

Cloud Computing Adoption by Universities: An Analysis Based on Lasbela University

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Abstract: Cloud computing has constructive characteristics such as easy access, large data storage, distance learning, cost effectiveness, and pay-per-use. It has widely been adopted by universities in most of the countries, whereas due to the lack of empirical research its adoption in Pakistan is extremely low. The objective of our research is to determine the factors that influence the cloud computing adoption within the context of Technology Organization & Environmental framework in the universities of Balochistan, Pakistan. The TOE is used to identify the components that influence the cloud computing adoption in universities by integrating the TOE framework. This is primary quantitative research, and a questionnaire was used for data collection. The questionnaire has circulated between faculty members & administrative staffs of Lasbela University & its campuses. SPSS is used for the data analysis as descriptive statistics are used for frequency, percentage, and graphical estimation. Inferential statistic and Chi-Square are used for hypothesis testing. The questionnaire's reliability test Coefficient of Cronbach's alpha is used. The results indicate that there is a lack of awareness of relative advantages, & IT skills. The compatibility, data security concerns, complexity, top management, technological readiness, and regularity policy have no positive significant effect on the cloud computing adoption at Lasbela University. University should adopt cloud computing services because it is an essential trending technology for the students, faculties, and administrative staffs; it facilitates faculty members and top management a better understanding and knowledge of learning.

Keyword: Cloud Computing, TOE, Lasbela, Chi-Square, Learning, Technology.

1. INTRODUCTION

Cloud computing resources and services are available on-demand such as application to cloud storage, servers, database, software, and computing power on the internet and using a pay-as-you-go base model. The cloud reduces the operating costs, runs infrastructure more effectively and efficiently, and typically pays only for cloud computing resources and services used. Cloud computing has been distributed over several location data centers. It is very hard to keep files on a hard drive to you everywhere. It is now possible through cloud computing storage that the electronic devices have the access to the data remotely and to save documents to the remote database. Cloud computing provides users with a different function including delivering software on demand, storage, backup, data retrieval, email, analyzing data, audio & video streaming, and creating applications. Cloud computing is included in different service models which are the following: Platform as a Service, Software as a Service, and Infrastructure as a Service. There are four cloud deployment models such as public, private, hybrid, & community cloud services. The cloud computing updating its resources and services gradually and is being used in several different educational institutions, big and small organizations, government & private agencies, and individual customers [1]. The evaluation in the universities is transforming from traditional outdated learning techniques into online learning through the information technology and cloud computing. The computer became an important part of human life, and its professional role develops online education learning tools. Holding new technologies in the universities that not only increase the academic activities, also provide new learning methodologies by using cloud computing such as cloud storage and applications tools. Adopting of cloud computing can solve several current educational activity issues by supplying all sorts of academic learning

tools over the internet. Cloud computing is like a model that supplies resources, services, infrastructure, and software applications over the internet connectivity on demand which are time efficient and low cost. Increasing computing system speed, internet speed, and storage with current advanced cloud computing resources and technologies made learning materials or information accessible at all the times in everywhere [2].

Balochistan's Universities are not quite aware about the cloud computing services and its flexible benefits. The cloud computing services adoptions can seek out the present issues facing educational institutions for the distance learning and online learning education. In the Information Technology era, the universities are trying to use the new trending technologies which are the requirements of this time and expectations of the students and faculties. Universities need to restructure and update themselves regularly according to the present requirement of the new technology. At present, due to cloud computing, most of the universities in the world are now experiencing a revolution in their technology sectors. Worldwide, universities are adopting cloud services and a rapid increase has been seen these days. Cloud computing provides various benefits of IT services to the universities with their limited resources without producing any new financial investments for the IT services. With the cloud computing services and resources in universities; the required knowledge can be achieved effectively to improve the efficiency of the academic performance [3]. In the last two years, the worldwide pandemic (COVID 19), all the education system has been affected. In that situation, all universities have been closed their physical classes temporarily; had stopped physical academic activities exposure trips, and soon they have switched the classes mood to the online learning environment. Whereas the quick increase has been seen toward using cloud computing applications during this worldwide epidemic outbreak. Most of the educational institutions have been purchased cloud services and converted them into online learning applications to keep up distance online learning education [5].

