

# Enhancing the Adoption and Use of Cloud-Based Services by Universities in Developing Countries

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**Abstract-** In the modern world, the adoption and use of cloud Computing are ubiquitous. Cloud Computing services are continuously playing a vital role in present Information Technology development paradigms. It is beyond reproach that aspects of cloud computing exist in almost all forms of manufacturing and service industries. Whereas the three Cloud Computing service models are vital, the most widely used service model is Software as a Service. In this service model, applications are outsourced under tenancy agreements by third parties known as Cloud Service Providers. Microsoft, Google, and IBM are the major players in the provision of Cloud Computing Services. Organizations migrating to the cloud operational model utilize Cloud Computing Services to gain a competitive edge, minimize operational costs, and utilize economies of scale. Unfortunately, the use of cloud computing service models in the educational sector in developing countries has not reached the expected capacity. Cloud Computing is still under-utilized by learning institutions in developing countries due to lack of infrastructure, lack of skillset, and lack of the equipment necessary for service operations. Most academicians in developing countries are unaware that the benefits of cloud services utilization education outweigh factors preventing its adoption. This research provides insight into the benefits of cloud computing services adoption in the educational sector and angles it as the perfect bridge in helping the achievement of academic goals. The paper seeks to convince academicians in developing countries that cloud computing services adoption can enhance the provision of cheap but quality education. If after reading through this paper, a scholar is compelled to incorporate cloud-based service design in their student's learning paradigms, then, this paper would have achieved its objectives.

**Index Terms-** Cloud Computing Services, Cloud Computing Adoption in Higher Learning Institutions, Cloud Computing Adoption theories, Technology Acceptance Model, Theory of Planned Behavior, Technology Organization and Environment

## I. INTRODUCTION

Knowledge is the most important basic resource of the information society. Knowledge shapes the actions of all actors in the information society environment and thus its production forms the basic dynamics of societies. We live in the age of knowledge where information has gained a strategic value. In present times, societies that cannot use, manage, or benefit from the power of knowledge because they lack access to it will never be able to live to the desired standards of industrialization (Aydin, 2021). Existing industrialization demands that humans mobilize their power of knowledge and benefit from information technology resources in the most efficient ways. Countries that have been referred to as developed are characterized as information societies that have well harnessed and utilized the power of Information and Communication Technology (ICT). The more a country utilizes Information technology, the more it increases its strength and becomes domineering among other countries. On

the other hand, countries that do not invest and develop ICT have become poorer and poorer by the day (Aydin, 2021).

For knowledge to rise in developing countries, technology acceptance must rise. Technology acceptance forms an important development process of any new technology (Ploysuayngam & Tangwannawit, 2022). The rising global business competition is exerting pressure on industries existing in developing countries to use technology to bring down production costs even as they try to enhance profitability. An organization that does not enhance information technology will most likely have stagnated productivity and may not survive in the ever-changing business environment. Information Technology has been proven to bring effectiveness in service delivery and enhance scalability, reliability, flexibility and availability thus offering firms a positive advantage in their operations (Singh & Mansotra, 2019).

We live in a digital society that is supported by continuously evolving trends in technology. Among the new technologies being angled especially for education is CC. The technology is not only used in universities and school-based settings but also across various industries such as health, insurance, finance, military and automotive (Aydin, 2021). In the digital society, Cloud computing is among the technologies of central focus. Cloud computing enables users to access many forms of virtual resources giving them a wide choice of tools and services to use at any moment of their daily livelihoods. This has ensured the application of cloud computing in many different contexts such as healthcare, entertainment, human resources, military operations, business, security, finance, and education (Conde, 2023). The application of CC in education provides a great opportunity to make knowledge global at minimum costs and maximum accessibility (Asadi et al., 2020). It is for this reason that it is important to understand the adoption trends of cloud computing in the education sector, specifically Higher Learning Institutions (HEIs)

