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Teaching and Learning by Cloud Computing in 21st Century

[1] Ms. S. Prathi, [2] MCA, M.Phil.

[1] [2] [3] Assistant Professor,Department of Information Technology, Vels Institute of Science,Technology and Advanced Studies (VISTAS)

Corresponding Author Email: [1] prathisundar2011@gmail.com

Abstract*— The 21st century has ushered in a new era where traditional knowledge and technical skills are no longer sufficient. Students today need broader skills to navigate and succeed in a rapidly changing world. Let's break down each of these essential skills: critical thinking, problem-solving, communication, and collaboration. These skills are often collectively referred to as "21st-century skills" or "soft skills," and they complement traditional academic knowledge. Educational institutions and employers increasingly recognize their importance, emphasizing their integration into curricula and workplace training programs. Cloud computing allows users to access software applications, hardware, storage, and computing processes directly from the internet (the "cloud"). This eliminates the need for on-premises infrastructure and provides scalability, flexibility, and accessibility advantages. It offers two paradigms in computing; SaaS and PaaS. This paper has been used to share references, create collaborative environments, hold virtual discussions, manage projects, and deploy web applications. This technology had enriched the learning processes of the students through collaborative learning, group projects and web-based software development.

Index Terms*— Cloud computing; collaborative; teaching; learning; web applications, technology, 21st century skills.

I. INTRODUCTION

Cloud computing technology is increasingly being used by enterprises and organizations. cloud computing integrates various independent technologies to deliver its benefits such as hardware virtualization, distributed processing, utility computing, network system, web services, platform as a service, and software as a service. This is fundamentally based on a Service-Oriented Architecture (SOA) model. Its offers high flexibility, scalability and interoperability. Cloud computing indeed represents a significant evolution of internet-based technologies and computer networks. It transforms how IT services are delivered, consumed, and managed, offering unprecedented flexibility, efficiency, and scalability compared to traditional IT infrastructures.

There are many definitions of cloud computing. Among them, cloud computing is a form of computing where the IT needs of a consumer can be bought from a cloud service provider. Another definition of cloud computing is a computing model based on a customer service needs. The term "cloud" in cloud computing often evokes the image of a cloud-shaped diagram, which is commonly used to symbolize the internet or the web. Cloud computing itself is a robust and versatile computing model that enables on-demand access to a shared pool of configurable computing resources infrastructure, processing power, storage and networking. The cloud is flexible and able to accommodate a small scale application or a large scale application.

Users can freely purchase cloud computing resources based on his current needs. (Taylor, 2005; Stanoesvska-Slabevaet al.,2010).

The term “cloud computing” was first used in 1996 to describe a computing model where all desktop applications live on the cloud. Unfortunately, during that time, the technology to deploy cloud computing were not readily available. The cloud computing model was reintroduced in 2006. Initially the response to this technology is fairly accepted. However, acceptance to cloud computing technology changed when the Internet giants like amazon.com, google.com, microsoft.com, and IBM started using this computational model and further offer this facility to other web users. Since then, various services, software and storage has been implemented based on cloud computing (Van Ommerenet al., 2009).

In this paper we discuss some of the characteristics and usage of cloud computing in teaching and learning. It promotes interaction and collaboration among all the users. Highlighting the scalability and flexibility of cloud computing compared to traditional client-server models is crucial.This aspect allows for dynamic adjustments in computing resources based on demand, which is typically challenging and less efficient in a traditional setup where hardware limitations can constrain scalability.

In the next section, we discuss the features and usage of cloud computing. Finally, we discuss the results from our experiences and summarize our contributions.

II. FEATURES OF CLOUD COMPUTING

Cloud computing has many advanced computing features that would benefit the users. Some of these features are;

- A user buys and uses the services by the cloud computing model via the Internet. Therefore, the Computing services are generally provided over

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standard networks and heterogeneous devices.

- The services offered by the cloud include data processing, storage, software, technical components, or a complete platform. A users typically have the flexibility to choose the type of service they need based on their requirements.
- The cloud service provider will provide and manage the cloud such as data centers, virtualization methods, hardware and storage. There is no maintenance on the user part.
- A user will be charged the cost of the services based on usage. The utility-based model of cloud computing, often likened to electricity or water services, allows users to pay only for the computing resources they consume.
- A users can combine multiple services from multiple cloud service providers to create a combination of services to fill his requirements. A user is not restricted to only one cloud service provider
- The cloud service provider is responsible for the upgrading the cloud services from time to time.

These are excellent examples showcasing the diverse applications of cloud computing in collaborative work, data storage, and service integration to create new applications. They demonstrate how cloud services like Zoho for collaboration, Amazon S3 for data backup, and platforms like Google App Engine for app creation leverage the scalability and accessibility of cloud infrastructure.

Regarding data security and confidentiality concerns, your points are crucial. Strategies like data fragmentation across multiple data centers and robust encryption help mitigate risks and ensure that sensitive information remains protected.