2. LITERATURE REVIEW

Cloud computing provides various computing services such as faster innovative, flexible resources, storage, server, database, software, network, and machine intelligence. The cloud computing is a demand supply model which makes available different applications, servers, and storage services to be used autonomously from the cloud platform providers, in a huge data processing centre environment [3]. Cloud computing is growing into a vast and dense ecosystem of technology fields, products, and services. Granted rise to a multi-billion-dollar economy whereas many cloud computing providers compete for an ever-increasing cloud service market share. As customers navigating this cloud computing environment is increasingly challenging. The Microsoft Azure, Amazon Web Services, & Google Cloud platforms are the large different cloud service providers to the technological market [7].

The cloud model was developed from different technologies such as the development of virtualization, web services, utility computing, grid computing, and the internet connectivity services. The development of cloud computing has contributed to the high-speed wireless networks, low storage, low-cost broadband, and hardware cost. Cloud computing services are to a greater extent outsourcing, and it has very important characteristics which distinguished cloud computing from outsourcing [8]. According to the National Institute of Standard & Technology, cloud computing is a service provider and deployment model in which resources and services are accessed with minimum administration efforts with service supplier communication. These cloud computing services are composed of three important service models such as SaaS, PaaS, & IaaS. The four deployment models such as private, public, community, & hybrid cloud. The five characteristics such as on-demand self-service, rapid elasticity, resource pooling, broad network access, & measured service [9]. According to Gartner (2019), cloud computing is a huge market for any type of organization. Where the cloud revenues reported more than \$150 billion for the first half of 2019. In the previous year, a 24 percent growth rate is recorded [10]. According to the Synergy Research (2021), in four key cloud computing service and infrastructure market portions, the vendors' and operators' revenues for the cloud ecosystem increased from 25% to \$235 billion in 2020. The huge growth was shown in cloud infrastructure services including PaaS and IaaS, that hosted private cloud services. IaaS grew by 37%, Enterprise SaaS grew by 24%, and for software and hardware private, public, and hybrid infrastructure increased by 16%. Around the worldwide of cloud environment, IT companies that presented the most significant among the first half of market sector leaders are Amazon (AWS), Microsoft, Google, Dell EMC, IBM, and Salesforce. The other cloud companies' players involved Adobe, Cisco, VMware, Digital Reality, Rackspace, SAP, and HPE. These companies aggregate revenues accounted for well over half of cloud computing services [11]. There are various profitable SaaS cloud computing services are accessible in the marketplace, such as Email-services, Customer Relationship Management Salesforce, Google applications, Enterprise Resource Planning (ERP) system, Microsoft applications, and Adobe services, where they are also targeting the education institutions [12]. Cloud supplier helps the institutions secure data which is a significant point for the security of data.

The clients do not suffer a critical decline and it also provides protection from the different virus attacks. Cloud computing services are managed by the world’s best IT professionals. The cloud services are very easy to access and use to upload and download. It does not require up-gradation and data can be accessed from one system to another through the internet [13].

3. Problem Statement

Universities in Balochistan are not aware of the cloud computing services and its benefits; some of them understand the cloud services and they are interested in integrating the traditional learning method into the cloud or new technology adoption. The advanced technology adoption can improve the quality of education delivery and increases the learning efficiency, effectiveness, & satisfaction, but it needs a huge initial advanced infrastructure investment [6]. Lasbela University and its campuses, do not have the MIS/CMS and still working manually, adopted the traditional learning method and unknown about the cloud computing services and its benefits. Cloud adoption is the solution to these IT issues confronted by universities in Balochistan.

4. Objective

- To find the technological, organizational, & environmental factors that affect cloud computing adoption by the university.
- To determine and analyze the factors that affect cloud computing adoption at university.

5. Present Situation at Universities

Practical knowledge and innovative thinking are important to be in competition in the Universities. Universities should possess the most advanced and trending technologies to adopt to impart the quality of education for the students. Cloud computing services have a progressively used of internet innovations for the management, faculty members and students to access the services from web programs [14]. This technological era still, the faculties’ teaching method is traditional and where the learning outcomes are not improving. This is the reason most of the teachers are not aware of these technological tools of cloud computing technology toward its educational benefits. Cloud computing technology provides the best learning education service for universities and other educational institutions. Some Universities still working manually such as attendance, teaching materials, and examination system [2].

