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CONCEPTS IN CLOUD COMPUTING AND HOW THEY ARE BEING USED TO FURTHER E-LEARNING

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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. In the last few of years, online learning platforms have grown at an astounding rate. The utilization of internet-sourced data in educational IT processing is called "data mining." databases designed to improve the educational learning paradigm while using computers to facilitate the learning process. The cloud may serve as a reliable infrastructure for online education tools. Long-term changes in computer resource use may be made automatically with the help of a scalable solution. When working with large e-learning datasets, a distributed data mining environment may greatly simplify the process. The research provides a brief overview of cloud computing at the present time as well as some instances of cloud-specific infrastructure. Moreover, it provides some real-world instances of cloud computing and e-learning approaches.

1. INTRODUCTION

The proliferation of the internet and other digital communication networks, together with the growth of distant learning, led to the development of e-learning [11]. It employs in a variety of forms and with various capabilities, to serve as instructional aids in the classroom. Some examples include online courses, email and web connections, online forums, and mobile apps. Students, content creators, and educators can all work together more effectively in an online setting, which improves the teaching and learning process overall. Most notably, learning using web-based technologies allows for more consistency and repetition in activities, as well as flexibility, accessibility, and convenience [16]. Following the spread of Covid-19 and the development of digital technology, the use of e-learning or virtual teaching platforms is expanding in the field of information technology (IT). Blackboard, Desire to Learn (D2L), and the Virtual Learning Centre at a number of colleges are just some of the E-learning formats being used on a worldwide scale [21, 22]. There is a clear ideal learning environment for people who can get their material online, and the frequency with which they may participate in virtual programs that are completely approved by the e-learning paradigm is much higher than in traditional attendance classes [6, 13, and 20]. Many things are affected by these numbers, including the fact that supporting so many students at once requires far more resources than is already in place. Excel beyond the capabilities of regular users of online applications. Even more so, there are often sudden 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. A pay-as-you-go model in which services are delivered depending on consumption and costs are incurred only when resources are actually utilised is feasible. The advent of cloud computing has made it possible to address these issues. The original idea behind cloud computing was to lower the price of processing while simultaneously increasing system availability and dependability [1, 30]. Cloud computing is an evolution of these original ideas.

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There is a difference between the two, however, in terms of how the tasks are determined in each environment [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 be transparent in its mobility and service acquisition, rather than requiring consumers to be experts in the underlying infrastructure. It offers a wide variety of services, not only hosting and word processing [37]. A key component of cloud computing is SOA, or Service Oriented Architecture (SOA). There are many various systems and protocols, the usage of hardware and software, and existing data systems that this technology is meant to assist programmers overcome [24, 39]. Other examples of such hurdles include application integration, concurrency control, and security protocols.

A cloud platform makes all of its features available to users while concealing their physical location and other technical details. Users' feedback on the system's underlying hardware and software [45]. It's easy to understand the benefits of this new computer paradigm when compared to other technologies. Cloud software companies aim to provide equivalent or greater capabilities and functionalities than if the apps were installed locally on end-user workstations, saving users the cost of purchasing new hardware [28]. Since 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 help corporations get their software fully operational faster, with a lesser provision of services from the IT division [14]. Large-scale online classrooms, like the ones we've been talking about, also result in voluminous records of students interacting with one another and with instructors. Large amounts of information are hidden away in these systems. Algorithms for data mining are required [25]. In this context, educational data mining (EDM) is a strategy that benefits teachers and students alike. The goal of this field is to develop original methods for analyzing the data produced by the aforementioned modern educational system. The end objective of this strategy is to get a deeper understanding of how students perform in order to develop procedures and resources that facilitate and enhance learning. Computer-based tutoring systems that were made to aid in education have a direct relationship to this strategy.

These are high-tech tools that help kids study by keeping tabs on their progress and giving them suggestions for improvement. By interacting with the EDM procedure, an instructional model is able to get access to new information and hone its existing understanding. In light of the exponential growth in storage, memory, and processing power of computers, cloud hosting is an evolutionary step toward storing and accessing data remotely. Algorithmic mining and application to any database [15, 42]. However, there are a number of other data mining techniques that suffer from a lack of scalability.

