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

N.Saritha[1], N.Savitha[2], N.Kamala Vikasini[3]

[1]Associate Professor , CSE(DS), Swarna Bharathi institute of science and technology, Khammam, TG, India. Email: sarithanune@gmail.com

[2]Assistant Professor, CSE(DS), Swarna Bharathi institute of science and technology, Khammam, TG, India. Email: savitha.natuva@gmail.com

[3]Assistant Professor, CSE(DS), Swarna Bharathi institute of science and technology, Khammam, TG, India. Email: vikasini574@gmail.com

ABSTRACT

Electronic learning, or e-learning, is a kind of remote learning and virtualized computing that makes use of internet communications services to assist classroom instruction. In the last two years, there has been a meteoric surge in the popularity of online education. When it comes to computerized learning, data mining for education information processing is all about using facts from online databases to improve the educational learning paradigm. Online education solutions are well-suited to the infrastructure that cloud computing provides. By offering a scalable way to change computer resource use in the long term, it may be automatically updated. Additionally, it facilitates the employment of data mining methods in a distributed setting, which is useful for dealing with large e-learning datasets. The report gives an overview of where cloud computing stands at the moment and shows instances of infrastructure that is specifically made for it. It goes on to explain how e-learning and cloud computing work using real-world examples.E-Learning, E-Cloud, Virtual Learning, Software as a Service, Platform as a Service, Infrastructure as a Service

INTRODUCTION

The proliferation of distant learning and other forms of digital communication led to the development of e-learning [11]. It incorporates a number of features and formats that could be useful in the classroom. Online learning environments include a wide range of tools, such as discussion forums, virtual classrooms, email, and online connections. The learning experience is improved since students, content creators, and experts are all integrated online. There are several advantages to learning via web-based tools, but among the most notable are the assignments' regularity and recurrence, customization, accessibility, and ease of access [16]. Following the COVID-19 pandemic and other technological developments, online education, sometimes known as virtual classrooms, is booming in the IT industry. Blackboard, Desire to Learn (D2L), and the Virtual Learning Center are some of the linked initiatives at different educational levels that have been deployed as E-learning formats internationally [21,22]. The e-learning paradigm wholeheartedly supports virtual programs over traditional in-person classes because of the clear advantages of a more conducive learning environment, including a much higher frequency of attendance for students who may access course materials online [6, 13, 20].Many things may happen as a result of these proportions; for instance, providing a concurrent service for that many learners is much more demanding on infrastructure than what is typically available to users of online applications. In addition, there are typically large surges in activity that cause the need for instructional resources to change quickly and dynamically.A far more sophisticated infrastructure than is typically necessary for the learning institution to operate regularly at certain times will be necessary to react to requests without impacting other system functions. One possibility is to implement a pay-per-use policy that only charges for resources that are really utilized, rather than providing services based on consumption. A solution to these issues is provided by cloud computing technology. The original goal of cloud computing was to improve system availability and dependability while decreasing computational expenses [1, 30]. Since then, cloud computing has taken up these aims. But the two are different in the way the tasks are computed in each environment [40]. Computing grids are more stable in terms of technological resources, and their primary purpose is to optimize computer system performance. However, cloud computing's primary goal is to make mobility visible so that customers may focus