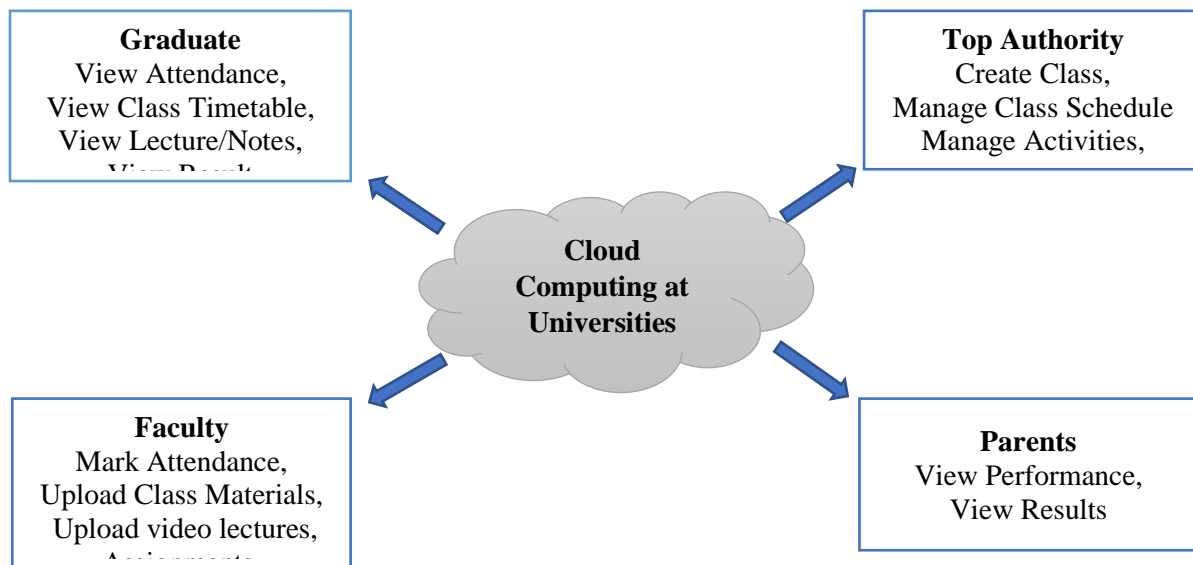


Figure 1. Cloud Computing service for universities (Kashif Ishaq, et al., 2019).

Cloud computing allows students to access learning materials from anywhere over the internet. Teachers can easily upload teaching materials or notes/lectures. Management can manage, control, and monitor the activities. Cloud computing identifies the importance of E-learning and Mobile learning as sources of enriching online learning and research which will ensure the good quality of education and research work [15].

There are a lot of universities that are extremely using the modern cloud computing resources and ICT with regard to achieve their optimal educational requirements for the knowledge delivery, collaboration, management, communications process and learning outcomes. The cloud computing technology is growing in the education field very quickly. The cloud computing services are provided by using web browsers access and high-speed internet to the educational institutions, where the faculties, students, and administrative staff is the key stakeholders [16]. The old traditional infrastructure of educational institutions needs to spend a large cost for the ICT and cloud computing infrastructure deployment. It is required to have a slightly qualified IT staff and demanding software application solutions that need a lot of money, space, and time to spend. In the last few years, cloud computing has empowered educational institutions to provide a different kind of cost-effective services effectively on-demand. The cloud-based services providers are including Google Applications, and OneDrive, Dropbox, social-media platforms such as Twitter, Facebook, and YouTube. Cloud computing services at universities can provide a different of services in the administration section, human resource, admission section, library, IT department, and finance section.

6. Types of Cloud Services

6.1. Infrastructure as a Service

IaaS is used to satisfy the infrastructure requirements of faculty members and students with several demanding hardware configurations for a certain academic activity. CSPs offer various services such as computing power, storage space on demand, networking services, switches, routing services, Rackspace, Go-Grid, and Flexiscale. For example, IBM, Datrium, and Finix [17].

6.2. Platform as a Service

PaaS is a virtual platform on the internet to enable clients to develop applications on their own choices without any financial burden and difficulty of purchasing and controlling the underlying hardware and software apps layers. CSPs provide a set of tools in the cloud, upon which applications can be developed and executed. For example, Microsoft Azure, Google Apps, Amazon - SimpleDB (S3), Acquia, and Heroku [17].

6.3. Software as a Service

In this layer, SaaS provides a single instance storage on the cloud for multiple clients, and it is the simplest layer through the internet accessing an application on-demand. It eradicates the need to run and install the applications on the client's private system and it makes maintenance and support easier. For example, Salesforce.com, Gmail, Facebook, Zoom, and Atlassian etc., [17, 18].