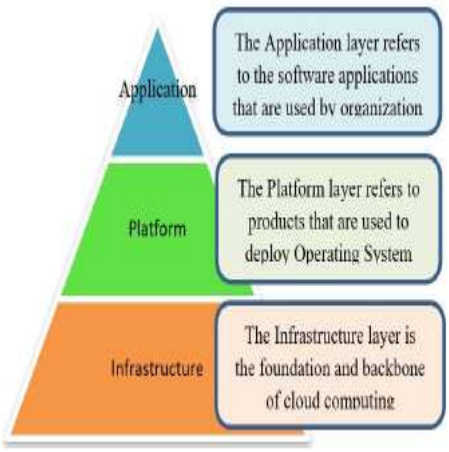
Scholars and industries alike are beginning to take note of this topic's growing importance. As a result of the Covid-19 epidemic, schools all around the world are transitioning to either a hybrid model or an online-only curriculum. The biggest obstacle is providing enough reliable materials to back up the E-learning system. The goal of this study is to examine cloud computing services for e-learning in order to help teachers take use of the cloud's scalability, adaptability, and security features to better facilitate and improve online education. Here is how the rest of the paper is structured. Cloud computing is defined and explained in Section 2, followed by a discussion of how cloud computing may be used for E-learning activities in Section 3, and finally a discussion of the potential difficulties that might arise from combining e-learning with cloud computing in Section 4. The article closes with Section 5.

2. FUNDAMENTAL NOTIONS OF CLOUD COMPUTING

Cloud computing has been reviewed in detail in the previous sections. The review relies on qualitative analysis to draw conclusions. Researchers to elaborately convey the idea a literature review is a comprehensive overview, summary, and analysis of a study topic that is based on a thorough examination of relevant publications, academic papers, and other source materials. Computing in the cloud is a new method of providing various resources and services through the internet, including data storage, servers, databases, networking, and software. This led to the development of service oriented architecture [36], a set of guidelines for system integration that combines a conceptual and technical framework to aid in the incorporation of a wide variety of services. When discussing cloud computing, a "service" is essentially a "wrapped" function that can be automated and given to clients in a standardized and organized manner. Services may be thought of as anything from hardware add-ons like memory or CPU cycles to software components like user authentication, email management, database administration, and operating system controls.

A core tenet of the cloud computing ethos is a change in the way problems are approached technologically [38]. Application development is

predicated on the consumption and combination of services. In contrast to more traditional approaches, such as distributed systems, the supply of functionality is dependent on the utilization and integration of services, rather than on the idea of processing algorithms. The advantages of this lie in its flexibility, reliability, scalability, and so on. Launching more instances of a service, for instance, might help keep an application's response time within acceptable bounds even if demand for its underlying resources increases owing to, say, an influx of new users or a surge in computing demand. A drop in demand calls for freeing up existing resources. All efforts are made to treat the consumer reasonably. The most striking features of cloud computing are its low connection requirements, high level of interoperability, as well as protocols that provide a buffer between the provider's code and its environment [41]. Its usual practice for a service oriented architecture to separate its components into several tiers or layers (rather than in precise boundaries). Some parts use services provided by lower levels to enable features in higher tiers. In addition, each sub-division may use a different set of corporate guidelines, building plans, etc. There are typically three primary sorts of layers that come together to make the term "according to the kind of arrangement being given." A cloud-based storage system that delivers data storage based on "files" or "blocks" is one of the three primary kinds of systems used today. A client of infrastructure as a service (Iasi) rents computational capabilities from the Iasi provider rather than buying and setting up their own infrastructure for computing. Since the cost of services is often calculated on a per-unit basis, the client pays only for the resources they actually use. By taking advantage of cloud computing capacity to dynamically scale, businesses may save costs by reducing resource use during periods of low demand. Iasi may make resources accessible to address the needs of a particular clientele when there is an especially pressing need for assistance. In most cases, the maximum amount a consumer may spend is spelled out in the service agreement. Scholars and scientists, for instance, are a typical Iasi user. Without the Iasi and the extensive infrastructure it offers as a service, these customers would be unable to conduct experiments or understand data to the same extent. One of the most well-liked IaaS providers now is Amazon, with its Elastic Computer Cloud (EC2). Extraordinary Infrastructure as a Service Rack Space, Google Cloud Platform, and Microsoft Azure are just some of the providers out there.