III. THE IMPLEMENTATIONS OF CLOUD COMPUTING MODEL IN TEACHING AND LEARNING

In this section we discuss some scenarios how the cloud can be used in both teaching and learning processes.In the first scenario, suppose a lecturer needs to share a journal paper with fifty of his graduate students. Using this method, a lecturer can e-mail this paper to his students. Using a client-server based Learning Management System (LMS) like SPIN for file uploads and downloads can indeed pose inefficiencies, especially when all users must access the central server for these operations. This centralized approach can lead to potential bottlenecks during peak usage times and may not scale well with increasing user demands.

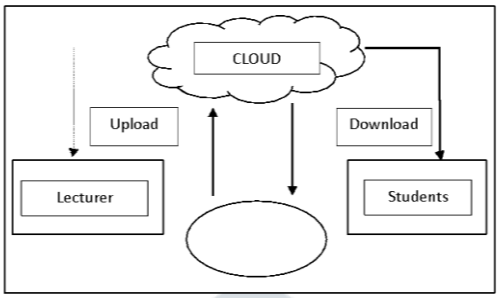

Figure 1. A client-server based model for sharing reference materials over the Internet using LCMS (Learning Content Management System such as SPIN).

Assume a student is inquired to share five journal papers with a lecturer and fifty other students. Based on a client-server computing model, the student can share the papers with the lecturer by uploading the papers to SPIN. However, the student needs to use e-mail to share the papers with other students. This is because SPIN uses the concept of one-way partnership where a lecturer can share materials with his students and vice-versa SPIN doesn't permit a student to share material with other students. In this scenario, SPIN doesn't have multi-directional feature that allow sharing among the students themselves. This sharing process is both time consuming and troublesome.

With a cloud computing model, we can use a cloud-based storage service to solve the multi-directional sharing problem. Using this service, each user can easily share materials between themselves. This service allows automatic synchronization between the users and does not require the users to login to any web sites. One of the cloud-based storage services is called Dropbox. Using Dropbox, a user can easily share journal papers, graphics and reference materials with other students and the lecturer. One vital feature of this cloud-based storage service is automatic synchronization, which is done automatically whenever a user has access to this cloud. This scenario is shown in Figure 3.

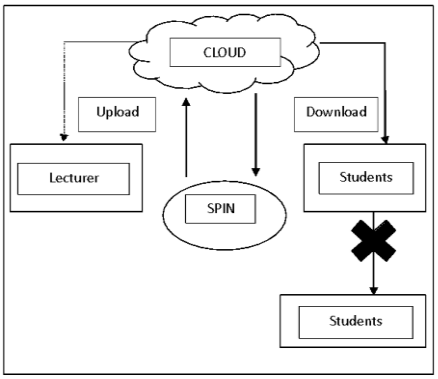

Figure1. Client-server based computing model only allow one direction sharing between a student and a lecturer. This model does not have a feature that allows sharing among students.

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This service encourages collaboration and interaction among all users. Introducing our innovative cloud-based sharing service, designed to streamline the exchange of research papers, journal articles, software, graphics, and other essential information among users.

Say goodbye to the hassle of emails, secondary storage devices, and the limitations of external storage. Our service offers a seamless, efficient solution for all your data-sharing needs. The first scenario is Collaborative Sharing with Cloud Storage,where a student needs to share five journal papers with a lecturer and fifty other students, the limitations of a traditional client-server LMS like SPIN become apparent. While the student can upload papers to SPIN for the lecturer, sharing with other students requires emailing the documents due to SPIN's one-way partnership model. This process is both time-consuming and inefficient.

The second scenario is the web-based application development which traditionally requires significant computing infrastructure, including storage, networking, software, databases, operating systems, and application frameworks. This infrastructure necessitates monetary investment and technical knowledge from users. Furthermore, if the application requires additional resources like more storage or computing power, the infrastructure must be upgraded, incurring further costs and maintenance efforts. Cloud computing addresses these issues by providing on-demand resources. Developers can create and host applications on the cloud, utilizing services such as computing power, storage, networking, and application development tools without the need for maintaining physical infrastructure. This model alleviates the burden of upgrading or maintaining computing resources, allowing developers to focus on the application itself while benefiting from scalable and cost-effective cloud services.

These scenarios illustrate how cloud computing enhances collaboration and simplifies the development and maintenance of web-based applications, making it a powerful alternative to traditional client-server models.

Features	Client-Server Model	Cloud Computing Model
Sharing of information	Upload and Download Needs to access a web site	Continuous automatic synchronization
Sharing direction	One direction Lecturer-student Student-lecturer	Multi directions Lecturer-student Student-student Student-lecturer
Type of information	Limited	All types of information
size	Limited	Minimum of 2GB

Two important features of cloud computing are flexibility and scalability.

Flexibility: Developers can choose from a variety of services offered by cloud service providers based on their specific needs. For example, if an application requires database support, developers can easily request and integrate a database service. This flexibility allows developers to select the most appropriate tools and resources for their projects without being limited by the constraints of traditional IT infrastructure.