## II. METHODOLOGY

This study takes on the angle of desktop research performed across research data from different relevant researchers in the niche of the adoption and use of cloud computing in developing countries. The methodology employed by other researchers whose work is of great significance in this study. Some researchers such as Samanta & Pasayat (2023), performed their research through a bibliographic database while others such as Ploysuayngam & Tangwannawit (2022), D.R. Robert (2022), and Abdelkader et al., (2021) performed their studies through online questionnaire surveys to establish cloud computing awareness among prospective teachers and determine factors affecting cloud computing adoption in schools. Anusha et al., (2022) performed an exploratory study to determine academic practitioners' awareness of cloud computing adoption using a quantitative survey approach. To obtain these researchers and their work, keywords were applied on authoritative academic databases such as IEEE Xplore, Google Scholar, and ProQuest from which 45 journals were identified for the study. An analysis and quick reading of the journals knocked out 20 journals leaving 25 for further critical analysis and study. An in-depth analysis for coherence, correctness, and validity was performed. This analysis left 13 journals that have been used and properly referenced in this study.

## III. CLOUD COMPUTING SERVICES

The National Institute of Standards and Technology (NIST) defines Cloud Computing (CC) as a model having convenient access, on-demand network access, and a pool of shared configurable resources that can be rapidly provisioned and released with minimal supervision for user interactions. CC is

thus a computational method that utilizes distributed systems architecture and tool-based computing (Asadi et al., 2020). Cloud computing is the means through which faster, innovative, and flexible resources through scaled computing services. CC services are popular due to their mobility and their capability to expand availability at the least cost (Asadi et al., 2020). CC services evolve around hardware such as servers, storage, networks, databases, and software such as applications, analytical tools, and machine intelligence. Cloud computing presents a distribution architecture model where applications and services are independently accessed over time, and space via vast data center infrastructures (Aydin, 2021).

Cloud computing has three services namely; Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). The four infrastructure models of CC are Public Cloud, Private Cloud, Hybrid Cloud, and Community Cloud. SaaS is an over-the-internet cloud application that eliminates the need to install and run end-user applications. PaaS provides a computing platform installed with all the applications for software development installed. Infrastructure as a service avail needed infrastructure as a service ensuring that users do not have to purchase servers, databases, and network resources (Asadi et al., 2020).

### 1. Characteristics of Cloud Computing Services

The emergence of cloud computing has been transformative in how ICT services are developed, acquired, deployed, and owned (Singh & Mansotra, 2019). As Carr states, what electricity is in industrial society is cloud computing in the information age (Carr, 2009). Cloud computing has several characteristics one of them being that it offers on-demand self-service. On-demand self-service is the ability to use information resources automatically as per laid down usage rates. Two, CC offers broad network access where cloud resources are accessed over a network using computers, iPads, and phones among other intelligent machines communicating through a network (Aydin, 2021). Another significant characteristic of Cloud computing is that it makes use of virtualization technology. Virtualization enables CC to support different learning subjects in education and minimizes the need for the purchase of expensive hardware, network equipment, storage, and servers. Thus, virtualization enables CC to save on downtime and improve operational efficiency (Samanta & Pasayat, 2023).

Cloud Computing is also known for its capability in resource pooling where information resources such as servers, network infrastructure, databases, applications, and operating systems are shared among multiple users. This offers rapid elasticity as resources are allocated to users when they need them the most and released to other users once they are finished with them. Finally, CC offers measured services where users only utilize resources allocated to them based on their subscriptions. As

such, Cloud Service Providers (CSPS) are enabled to charge for the cloud services across their user base while ensuring users pay only for resources utilized (Aydin, 2021).

## 2. Use of Cloud Computing Services in Education

Before cloud computing, existed the era of mainframe computers, desktop computers, laptop computers, client-server-based computers, and the internet-based use of computers. The rise of CC changed all these with its technologies being presently considered as the ones forming the backbone of the next computing generation (Rahman et al., 2018; Samanta & Pasayat, 2023). To make use of the economies of scale, lower operational costs and increase their effectiveness, organizations are opting for the use of cloud computing services in their day-to-day operations. The adoption and use of cloud computing have increased manifold over short periods. This is because it does not need the development capital on huge infrastructures to use CC. The technology also significantly prevents the wastage of enormous efforts and resources on the implementation of existing applications. The challenge however is on how to best gain an in-depth understanding of the factors leading to the smooth adoption of cloud computing (Singh & Mansotra, 2019).