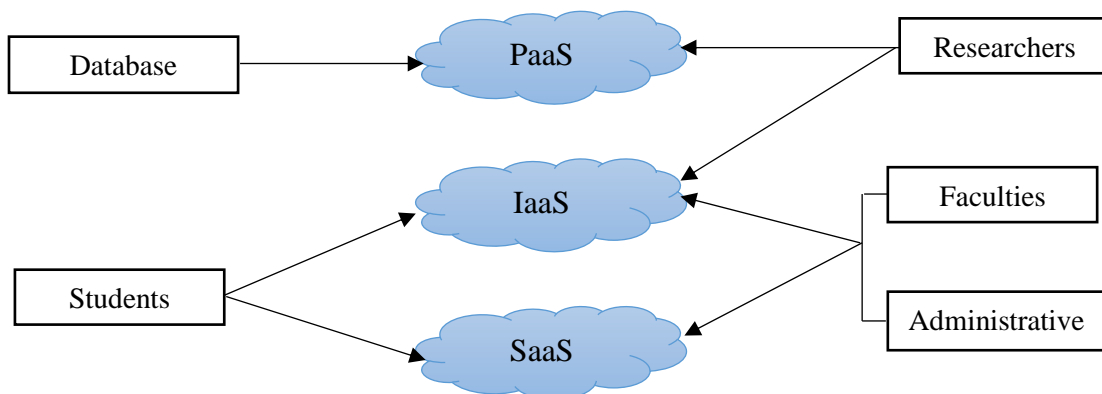


Figure 2. Cloud Service Model for the Universities (Abdulrehman A., at al., 2015).

6.4. Computing as a Service

The CaaS has the capability to provide cloud computing services, that customers are the providing and use of processing resources required to run and deploy the software, such as Amazon and EC2. It also provides entrance to raw computing power on the virtual servers of Amazon, and EC2 services [17, 19].

7. Cloud Computing Benefits for Universities

7.1. Reduces Cost

Cloud computing resources or services reduced the IT infrastructure costs, as an institution pays only for the services and resources consumed and required storage. Cloud computing can help a customer to save the capital costs and it does not require any early investment for hardware and software applications. The service provider control, manage and buying of equipment, and reduce the cost of individual training to maintain hardware and software applications [14].

7.2. Speedy Backup and Restore

Cloud computing technology helps the Information is stored on huge servers around the world. It is very easy and speedy access to get back up and recover the data in case of any technical problem you lost the information. Educational institutions can store confidential data on the cloud computing [14].

7.3. Reliability in Works

Faculties, Students, and management staff can access any information from cloud computing without installing any expensive applications. It is reliable in accessing data into interdepartmental collaboration. It leads to an efficient distribution of works and information that can be edited and updated by different people from any system. It provides instant updates with reference to the changes in the cloud computing [14].

7.4. Easy Access

A cloud computing platform improves digital access to various resources and services. It is very simple for the faculties, students, and administrative staffs to access learning materials such as notes, lectures, attendance, marks, and resources efficiently. At the same time, several students from different campuses can access the same learning materials [2].

7.5. Mobility

Cloud computing offers accessibility to the mobile devices to institutions' information through smartphones and portable gadgets and devices. It provides a big opportunity to guarantee that nobody should be left out of this communication process. Any student, faculty, and administrative officer who live a long way from the institution premises can get access to keep up to date with their clients. Users can access their works using any device all around the world when they stay connected to the internet [15].

7.6. Data Security

Data security is very important for universities, and CSPs provide advanced security firewalls that guarantee the protection of stored data. Cybercrime and data breaches can show a bad impact on an organization's image. CSPs apply baseline protections of data such as encryption, authentication, and access control [15].

8. METHODOLOGY

Technology Organization & Environmental framework (TOE) is appropriate to use for cloud computing adoption in the universities. TOE Model was created by Tornatzky and Fleisher (1990). TOE framework has been fully explained through the researchers in analyzing the cloud services adoption of different types of Information Systems and new trending technological ideas of the IT section [22]. We have adopted the TOE for our research, to analyze the factors that influence the cloud computing adoption at Lasbela university and its campuses.

9. Technology Organization Environmental Framework

The TOE framework is appropriate to use for cloud computing adoption in educational institutions or organizations level [23]. The TOE framework has been fully explained through the researchers in analyzing the cloud services adoption of different types of Information Systems and new trending technological ideas of the IT section. The TOE takes into consideration the suitability factors because it assists the larger scope of understanding technological and cloud services adoption and includes institutional features and its external environmental factors [24].