The Cloud's Stack (Figure 1) Authors' own work [7]

In the second tier, known as Platform as a Service (Peas), the underlying technology is hosted by the service provider. It provides a central location for app creation and contains all the necessary tools for designing and distributing applications [27, 31]. Although Peas providers don't often supply infrastructure itself, by using Iasi services, architects may get the tools they need to build on top of the underlying infrastructure [31]. The platform as a service (Peas) may be thought of as a "software layer" since it facilitates the development of app components and whole applications. At each point in the software development process, engineers may benefit from a well-connected development environment or a set of standalone tools for fixing software bugs. This covers everything from identifying the issue at hand and creating a model of it, to developing a solution, testing it, and finally putting it into production. Just like this, the ability to deploy the same program on several systems without rewriting the code is a key feature of computer languages that take use of multiple operating mechanism compilers and modules. Google App Engine, Amazon Web Services, Hurok, Open Shift-Red Hat, etc. are only some of the major companies in the Peas-cloud computing services industry.

The greatest level of early cloud service use, Software as a Service (Seas) emerged around the time when internet penetration was at an all-time high [32]. Some companies gave to all users the programs that manifested as customer contact managements from the Platform as a service [28]. As a result, companies, people, and schools may now choose from a wide range of viable alternatives. Although these services are provided online, making them accessible from anywhere, the direct exchange of information raises privacy concerns. It's for this reason why virtual private networks (VPNs) are so popular; they allow users to send sensitive information (such as credentials

for their Seas accounts) across the internet in an encrypted file.

3. E-LEARNING TASKS AND CLOUD COMPUTING

Due to factors including the elimination of traditional classrooms and the explosion of available information, the use of online learning platforms is rapidly growing. Information on the number of students, the curriculum being taught, the support services provided, and the resources made available [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. In comparison to more "conventional" classroom settings, the benefits of cloud computing may be better understood if we define the promise of Seas applications for robust and complete distant learning. We should provide the "road" for encouraging the transition to such a paradigm in order to realize the full potential of online resources and interactive services like lesson plans, audio/video recordings, educational resources, peer training, etc.

There is little doubt that cloud computing will continue to gain popularity in the academic world in [19]. Initiatives like JISC (2012) have been implemented in several countries, including the UK, to provide an education cloud equipped with the necessary tools 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 (Seas) e-learning platforms. It can be set up quickly by the end-user because of the low hardware requirements. Furthermore, it releases the provider from service and maintenance obligations, allowing the manufacturer to save time and energy on less important tasks while still obtaining key updates and support using Web 2.0 tools. Consistency, harmony, effective resource usage, and long-term stability of the e-learning ecosystem from a technology perspective in education [10] through the use of cloud computing platforms as part of the e-learning system design. Consequences and implications of creating e-learning solutions in the cloud computing system are summed up in [29]. Because the program may be accessible from anywhere at any time, there is an initial higher need for web development skills. Due to not having to pay for software, deployment, or server administration, the subscriber has seen cost savings. Total costs will go down, deployment time will shorten, and less IT staff will be required. Also helpful [16] in time-sensitive circumstances like Coivd-19. For this reason, the educational sector should be the one to foot the bill for content consumption, freeing it up for use in more complex and obligatory software.