The type of CC services adopted in the education sector range from electronic reading materials such as textbooks and class notes to platforms for the provision of online assignments, schedules, and e-timetables which can be stored and retrieved electronically by both students and faculty at any time that they are needed and from anywhere across the globe. CC adoption ensures that Students enjoy real-time collaboration with one another, with given experts, or even with their teachers through CC services. Learning practices can be through video, augmented, and virtual realities. More to this, cloud-based storage, sets of infrastructure, and applications such as YouTube, Google Drive, Learning Management Systems (LMS), virtual labs, and virtual classrooms help enhance the learning and teaching experience (Rahman et al., 2018). Applications such as Google Apps, Dropbox, Google Apps for Education, Blackboard, CenturyTech, and ClassDojo have been extensively employed in the academic field (Aydin, 2021). This is unlike the traditional classroom experience and motivates students to learn through peer interactions.

In the academic world, cloud computing provides different sets of cloud learning platforms such as Google Suite for Education (GAFE), and Google Educator. When students and instructors make use of CC, they improve cooperation and productivity. CC ensures that access to the right tools makes students' and instructors' data accessible anywhere, at any time. There are also a host of cloud-based platforms such as Google Notebook, Microsoft Office 365, Book Search,

Google Notebook, News, and iGoogle that have been created specifically for instructors (Riza et al., 2023).

Developing countries can utilize CC in Education through applications such as the University Management System and Student Management Systems. Student management systems help universities manage admission, ID cards, attendance registers, notice boards, parents' logins, report cards, performance tracking, and transfer certificates. The users of CC for academics include administrative staff, faculty, students, examination offices, and admission offices (Asadi et al., 2020)

## 3. Adoption of CC Services by Universities in Developing Countries

Cloud computing creates chances and challenges for its users in equal measure (Asadi et al., 2020). It is a breakthrough technology that enables quality education to reach even the remotest parts of developing countries. Cloud computing presents technologies that can ultimately assist in the development of high-quality education (Anusha et al., 2022). Developing countries need to change their outlook towards the adoption and implementation of cloud computing in Higher Education Institutions (Rahman et al., 2018). Universities must embrace technology to meet the existing market demands, maintain a competitive edge, and fulfill the dynamic expectations of their learners such as quality of education (Anusha et al., 2022). It is of extreme importance that governments invest in high-quality universities by offering such universities access to high-standard Information Technology infrastructure and the most effective learning tools useful for easy data sharing and knowledge dissemination within a classroom setting (Riza et al., 2023).

Universities in developing countries should adopt Cloud Computing because it plays an important role in boosting the quality of education through the provision of benefits such as collaboration, scalability, low-cost infrastructure, and simplicity of usage. These qualities have enabled an increase in e-learning particularly among students pursuing higher education in recent decades (Riza et al., 2023). Universities need to offer satisfaction to their students through an ICT implementation that ensures smart, fluent, and secure service delivery to instructors, students, researchers, and staff members of any institute of learning. Thus, any university transitioning to cloud computing makes an important step in the right direction regarding online learning, combating economic crises, embracing globalization, and combating global health crises such as the COVID-19 pandemic (Aydin, 2021). The role cloud computing services played in ensuring learning continuity during the COVID-19 pandemic in developing countries cannot be understated.

Cloud computing is used as the most preferred mode of teaching and learning because of its flexibility. It offers a

convenient platform for faculty to prepare course materials, tutorials, presentations, and online student tests. More to this, students and their lecturers can utilize their devices from anywhere, perform grading, and offer student feedback. This saves time for both students and their teachers. CC also offers online discussion forums and virtual classrooms where lecturers are enabled to meet and interact with their students residing in different locations. With the introduction of electronic books, Online learning reduces the costs of printing and purchasing hardcopy books. Interesting video materials are prepared for teaching students. Because HEIs are realizing these benefits, they have aggressively begun the adoption and implementation of CC to keep pace with renowned universities across the world (Rahman et al., 2018).