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on acquiring services rather than learning the underlying technology. Its feature set is extensive, comprising more than just hosting and word processing [37]. It must be emphasized that a cornerstone of SOA is the foundation of cloud computing. Application integration, concurrency control, security protocols, multiple systems and protocols, the use of hardware and software that we may be directly exposed to, and existing data systems are just a few of the dispersed organizational computing hurdles that this type of technology aims to assist programmers in overcoming [24, 39]. Users are not made aware of the physical location or any other technical details of the underlying computer infrastructure when they utilize any of the features of a cloud platform [45]. The benefits of this new paradigm in computing stand out when compared to other competing technologies.Cloud software manufacturers aim to provide users with the same or greater capabilities and functionalities as if the apps were installed locally on their PCs, saving them money on new hardware investments [28]. Instantaneously anticipating business needs through interactively assigning IT assets (servers) based on computation complexity in virtual environments, these computing and storage initiatives help corporations get their software fully operational with less provision of services from the IT division [14]. Large archives of student involvement with peers and professors are also produced by massive e-learning environments, like the ones mentioned previously.Large amounts of unannounced data are kept in these systems. There's a requirement for data mining algorithms [25]. One strategy that might assist in this regard is educational data mining (EDM) [2], which is useful for both teachers and students. The goal of this field is to develop new approaches to analyzing the data generated by the aforementioned activities taking place in the education system right now. Understanding student performance better and developing procedures and resources to make learning more interesting and easy is the ultimate objective of this strategy. This method is closely related to computer-based tutoring tools that have been designed to aid in the process of teaching and learning. These advanced programs help students learn by keeping track of their progress and offering comments on their work. Through its interactions with the EDM process, an instructional model is able to expand and enhance its knowledge base. Cloud hosting is a method for embracing data mining methods and applying them to all databases, taking into account the magnitude and capacity increase of computer capabilities (solid space, RAM, and CPUs) [15, 42]. However, other more data mining strategies lack scalability. Academics and companies alike are taking note of this rapidly evolving field.Worldwide, schools are using blended or online curricula as a response to the COVID-19 epidemic. The provision of sufficient and safe resources to bolster the E-learning process is the primary obstacle. The goal of this study is to provide educators with the knowledge they need to make use of the scalability, flexibility, and security features offered by cloud computing services in order to improve and promote online learning. Here is how the rest of the paper is structured. In Section 2, we will go over the basics of cloud computing. In Section 3, we will talk about E-learning tasks and cloud computing. Finally, in Section 4, we will highlight the issues that come from a viewpoint on both e-learning and cloud computing. Section 5 serves as the paper's conclusion.

1. FUNDAMENTAL NOTIONS OF CLOUD COMPUTING

Everything you've read up to this point has been a review of cloud computing. Since the evaluation is grounded in qualitative analysis, the idea may be presented in a more detailed manner by the researchers.The purpose of a literature review is to address research by providing an overview, summary, and analysis of a subject by reviewing relevant publications, academic papers, and other source materials on the topic. One such method is cloud computing, which involves delivering various resources and services including software, servers, databases, networking, and data storage over the internet. This leads us to the idea of service-oriented architecture (SOA) [36], an integration framework that combines a rational and technological framework to aid and include all kinds of facilities. To put it simply, service in the context of cloud computing is a function that has been packaged in a way that it may be automated and given to clients in an organized and standardized manner. A service may be anything from the physical characteristics of the hardware itself, such storage capacity or processing time, to the software components that are used for user verification, mail handling, database management, or operating system regulation. At its core, the idea of cloud computing proposes a change in the way problems are addressed by means of technology [38]. The foundation of application is the use and combination of services.design. Functionality is provided by the use and integration of services rather than processor algorithms, as is the case with more traditional approaches like distributed systems. To rephrase, this provides advantages in terms of being flexible, reliable, scalable, etc. For instance, when resource needs spike owing to an increase in computational load or a surge in clients, it is possible to create extra instances of a certain service to ensure that the application's response time remains suitable for users.When demand drops, you should release the resources you have.

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To the consumer, everything is done sensibly.Few connections, great interoperability, and protocols that isolate the provider's execution from the environment are some of the most distinctive features of cloud computing [41]. Rather of using hard and fast boundaries, it is usual practice for a service-oriented architecture (SOA) to partition its processes into layers. In order for higher-level components to access other capabilities, some of them rely on services provided by lower-level components. In addition, these departments may use different architectural plans, corporate structures, and the like. When you put all three kinds of layers together, you obtain what is known as "According to the kind of arrangement being offered." The specifics of the arrangement dictate which layers are used. Along with the three main categories of coatings, there is also what is essentially a cloud-based storage system that stores data in "files" or "blocks."A compute cloud provides full execution services, and cloud computing is a network of registers, columns, or entities that deliver services.The cloud computing approach is helping megaprojects [35].The high computational demands of many scientific and commercial applications are well-known. Because stable systems store massive quantities of data, a continual data flow requires a high-level communication connection to accommodate the data's storage requirements. A number of categories may be used to classify service-oriented systems. The degree of complexity these systems provide to the user is a popular metric for classifying them.Figure 1 shows that this strategy often differentiates between three different levels. Data centers, networks, memory, and computation are all examples of infrastructure that is made available via infrastructure as a service (IaaS) [26]. Other crucial components include computer systems and the abstraction of physical components. When we think of IaaS as a monolithic computer platform, the software and computer programs are what make up the platform. All of the system's resources are accessible and managed by the operating system. The client of the infrastructure as a service (IaaS) model rents computational capabilities from the provider, rather than buying and constructing its own computer infrastructure. Customers only pay for the resources they really use, as most service prices are tied to consumption. When the burden is low, they use (and pay for) less resources because to cloud computing's dynamic scalability. With IaaS, they may be made accessible to satisfy the needs of a particular client in cases when their need for assistance is more important. The vast majority of service agreements include a limit value that clients are not allowed to exceed. One example of a common IaaS client is someone working in the scientific field, such as a professor or researcher. Due to the extensive infrastructure that the IaaS offers as a service, these customers are able to conduct experiments and analyze data to an extent that would be impossible without it. Among the many IaaS providers available today, Amazon's Elastic Computer Cloud ranks high (EC2). Microsoft Azure, RackSpace, and Google Compute Engine are a few more well-known IaaS providers.