A software as a service (SaaS) server has several potential uses in the academic world the idea that just one central point has to be governed in order to keep tabs on whose accessing data is a huge boon to efficiency when compared to the alternative of monitoring hundreds of machines spread out throughout a wider area. Plus, cloud computing centralized data storage makes it easy to test and implement cyber security updates for all users at once [8]. Accordingly, 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]. In addition to meeting the needs of students in conventional classrooms, it may also serve those students who choose to study in non-classroom settings. It has the potential to reach more students with more relevant information in a wider variety of settings [10]. Cloud computing relation to e-learning is shown in all its aspects in Figure 2.

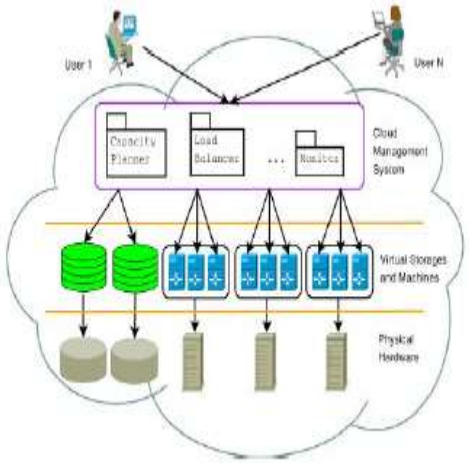


Figure 2: A glimpse of Cloud computing for E-Learning. Source [12]

Figure 2 shows the typical architecture of a cloud-based e-learning solution, which consists of three layers: a virtualized platform, a cloud, and an application layer. Underlying management and service layer. The sphere-based private cloud architecture consists of two computer pools used for instruction: a C pool with a thin client and a server pool running the hypervisor. All of the hosts and services that make up the virtual infrastructure may be monitored and managed in real time using a web browser. Not only can performance and configuration metrics be tracked, but also alarm history and access control configurations. A single hardware host hypervisor is required to support multiple Oases. By dynamically assigning system resources to individual virtual computers, a

hypervisor keeps them from interfering with one another. A hypervisor that can function natively on the hardware is preferable here. The requirements of Peas and Seas cloud customers are met by this layer, which acts as an interface to the outside world. The virtual computers are assembled by the course organizers who choose the initial images and then install the desired applications [27]. As a result, students may connect to the appropriate VM over the distant network, and teachers can develop standard web technologies for use in various course assignments.

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

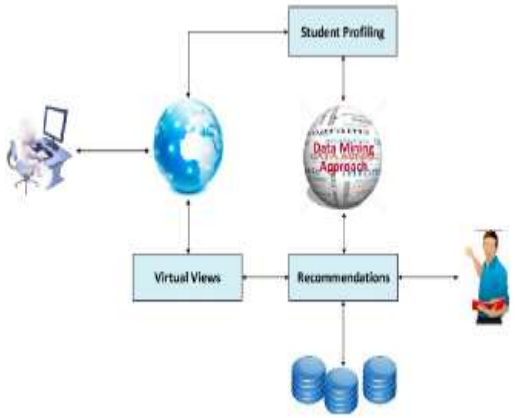


Figure 3: Personalized E-learning Architecture. Source [17]

More institutions are investing in cloud-based e-learning because of the growing demand for this combination. Education. The vast majority of universities and colleges saw it as a viable and appropriate alternative to e-Learning. Nonetheless, a lack of studies may give a theoretical basis upon which a technique might be built. On the other hand, the advantages of cloud computing in developing an analytical framework and effective pedagogical methods may have been emphasized [34]. A major shortcoming of this area of study is the lack of studies that provide a strategic or tactical overview of the topic.

On the other side, the general properties of the cloud are linked to social interaction and the desire of collaborative learning [28]. The authors of [9] probe students' conceptions of excellence and accountability in relation to different forms of engagement while using Google Docs. Learning strategies that employ digital tools to enhance and modify the group learning experience while completing a common task. In addition, much research comparing the efficacy of online models to more traditional techniques may be found in the cloud [43].