Scalability: Cloud computing can cater to varying numbers of users without any reduction in processing time or response time of the applications. If an application experiences increased demand and requires additional storage or processing power, the cloud infrastructure adjusts automatically to meet these needs. This automatic scaling ensures that applications remain responsive and performant, regardless of the number of users or the volume of data being processed.

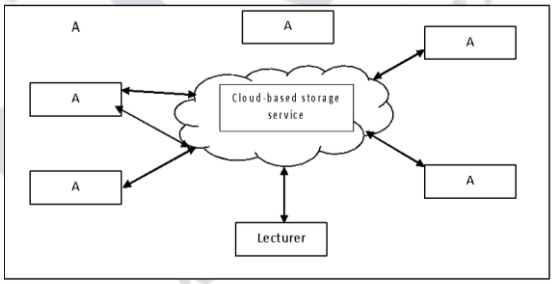

Figure 3. A storage service in the cloud allows easy collaboration and synchronization between students and a lecturer.

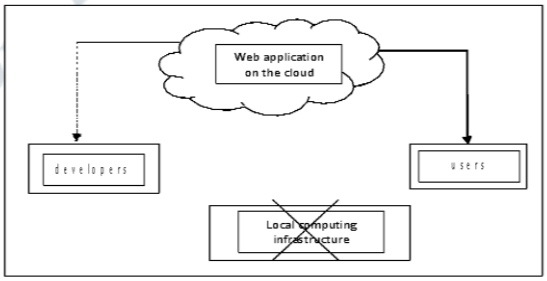

Figure 4. Web application using cloud computing model.

Cloud computing significantly enhances the development and deployment of web applications by removing the necessity for local infrastructure setup and maintenance. For instance, the web application at rumi-to-jawi.appspot.com provides a transliteration service from Rumi to Jawi. The developer created the application on a local computer and then uploaded it to the cloud. With cloud computing, the developer is relieved from the burdens of setting up and maintaining local computing infrastructure, enabling them to concentrate solely on application development. The cloud handles all the infrastructure management, offering a

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seamless way to provide services on the internet.

A similar advantage is observed in the third scenario, involving teaching and learning through video streaming technology. A lecturer can record lectures, upload the videos to a website, and make them available for online viewing via video streaming technology, much like the service offered by YouTube. Setting up video streaming on a traditional client-server model can be complex and resource-intensive. However, with cloud computing, the process is streamlined and simplified. The lecturer can leverage cloud-based video streaming services to facilitate video playback on their website. These services are integrated within the cloud infrastructure, making it easy to embed them into a website.

Furthermore, cloud computing's scalability ensures that the website can handle varying numbers of users, ranging from 10 to 100,000 or more, without performance issues. This scalability is a crucial feature of cloud computing, accommodating fluctuating demand seamlessly and efficiently.

IV. RESULT

The integration of cloud computing in teaching and learning environments has significantly enhanced collaborative learning among students. With cloud-based storage services, students can effortlessly share reference materials, papers, journals, software, and other resources. This collaborative approach fosters a more interactive relationship between students and lecturers, particularly in writing and programming tasks. Cloud-based storage services enable the creation, editing, sharing, commenting, and evaluation of written materials and programming source codes, thereby streamlining the academic workflow. Moreover, cloud computing facilitates the distribution of multimedia materials, promoting multi-modal learning. Students can access these materials from any location using embedded video streaming services. This accessibility ensures that students can engage with learning resources at their convenience, making the learning process more flexible and inclusive. Additionally, the deployment of the latest technology and methodologies in web application development is streamlined with cloud computing. The cloud serves as a platform for development, allowing educators and students to utilize cutting-edge tools and techniques without the need for extensive local infrastructure. This capability not only enhances the learning experience but also prepares students to work with modern technologies in their future careers.

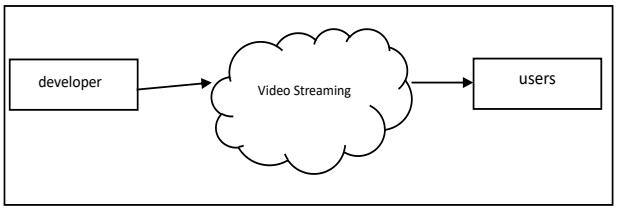

Figure 5. A cloud computing make it easy to offer video streaming to users.

V. CONCLUSION

Using cloud computing in education, specifically in teaching a networking course, demonstrates its versatility in enhancing learning experiences through collaboration, accessibility, and practical application of theoretical knowledge. As technology continues to evolve, integrating cloud computing into educational practices can prepare students for the dynamic demands of the modern workforce. Cloud computing has indeed become a catalyst for developing 21st-century skills such as collaboration and communication in educational settings. Here's how it contributes, along with considerations for educators: Many applications are now available to facilitate and store teachers' and students' work such as Google Classroom, Google Docs and Google Slides. while cloud computing offers significant benefits for education, educators must be mindful of potential drawbacks and take proactive steps to mitigate risks. By doing so, they can ensure that students have a positive and engaging learning experience while developing essential 21st-century skills.

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