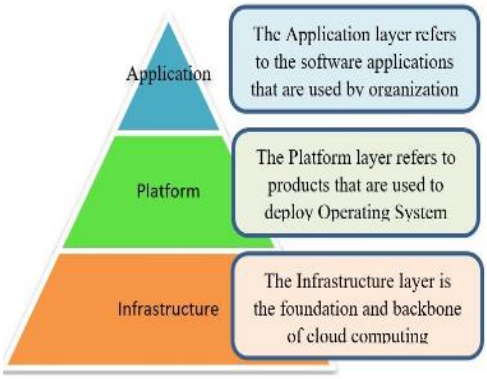

Figure 1: Layers of Cloud computing Source [7]

The second tier, known as Platform as a service (PaaS), is an infrastructure that is offered by a provider. It consists of an integrated software package that gives developers a hub to build applications throughout the design and delivery phases [27, 31]. Despite the fact that PaaS providers do not supply infrastructure directly, developers may still access the architecture they need by using IaaS services, which provide them the tools they need to indirectly connect to the IaaS infrastructure [31]. One way to look at the PaaS is as a "software layer" that provides resources for both applications and software to be built on top of the platform as a service. Engineers will be able to fix software issues at any point in the software development lifecycle with the aid of an integrated developer setup or a set of standalone tools. The whole process, from problem identification and modeling to solution creation, testing, and deployment, falls under this umbrella.The same holds true for computer languages that make use of several OS compilers and modules; this allows for the deployment of the same program on many platforms without rewriting any code. "Google App Engine," "Amazon Web Services," "Heroku," "OpenShift—Red Hat," and many more are prominent examples of PaaS-cloud computing services industry companies. The most advanced kind of cloud computing during the early days of the internet was known as software as a service, or SaaS [32]. These apps first arose as customer contact managements from the host functionalities of the Platform as a service, which some corporations made available to everyone [28]. There are now a plethora of choices for schools,

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people, and companies alike. While these services are accessible from anywhere in the world thanks to the internet, there is no guarantee that the data shared in this way will remain private. That's why virtual private networks (VPNs) are so popular; they encrypt data before sending it over the internet, protecting both users' and SaaS providers' information.

2. E-LEARNING TASKS AND CLOUD COMPUTING

The massive increase in the quantity of students, instructional content, services, and resources made available, as well as the suspension of on-campus courses, have all contributed to the exponential growth of e-learning systems in recent years [21,23]. Choose a platform that can grow with your business, keeping costs low and making the most efficient use of your resources in terms of processing, storage, and communication. What we are seeing here is the manifestation of cloud computing in the form of content and information delivery and retrieval. We may better understand the technical and pedagogical benefits of cloud computing if we distinguish it from prior "traditional" learning settings and describe the potential of software as a service applications for robust and all-encompassing distant learning. We need to pave the way for migration to an effective system for online tools and interactive services including recordings, educational resources, teaching materials, peer instruction, and so on. Cloud computing is quickly becoming the norm schools, and its future is bright [19]. Education clouds equipped with data management and storage capabilities are already in existence in several nations, including the UK, thanks to efforts like JISC (2012) [33]. Knowledge acquisition One kind of cloud-based e-learning system that lets users take use of cloud computing is called SaaS. Quick deployment by the end user is possible because of its low hardware requirements. In addition, the manufacturer may concentrate on their most important business while still taking use of Web 2.0 resources and free automated upgrades since the provider of system servicing and maintenance is relieved of this task. From a technical perspective, the long-term stability of the e-learning ecosystem, as well as its components—including cloud computing systems and e-learning system architecture—are important considerations in education [10]. The authors summed up the consequences and effects of creating cloud-based e-learning systems in [29]. Since the program may be accessible from anywhere at any time, web development skills are in high demand initially. Consequently, the subscriber has conserved funds by avoiding expenses related to software, deployment, and server administration. Consequently, the institution will save money, deploy more quickly, and need fewer IT staff. In cases when time is of the essence, such as COVID-19, this will be just as useful [16]. More advanced programs and necessary applications should be able to access material reading, which is why the program type education sector should pay for it.

