also produced by expansive e-learning settings, like those previously outlined. These systems include significant data that hasn't been stated openly. Data mining methods are required [25]. In this circumstance, educational data mining (EDM) is a strategy that aids both teachers and students in improving instruction and learning [2]. This field focuses on developing new approaches for analyzing the data produced by the aforementioned present educational system activities. The ultimate objective of this approach is to better analyze student performance and develop procedures and tools that will make learning more enjoyable and simple. Computer-based tutoring programs have been created with this approach in mind in order to support the teaching and learning process. These advanced applications help kids study by keeping track of their progress and giving them feedback. The EDM process interacts with an educational model, extending and improving the information it already contains. Cloud hosting is a step toward adopting data mining methods and putting them into practice for every database, taking into account the size and capacity growth of computer capabilities (solid space, ram, and CPUs) [15, 42]. On the other hand, a few other data mining techniques aren't extremely scalable.

Scholars and corporations alike are taking note of this issue since it is becoming so important.

Due to the Covid-19 epidemic, educational institutions all across the world are switching to mixed learning or entirely online instruction. Delivering safe and sufficient resources to assist the E-learning process is the main difficulty. The goal of this study is to analyze cloud computing services for e-learning so that teachers may take use of their scalability, flexibility, and security to support and improve e-learning. The rest of this essay is structured as follows. The basic concepts of cloud computing are introduced in Section 2, E-learning tasks and cloud computing are covered in Section 3, and projected problems of e-learning and cloud computing are covered in Section 4. Section 5 brings the paper to a close.

2. FUNDAMENTAL NOTIONS OF CLOUDCOMPUTING

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 usto 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 thecontext 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 theoperating 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 applicationdesign. The supply of functioning focuses on the utilization and integration of services rather than the idea of processor algorithms, as with more traditional techniques, such as distributed systems. With regard to flexibility, reliability, scalability, and other factors, this is advantageous. For instance, multiple instances of a particular service may be started so that, in the event of a spike in resource needs brought on by an increase in users or a surge in computational load, the response time of the application remains adequate for users.

Resources should be made available as a result of a drop in demand. Everything is done in a customer-friendly manner. The least amount of connection, high level of interoperability, and protocols that separate the provider's execution and environment are some of the most significant aspects of cloud computing [41]. An SOA often divides its processes into levels or layers (instead of clear boundaries). Some components use the services provided by lower levels in order to provide upper tiers access to additional capabilities. In addition, these divisions could use different corporate structures, architectural layouts, etc. There are typically three fundamental sorts of layers that come together to make what is referred to as an arrangement, depending on the type of arrangement being given. based on the kind of arrangement being provided. Generally speaking, there are three different sorts of coatings, including what is referred to be a cloud-based storage system that offers data storage based on "files" or "blocks." A compute cloud is made out of a number of registers, columns, or other entities that provide services and give full execution capabilities. Benefits of the cloud computing concept for large-scale projects [35]. It is commonly known that many corporate and scientific applications have high computing needs. Since processing huge volumes of data stored in reliable systems needs a high level of communication connection, a continual data flow also suggests a large quantity of storage space.

Several categories may be used to organize service-oriented systems. One often used characteristic for classifying these systems is the complexity level that they provide to the system user. This approach usually differentiates between three different levels, as seen in Figure 1.

Providing infrastructure, such as data centers, network technologies, memory, or computation, is what infrastructure as a service (IaaS) does.

components such as computer systems and hardware element abstraction [26]. The software and computer program together stand in for the IaaS when compared to a single computer platform. The operating system controls and facilitates access to the system resources. The IaaS client rents computer resources from the IaaS provider rather than acquiring and setting up its whole computing infrastructure. The consumer only pays for what they use since services are often charged based on actual consumption. Because of the dynamic scalability of cloud computing, businesses use (and pay for) less resources when the demand is low. IaaS may make them accessible when there is a more pressing need for assistance in order to satisfy the needs of that particular client. Most service agreements have a top dollar amount that customers are not allowed to exceed. Scientific researchers and practitioners are a good illustration of a typical IaaS client. Due to the IaaS and the substantial infrastructure it offers as a service, these customers are able to plan experiments and analyze data to a degree that would not be possible otherwise. One of the most well-known IaaS providers nowadays is Amazon's Elastic Computer Cloud (EC2). IaaS service providers like RackSpace, Google Compute Engine, and Windows Azure are also well-known.