Technology Organization Environment framework can be applied over education institutions level in difference to the Technology Acceptance Model. The analysis can be focused on technical aspects at the education institutions level. The educational environmental factors that are running the technological instruments can be integrated and described through the TOE framework [21].

Diagram 1. TOE Theoretical Framework

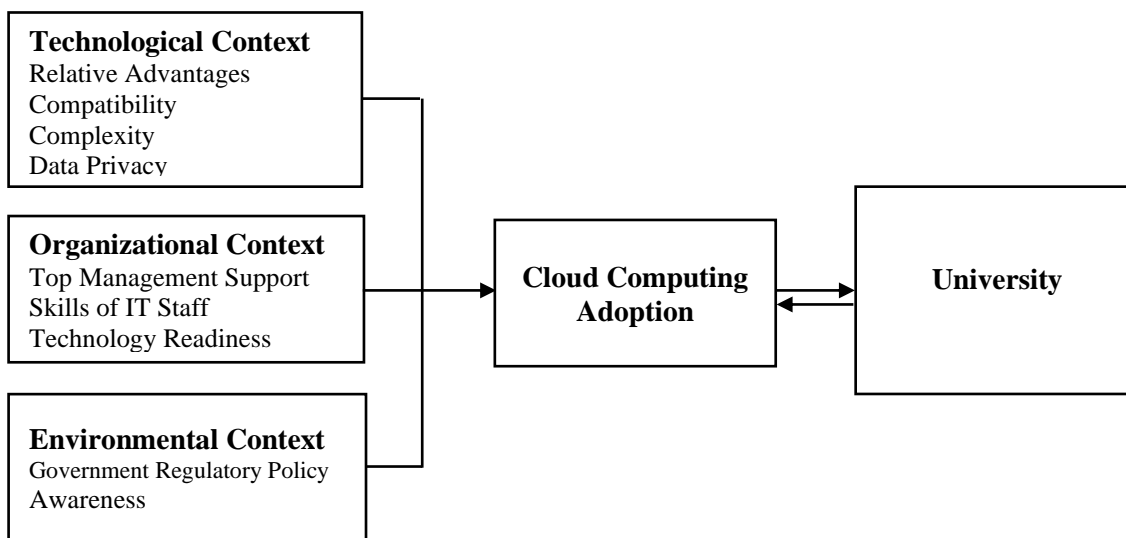


Figure 3. Theoretical framework (Tornatzky, L. G., and Fleischer, M., 1990).

10. Data Collection & Research Design

This study is exploratory quantitative research. The research instrument structure survey is used to apply for the primary data collection. The closed-ended survey questionnaires are used to capture quantitative data. The target population of the study were the respondents of faculty members and administrative staff of the Lesbela University of Water and Marine Sciences, Dera Murad Jamali Campus and Wadh Campus. We have used stratified sampling method because universities have multiple departments, but we have selected the computer science, IT departments and IT section. The closed-ended survey questions are included to capture significant quantitative data which are related to cloud computing adoption in the instructions [9]. SPSS is used for the data analysis of the questionnaire. Cronbach's Alpha was used for the questionnaire's reliability and validity test and where the parameters were analyzed respectively. To find the quantitative analysis we have used descriptive and inferential statistics. In descriptive analysis we have find out the frequency distribution to describe the data in the form of table and graphs. The Chi-Square test was used to test the research hypotheses and to measure the relationship between the parameters or variables.

11. RESULTS AND DESCRIPTIVE STATISTICS ANALYSIS

In this survey 35 faculty members and administrative staff from Lasbela university and its campuses participated in this research. The survey questionnaire was responded by 25 faculty members, 10 administration staff; the male frequency was 28 which is 80% of the respondents and female respondents were 7 which is 20%. The frequency of faculty members was 25 which is 71.4% and administration staffs were 10 which is 28.6% overall respondents. Only Computer Science, Computer Engineering, Information Technology, and Computing related disciplines participated to responded and solve the questionnaires.