A SaaS server is suitable for many schools. Being hosted on a cloud server makes scalability an inherent part of the system. There will be no degradation in the software's performance due to an increase in student use. A sophisticated degree of security is necessary for the SaaS provider to gain the trust of customers and supply them with complete system software. There is a growing need for platforms and data integrators in the education sector as a whole to help bring together the disparate consumer data sets that are necessary for a full view of the company. Prior research by some writers has examined the benefits of a cloud-based curriculum from a technology perspective.

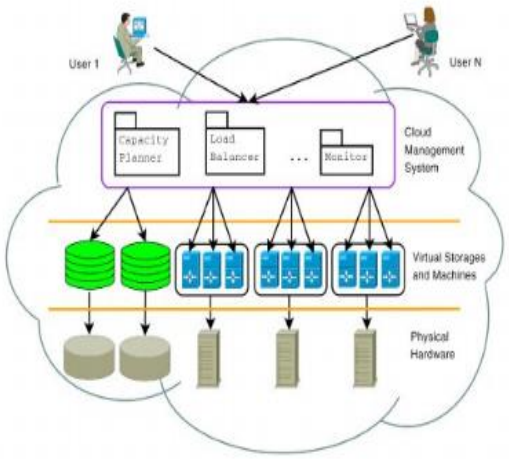

Figure 2: A glimpse of Cloud computing for E-Learning. Source [12]

Figure 2 clearly shows that the majority of cloud Online learning methods rely on three primary tiers: on top of a cloud-based virtualized platform management system and services layer below that. Two computer pools are utilized for teaching:
a C pool equipped with a slim client and a server pool that operates the hypervisor, with the private cloud architecture built on the vSphere platform.
Sure, you can watch and oversee every host in the virtual infrastructure and services with the use of a web browser in a moment. Efficiency and setup are two examples of kept tabs on while also documenting and storing warning data and configuration of rights. For the purpose of supporting several OSes, a Hypervisors on a single host hardware are mandatory.A Using a hypervisor

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stops virtual computers from conflicting with one another via the distribution of resources to each piece when they are necessary.When this occurs, a virtual machine that operates on top of the underlying hardware would be the superior choice.
This stratum, and facilitates communication with the outside world,supplies the PaaS and SaaS cloud consumers' demands.
The instructional coordinators build the virtual PCs, selecting the reference photos and setting up the program they ultimately decided on [27]. Thus, created with web standards in mind in order to students working on individual assignments have the opportunity to across the external network to the corresponding virtual machine. The third figure. displays the individualized digital representation for Distance Education.

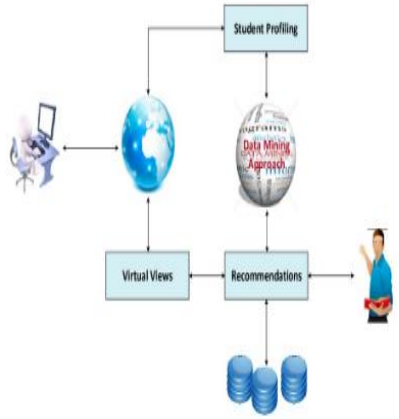

Figure 3: Personalized E-learning Architecture. Source [17]