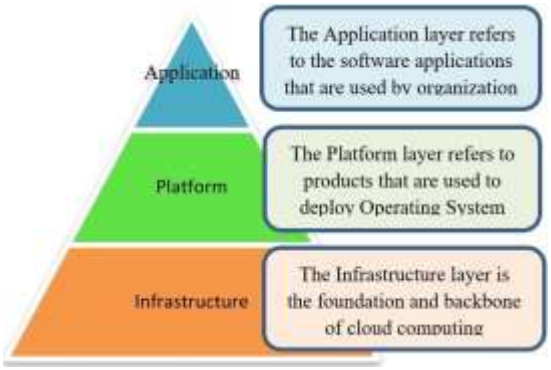

Figure 1: Layers of Cloud computing Source [7]

Platform as a Service (PaaS), which is the second level, is a provider-provided infrastructure that consists of an integrated software package with all the tools a development hub needs to build applications throughout the design and delivery phases [27, 31]. Although PaaS providers do not directly supply infrastructure, using IaaS services gives developers the resources they need to have an indirect link to the IaaS infrastructure and, therefore, the architecture they need [31]. A software layer might be thought of as the PaaS, enabling components for applications and

The creation of all applications will be built upon the PaaS. Throughout the whole software development lifecycle, engineers may work on software bugs using a networked developer setup or a variety of standalone tools. This comprises all steps from problem analysis and modeling through solution creation, testing, and deployment. Similar to this, it is feasible to deploy the same program on several platforms without having to modify any code thanks to a computer language that utilizes a variety of operating system compilers and modules. Google App Engine, Amazon Web Services, Heroku, OpenShift-Red Hat, and others are notable instances of PaaS-cloud computing service industry participants.

Software as a Service (SaaS) is the pinnacle of the early adoption of cloud computing when internet use was on the rise [32]. Some companies made available to everyone the apps that looked to be customer contact managements from the host functionalities of the Platform as a Service [28]. There are currently a lot of solutions accessible for education, corporations, and private citizens. The direct exchange of data in this way does not protect its secrecy even if these services are provided through the internet, which permits geographic flexibility. Because they make it possible to send data over the internet in an encrypted format, VPNs are widely used to keep user and SaaS data secure.

3. E-LEARNING TASKS AND CLOUDCOMPUTING

Due to the suspension of on-campus courses, the enormous growth in the number of students, instructional content, services offered, and resources made accessible, e-learning systems are advancing at an exponential pace [21,23]. It's crucial to choose a platform that can expand to accommodate demand while limiting costs and streamlining resource processing, storage, and communication needs. What is taking place in this instance is cloud computing in the form of the distribution and retrieval of material and information. Comparing current "cloud" learning settings to prior "traditional" learning environments might help us better understand the benefits of cloud computing, particularly on a technical and pedagogical level. We should provide the "road" for assisting migration to such a model in terms of developing a good system for online tools and interactive services, such as teaching materials, recordings, educational resources, peer instruction, and so on.

Cloud computing is currently widely used in educational institutions, and it is clear that it has a bright future in [19]. Initiatives like JISC (2012) are in place in several nations, including the UK, to integrate an education cloud with the necessary tools to handle and store the data [33]. A cloud-based e-learning

platform that enables users to take use of cloud computing is referred to as an education SaaS. Its minimal hardware requirements allow for quick deployment by the end-user. Additionally, it frees up the provider from system support and maintenance duties, allowing the manufacturer to concentrate on the most important aspects of their company while still getting free automated upgrades and supplying necessary resources through Web 2.0.

From a technology perspective in education, e-learning system design and cloud computing platforms are essential to the coherence, harmony, efficient use of resources, and long-term stability of the e-learning ecosystem [10]. The authors' summary of the effects and implications of creating e-learning solutions for the cloud computing system can be found in [29]. Because the application may be accessible from anywhere, at any time, there is initially a larger need for web development skills. Due to not having to pay for software, deployment, or server administration, the subscriber has saved money as a consequence. As a consequence, the institution will spend less overall, deploy more quickly, and employ fewer IT personnel. This will be useful in circumstances like Coivd-