The use of cloud-based educational platforms implies the importance of information creation and application in the social-technological transformation. The factors that enhance the adoption of cloud computing in higher education include the high cost of resources such as servers, and physical storage. Cloud service adoption has enabled HEIs to reduce the cost of deployment by 50-65% (Samanta & Pasayat, 2023), and thus, developing countries should not be left behind in cloud computing adoption. Reduction of downtime and constant access to resources benefits both students and instructors. The use of cloud computing services opens up equal global opportunities for understanding by students (D. R. Robert, 2022) through easy information sharing and data access (Asadi et al., 2020). Universities in developing countries must adopt its use to eliminate the glaring gender and social status disparities.

CC has led to a revolution in the manner that teaching occurs in universities. Cloud applications have ensured that knowledge is managed effectively to increase effectiveness in classes, enhance academic performance, and increase efficiency in universities (Aydin, 2021). Cloud computing offers universities greater operational efficiency, flexibility, sustainability cost savings, great opportunities, varied teaching choices, and simplicity of deployment of cloud-based applications (Riza et al., 2023; Singh & Mansotra, 2019; Abdelkader et al., 2021; Rahman et al., 2018). It enables stakeholders to use the same structure for tutoring, and literacy thus helping to save resources, time, and energy.

Without new techniques presented by modern technologies, schools, colleges, and universities will fail to deliver on academic goals. New technologies enable tutors to hold practical demonstrations through virtualizations, presentations, and animations thus making it easier for students to conceptualize ideas (Anusha et al., 2022). The challenges include security, integrity issues, affordability, complexity, lack of proper management, staff training issues, and availability (Abdelkader et al., 2021). CC can reduce inequalities in education in developing countries through

equal and easy sharing of information, and bring about social justice realization (Asadi et al., 2020). Educational institutions in developing countries are adopting CC because of its reliability, security, and compatibility (Riza et al., 2023; Singh & Mansotra, 2019).

#### 4. Cloud Computing Services Adoption Theories

To assess the technology adoption likelihood by universities, researchers from across the world have various theories such as the Technology, Organization, and Environment (TOE) theory and the technology Acceptance Model (TAM) theory. The Diffusion of Innovation (DOI) theory, is the unified theory of acceptance and use of technology (UTAUT). Studies on TOE and DOI theories focus only on the implementation stage but not on the resources and social support needed for the adoption of CC (Rahman et al., 2018). The theory of planned behavior stands out as one of the most commonly used theories. TAM and TOE are commonly used at the organizational level while TAM, Unified Theory of Acceptance (UTAUT), and TPB are used at individual levels (Singh & Mansotra, 2019; Ploysuayngam & Tangwannawit, 2022; Asadi et al., 2020; Riza et al., 2023; Rahman et al., 2018).

#### 5. Factors Influencing CC Services Adoption in Developing Countries

Cloud computing technology will determine the future of information systems as it is seen as the perfect solution to improving the competitiveness and performance of organizations. CC gives learners access to varying computer applications from remote locations through the internet and this has brought many benefits specifically to learners residing in developed countries. In the case of developing countries, concrete research is limited on the factors influencing the adoption of cloud computing across HEIs (Rahman et al., 2018). There are many problems associated with CC adoption (Singh & Mansotra, 2019). The analysis and study of factors affecting CC adoption in HEIs in developing countries is important as it helps determine a proper implementation of CC in their HEIs. The reasons that determine the adoption of CC include the technology readiness of an institution, government regulations and policies, top management support and goodwill, its relative advantage, and culture (Riza et al., 2023; Singh & Mansotra, 2019).