4.PERSPECTIVE CHALLENGES E-LEARNING AND CLOUD COMPUTING

As a profitable market, e-learning stands to gain a lot from the cloud computing, apps, and capabilities available today [4,13]. Traditional on-premises computer laboratories and platforms have their limitations, but an online learning system hosted in the cloud may help alleviate these issues to a large extent. However, in order for the cloud to be extensively used and accepted to support and advance e-learning, several essential issues and hurdles must be overcome. In order to make effective use of cloud computing for online education, both teachers and students must go through a period of adjustment, and schools must provide enough IT support [18, 33]. You are free to make whatever use you want of third-party solutions or existing public or commercial cloud resources and services. The teacher should not only have training, but also be knowledgeable about cloud capabilities. They should also confer with the university's IT staff to determine the optimal cloud model for the class's needs. The teacher has to learn how to create student accounts, allocate cloud resources, and manage their own settings. Additionally, students will need guidance and instruction on how to use the course materials stored in the cloud. The learning curve for both students and teachers might be steep or flat, depending on the course's needs and design. It may be simpler for professors teaching computer science and related subjects to understand and use the cloud than professors teaching other subjects.
Online education may take use of the many benefits of cloud computing, including scalability, fault tolerance, improved accessibility, and distant connection, by adopting a system that is cloud-based. With careful preparation before using cloud technology, you can get the most out of it [3, 4, 5]. To transition from their current e-learning platform to one hosted in the cloud, businesses may take use of any of the following methods. Installing OS and middleware, as well as building server and client modules, are a few of the many phases involved in converting an e-learning program.User requirements, the state of the IT infrastructure, and a cost-benefit analysis are all essential components of a migration feasibility study [44]. By minimizing resource under-utilization via virtualization and optimizing the mapping of current resources to the cloud tiered architecture, system costs may be maintained low.A poor internet connection may greatly hinder cloud-based education and e-learning, even if connectivity and speed have improved substantially over the last decade to an acceptable level globally. The problem is made much worse when cloud datacenters located outside of the area are used to access data and services. Users and students using e-learning systems hosted in the cloud may experience lengthy delays as a result of this issue. If students need access to specialized software, hardware, and resources in physical laboratories, then the cloud may not be the best platform for their education [33]. Equipment might include digital forensics tools, physical network devices, robots, and mainboards that need a hardware dongle. While this may not always be feasible, it is certainly doable with some cloud computing. For such subjects, extensive research and investigation on cloud power use is required. It is possible that the answer to this challenge lies in tools that closely mimic the hardware environment. The idea of a hybrid cloud should include using software and resources from both on-and off-cloud sources.

5.CONCLUSION

According to the analysis's high-level summary, cloud computing is a great option for online education since it gives educators access to the main tenet of E-learning, which is instruction that can be accessed from any device, at any time,

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thanks to the cloud's adaptability, flexibility, and security. The possibilities presented by the modern educational paradigm may be fully exploited when a well-designed learning environment with specialized material is readily adaptable to it. Increased There are many benefits to integrating an e-learning system into the cloud, including storage, computing, and network access. Priority should be given to software and hardware cost reductions. On the other hand, it offers a vast array of instructional programs at a lower cost for licenses. But since the computers last longer, the replacement rate goes down. The reduction in expenditures connected with IT professionals doing software upgrades and computer lab upkeep contributes to these savings. Customization and personalization of learning for each user is an area where current e-learning systems and services fall short. This method leads to students receiving generic online education that does not address their unique requirements. The widespread use and advancement of cloud-based customized learning across a wide range of subject areas need more study and development. The quality of each student's learning experience is greatly enhanced in most contemporary systems by the interaction between professors and students. Online and real-time training should be able to integrate with cloud-based e-learning services like video conferencing or instant messaging. By using email, voice-over-IP, and applications like Skype, modern cloud-based e-learning systems compensate for these limitations. The vast majority of services that are hosted on the cloud still worry about this. When trying to put a number on the magnitude of an issue, there are a lot of moving parts. In reaction to customer worries over privacy and security, cloud service companies have poured a lot of money into cloud infrastructure. In addition, it is crucial to adhere to national limitations, since some nations have laws that make it illegal to store data remotely or outside of their borders. Researchers now have a plethora of data at their fingertips, which could be useful for building and implementing e-learning frameworks in the cloud.

Moving to an e-learning platform in the cloud will be the subject of future quantitative studies that examine its effects on several metrics including return, educational quality, and access speed.

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