19 if there is a time limit [16]. It is reasonable for the program type education sector to pay for content consumption so that more complex programs and necessary applications may access it. A SaaS server may be used by several educational institutions. Because the system is hosted on a cloud server, scalability is already integrated into the design. The software's performance won't suffer from increased student use. The SaaS supplier requires a sophisticated degree of security in order to win over customers' trust and supply users with complete system software. There is a greater demand for platforms and data integrators for education since customer data is distributed across many services and must be combined to provide a complete view of the company. Specific writers have already examined the benefits of a cloud-based curriculum from a technology perspective. While

The most commonly mentioned issue is price, but there are other factors to take into account, such as those emphasized for cloud use across the board [33, 39, 40, 41]. Using a hard disk to back up and transfer data across devices is not required. By building up a reservoir of knowledge, students may retain it for as long as they choose, and it will develop with them. In this case, it appears nearly wholly unnecessary to recover after a collision. If the user computer crashes, almost no information is lost. Students may access their files and make changes to them while working from other places thanks to virtualized applications, which have also lately assisted universities in implementing E-Learning, particularly during the lockout. It provides academic institutions with a barely more cost-effective option for their faculty, staff, and students.

The idea that just one place must be managed rather than hundreds of computers scattered over a greater territory makes data access monitoring easier. A single database for all users in the cloud also makes it possible to review and implement cybersecurity changes quickly [8]. Thus, even though more research is needed to ascertain how cloud-related pedagogies or assessments of learning purposes [11] will affect learning outcomes, from a scholarly perspective, one benefit of the cloud is its accessibility [16], as it was primarily designed to allow users to collaborate from anywhere at any time. Outside of the typical classroom setting, it may reach more students and satisfy their needs. It can provide more insightful information to a wider number of pupils in a wider variety of circumstances [10]. Figure 2 illustrates the characteristics of cloud computing in relation to e-learning.

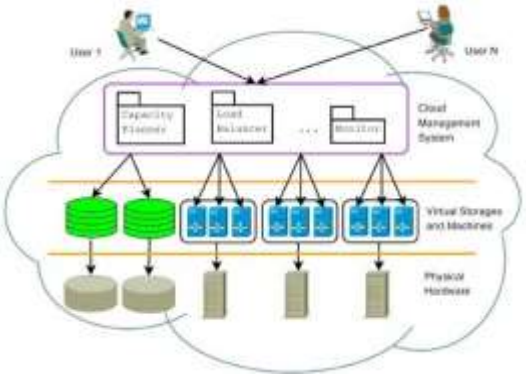

Figure 2: A glimpse of Cloud computing for E-Learning.
Source [12]

Figure 2 makes it clear that the majority of cloud e-learning systems use three basic layers: a virtualized platform on top, followed by a cloud management system and services layer. A C pool with a thin client and a server pool running the hypervisor with the private cloud architecture built using vSphere are the two computer pools used for teaching. Using a web browser, all hosts and services of the virtual infrastructure are instantly visible and manageable. Along with recording alarm data and authorization settings, monitoring things like efficiency and configuration is possible.

A single hardware host hypervisor is necessary to support several operating systems. A hypervisor allots resources to each component as they are needed, preventing virtual computers from interfering with one another. The preferable choice in this scenario is a hypervisor that operates directly on the underlying hardware. This layer meets the demands of PaaS and SaaS cloud consumers and acts as an interface to the outside world. The instructional coordinators assemble the virtual computers, selecting the basis images and then installing the necessary software [27]. As a result, for certain course projects, standard web technologies are created, and students may connect to the corresponding VM utilizing the distant network. The individualized virtual model for e-learning is shown in Figure 3.

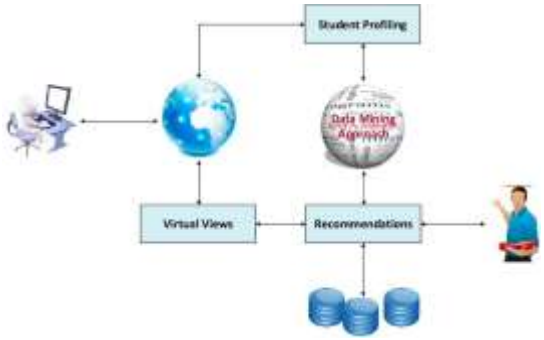

Figure 3: Personalized E-learning Architecture. Source[17]

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 alternativefor e-Learning. Nevertheless, an absence ofresearch 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 howeveryou 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 havean 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 costcan 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 areaccessed 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 disciplinesif 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 thisproblem'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. Studentsobtain 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 numerousparameters 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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