The obstacles to adopting cloud computing are such as the cost of switching, privacy issues, technology satisfaction, and reliability of data (Asadi et al., 2020). When the adoption of cloud computing is investigated, parameters such as the physical barriers, skillset needed for using CC, infrastructure, and CC services based on user needs need to be considered (Asadi et al., 2020). The decision-making process for the adoption of CC also depends on factors such as internet access speeds and the level of knowledge availed of cloud computing. Universities should be engaged in academic

workshops and implement CC adoption models to overcome these barriers (Riza et al., 2023). Cloud computing is accepted as a simple approach to managing IT though ironically, its adoption has been slowed down because organizations saw it as a complex system. Complexity is defined by Backlund (2002) as the effort needed to understand and cope with a given system. Complexity analysis is often performed in modern times to gauge the effort it will take to build a system (Ali et al., 2022).

Complexity in the adoption of a system increases in emerging technologies because the value of an emerging technology is vague and unknown. The process of analyzing the adoption of IT is challenging due to technological and organizational factors making the management of the adoption process complex. This presents a significant challenge to a researcher performing research on the adoption of cloud computing technologies (Ali et al., 2022). Decisions related to the adoption of cloud computing are complicated by many uncertainties and challenges over the expected business value, and how the technology will impact an organization. This has led to the formulation of varying technology acceptance theories and models for use in testing and validating the chances of cloud computing adoption at individual and organizational levels (Singh & Mansotra, 2019).

For researchers to manage and control the complexity of cloud computing adoption, they must first understand the characteristics that make the technology complex. Whereas many studies exist on the complexity of the development and implementation of information systems, there are limited studies investigating the factors used to assess the complexity of cloud computing adoption by organizations. When complexity is in question, the aspects to be considered in cloud computing adoption are an organization's dynamic complexity, the structural complexity of technology, and the dynamic complexity of technology. An organization's complexity is seen in the complexity of its business operations, the complexity of technology is seen in interoperability and data processing capabilities, and the dynamic complexity of technology is seen in aspects such as system integration, and IT infrastructure updates (Ali et al., 2022).

The key hurdles to cloud computing adoption are trust difficulties, personnel redeployment, availability, and security issues (Riza et al., 2023; Singh & Mansotra, 2019). While attempting to embrace ICT, universities meet a host of challenges such as high budget costs for hardware, skill sets, software, and licensing (Aydin, 2021). A study in Malaysia indicated that factors affecting technology adoption in HEIs in developing countries include technology readiness, environment, organizational support, human readiness, security, and privacy. Rahman also lists factors affecting technology adoption with some of them being the skills

needed to learn new technology, the social influence of other stakeholders, the behavioral intentions, the facilitating conditions such as availability of support and technological infrastructure, techno-philia and techno-phobia which are the love or fear for technology, complexity, and perceived risks (Rahman et al., 2018).

## 6. Research Results

The adoption of CC in HEIs has potential benefits. Research-based on the TOE framework targeting HEIs in Saudi Arabia found three significant factors namely relative advantage, complexity, and data concerns as the most significant factors to CC adoption in HEIs (Abdelkader et al., 2021). Asadi et al., state that most IT companies will not adopt CC because of security and standardization issues. He further adds that security brilliantly affects the adoption of CC. Privacy issues are listed by this finding as one of the most important concerns in CC adoption and stand among the main barriers to cloud computing adoption. The use of theoretical models to determine the effectiveness of user adoption of CC is at very basic levels (Asadi et al., 2020).

A study done by Anusha (2022) to discover how Sri Lankan universities understand and accept cloud computing use indicates that Academic libraries have a poor acceptance rate for cloud computing. This is because institutions use authenticated course guidelines and need only authenticated courses from CSPs. Further, the adoption of online learning only took a positive turn in developing countries after the COVID-19 pandemic which affected all countries in the world. The pandemic transformed the teaching environment into a virtual platform and this is promoted by CC which helps in changing teaching and productivity techniques in universities (Anusha et al., 2022). The results of the study by Anusha et al. indicated that academicians were slow to adopt cloud computing services. The study also discovered that 55 of the respondents (22.9%) of the tutors were unfamiliar with cloud computing and this prevented academicians from taking advantage of cloud computing services. The majority of the tutors in the study however believed that CC adoption can help in lecturing and skilling and can be of great benefit to their students (Anusha et al., 2022).