4. PERSPECTIVE CHALLENGES ELEARNING AND CLOUD COMPUTING

Cloud computing, apps, and capacities of the present day may be very beneficial to the e-learning industry's potential for success [4, 13]. An online educational platform hosted in the cloud when used to supplement local physical laboratories and computer platforms, a system may be a huge help in making up for their deficiencies.

But before the cloud can be extensively utilized and embraced to assist and promote e-learning, basic challenges and obstacles must be overcome. To make effective use of cloud computing for e-learning and teaching, it is crucial that both instructors and students go through a learning curve, and that educational institutions provide IT assistance [18, 33]. If you choose not to build your own infrastructure in the cloud, feel free to make use of existing public or commercial cloud resources and services. The teacher should be familiar with cloud capabilities and work with the school's IT staff to determine which cloud model is ideal for the needs of the course. The educator needs guidance on how to implement cloud services, such as creating and allocating resources and managing user accounts.

In addition, students need guidance and instruction on how to access and make use of cloud-based course materials. Teachers and students may have a steep or gentle learning curve depending on the course's structure and prerequisites. Teachers in subjects like computer science and related courses may find it simpler to adapt to and benefit from the cloud. The benefits of cloud computing, such as reduced overhead, increased reliability, and better accessibility from afar, may be incorporated into e-learning via a cloud-based system. Planning ahead for the use of cloud technology is essential for maximizing its advantages [3, 4, and 5]. To make the switch from on-premises to a cloud-based e-learning system, businesses might use any of the following strategies.

Installing the OS and middleware and creating the server and client modules are only a few of the many tasks involved in converting an e-learning program. User requirements, the state of the current information technology framework, and a timeline for the transfer should all be included into any feasibility assessment of the examination of the costs and benefits [44]. By mapping current resources to the cloud tiered architecture in an efficient manner, virtualization may help keep costs down by minimizing unused resources. A poor internet connection may considerably hinder cloud-based education and e-learning, despite the fact that connectivity and speed have drastically improved over the preceding decade to an acceptable level globally. When information and services are

accessible from cloud data enters outside of their normal location, the problem becomes much more acute. Users and students using cloud-based e-learning systems may experience significant delays as a result of this issue. If students require access to specialized software or hardware in physical laboratories, the cloud may not be a suitable Platform for the teaching of such subjects. [33]. Equipment may include digital forensics tools, motherboards, physical network devices, and robots. While this may not always be practicable, it is conceivable to utilize the cloud for this reason. To this end, more research and study into the usage of cloud power is required. The answer to this issue may be found in tools that can simulate a hardware setting as accurately as possible. The notion of a hybrid cloud includes the use of on-cloud and off-cloud resources and applications.

5. CONCLUSION

According to the analysis's summary, adopting cloud services in E-learning is a great option since it gives educators access to a wealth of resources. Because of the cloud's scalability, portability, and safety, e-learning can take place anytime, anywhere, and on any device. We can make the most of the chances it affords us if we have access to a highly effective learning environment that includes specialized information that can be readily adapted to the current educational paradigm. The integration of an e-learning system into the cloud has several benefits, including increased storage, processing, and network connection. Budget-friendly software and hardware are a top priority. Instead, it offers a more impressive variety of instructional programs for a lower licensing price. However, since computers are lasting longer, there is less need to constantly replace them among students. Having fewer IT workers to pay for routine tasks like lab computers' upkeep and software upgrades increases these cost reductions. When it comes to tailoring lessons to each individual, current e-learning platforms and services fall short. This method results in students receiving impersonal, cookie-cutter e-learning. The use and improvement of cloud-based customized learning across numerous subject areas calls for new research and development. Professor-student dialogue is essential in most contemporary educational institutions 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 and instant messaging. These drawbacks are mitigated in today's cloud-based e-learning platforms by use of email, voice-over-IP, and programs comparable to Skype. This is still a problem for the vast majority of cloud-based services. Estimating the scale of an issue is complicated by a number of reasons. As a result of customer concerns about security and privacy, cloud service providers have made substantial investments in cloud infrastructure and platforms.

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