A study done by Asadi et al. used TPB to try and predict the intent of the use of CC services by tutors. The study, conducted from August to October 2017, was cross-sectional, used questionnaires, and had a target population of 240 tutors. The study aimed to understand faculty members' behavior in consideration of CC adoption by establishing the position of cloud computing knowledge among practitioners. The findings indicate that 75% of the participants do not know CC services and are not well qualified to use them. Further, the study concluded that it is imperative to understand factors affecting tutors' attitudes toward the use and adoption of CC

services and that TPB is still a firm foundation for studies on CC adoption (Asadi et al., 2020).

A study done by Aydin on the importance of IT departments in the implementation of cloud computing using 105 departments. His findings indicate that IT departments are critical in the implementation of cloud computing. Despite this, 74.7% of the departments were unresponsive to the questions on their use of PaaS, IaaS, and SaaS. This means they lack sufficient knowledge of cloud services. His study data revealed that cloud applications are not widely used and found that there is a relationship between cloud application awareness and use. Interestingly, half of the universities do not have sufficient knowledge about cloud computing technology (Aydin, 2021).

#### IV. DISCUSSION

In today's information age, universities form the most important piece of social development with the most important role of a university in society being education and research. The role of every university is to improve the levels of technical and scientific knowledge, to train well-equipped and qualified personnel who can meet societal needs and requirements, to increase the intellectual power of society, and to improve student cultures and standards to the expectations of society. Delivery of information services presents many challenges to universities with the main ones being budget costs, system licenses, software and hardware integration, and system management. CC helps universities overcome these challenges and operate cost-effectively. Universities with budget shortages will reap huge benefits through the adoption and use of CC (Aydin, 2021).

For a new technology to be successful, stakeholders must work together toward its adoption. CC adoption needs not only cloud service providers but also the willingness of universities and students to accept its structure and services. If stakeholders do not work together, and there is no user readiness, then it is next to impossible to adopt and use CC in education (Rahman et al., 2018). The observed dimensions in CC adoption are positively associated with perceived ease of use and usefulness. The complexity of a CC service can also hurt its adoption. Economic factors also negatively affect cloud computing adoption in developing countries. Among students, the ease of use has a direct and significant relationship with their willingness to adopt CC. This ultimately determines their academic performance in online learning platforms (Raza & Khan, 2022). Thus, we can conclude that the adoption of CC services in universities in developing countries is still extremely low and below the expected standards for higher learning institutions.

#### V. CONCLUSION

Cloud computing technology provides equal opportunities for all students in developing countries having a desire to learn through technologies available from across the world. Cloud computing services not only lessen the load for tutors but also encourage students to be proactive enough to collect information on their own. Developing countries are struggling to adopt and use cloud computing in their educational environment. The twelve variables affecting cloud computing adoption are Privacy and security, service provider support, reliability, lack of proper infrastructure for integration, management, price of accessing CC services, performance, IT skills and knowledge, internet speeds, personal behavior and attitude, presence of electric power, and institutional support. In the adoption of cloud computing services, there are theories such as the Technology Acceptance Model, Theory of Planned Behavior, and Technology, Organization, and Environment Theories that are used to assess cloud computing adoption. The results of a study done based on TOE on CC adoption in universities indicated that the technology and contextual environment play a positive and significant role in a school's decision to adopt cloud computing in its various departments. The study however found that the decision to adopt cloud computing was not influenced by organizational factors.

Some of the benefits of adopting CC in education include elasticity, measurability, accessibility, personalized learning, more economical, green computing, and standardization. Some of the challenges of CC adoption include security issues, compliance issues, lock-in, and lack of skills. Insufficient support, Cloud policies, the complexity of cloud technologies, and privacy. We can thus conclude that Cloud Computing services do save universities operational costs and education to developing countries in various forms such as Cloud Picture, and other cooperating e-learning techniques such as online learning games. It is thus wise for educational institutions in developing countries to adopt and use cloud computing services.

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