Table 1. Demographic Profile

Demographic Profile		Percent
Gender of Respondents	Male	80
	Female	20
Profession of Respondents	Faculty Member	71.4
	Administration Staff	28.6
University Campus	LUAWMS Main Campus	68.6
	LUAWMS DMJ Campus	17.1
	LUAWMS Wadh Campus	14.3

We have analyzed the technological, organizational, & environmental factors that affect cloud computing adoption through surveys from Lasbela University of Agriculture Water & Marine Sciences and its Campuses. we have assessed the determinant of the cloud computing adoption by universities: that Relative advantages, compatibility, complexity, data privacy, top management, IT skills, technological readiness, regulatory policy, and technological awareness, are the key variables that influence the cloud computing adoption at the universities. These parameters have significant contributions to cloud computing adoption by universities. Previous studies assure that these parameters are the factors that affect the cloud computing adoption in the universities [25]. Most of the respondents view that the technological, organizational, & environmental determinants are suitable to use and adopt cloud computing service and resources for the university.

Table 2. TOE Determinants

Determinants		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
TECHNOLOGY						
Relative Advantages	Adoption of cloud computing in universities will lower the IT equ. Cost.	22.9	48.6	20	8.6	0
	Adoption of cloud computing in universities will improve the quality of education.	22.9	65.7	8.6	0	2.9
Compatibility	Adoption of cloud computing will be compatible with university academic activities.	20	68.6	8.6	2.9	0

	Adoption of cloud computing will be compatible with IT infrastructure of your university	31.4	45.7	17.1	5.7	0
Data Security	Is there vulnerability about the leakage of confidential data?	2.9	28.6	51.4	17.1	0
	Is there privacy and insecurity of data while using cloud computing services?	8.6	34.3	31.4	25.7	0
Complexity	The skills needed to adopt cloud computing are too complex for university employees	11.4	31.4	28.6	28.6	0
	Integrating cloud computing in our current work practices will be a big challenge	5.7	57.1	17.1	20	0
ORGANIZATION						
Top Management	Top management understands the benefits of cloud computing resources and services	8.6	45.7	11.4	34.3	0
	Top management supports the transition to the adoption and use of cloud computing	2.9	57.1	8.6	25.7	5.7
IT Skills	Do University employees have enough IT and computing skills to use cloud computing services?	11.4	40	17.1	31.4	0
	Does university provide training programs for employees relating to cloud computing technologies?	11.4	31.4	25.7	28.6	2.9
Technology Readiness	University is willing to adopt cloud computing Services?	8.6	40	25.7	25.7	0
	University needs cloud computing to meet its IT requirements free of cost?	20	48.6	22.9	8.6	0
ENVIRONMENT						
Regulatory Policy	There is a lack of security rules, policies, and privacy laws for the use of cloud services.	5.7	42.9	22.9	28.6	0
	Government laws & regulations that exist facilitate the use of cloud computing at university?	2.9	45.7	34.3	17.1	0
Technological Awareness	Does university management aware about cloud computing services?	5.7	22.9	34.3	31.4	5.7
	University holds seminars to increase the awareness of the benefits of cloud computing?	14.3	25.7	14.3	40	5.7

12. Hypotheses Statistical Analyze

We can observe p-value, degrees of freedom, and statistical significance value. If calculated value is less than formulated value ($p < .05$), this means that (H0) null hypothesis is Rejected, & if calculated value is greater than the formulated value ($p > .05$), means the null hypothesis (H0) is Accepted.

Table 3. Pearson Chi-Square statistics values shows that relative advantage, IT skills, and technological awareness has a positives significant effect and whereas compatibility, data security, complexity, top management, technological readiness, and regulatory policy has no significant effect on cloud computing adoption at university.

Table 3. Hypotheses

	Hypotheses	Calculated Value	df	Significance value	Remarks
Relative Advantage	Relative Advantage has a positive significant effect on the cloud computing adoption at university.	14.353 ^a	3	0.002	Rejected
Compatibility	Compatibility has no positive significant effect on the cloud computing adoption at university.	3.452 ^a	3	0.327	Accepted
Data Security	Data Security has no positive significant effect on the cloud computing adoption at university.	3.880 ^a	3	0.275	Accepted
Complexity	Complexity has no positive significant effect on the cloud computing adoption at university.	3.140 ^a	3	0.371	Accepted
Top Management	Top Management has no positive significant effect on the cloud computing adoption at university.	5.182 ^a	3	0.159	Accepted
IT Skill	Skill of IT Staff has a positive significant effect on the cloud computing adoption at university.	10.873 ^a	3	0.012	Rejected
Technology Readiness	Technology Readiness has no positive significant effect on the cloud computing adoption at university.	4.006 ^a	3	0.261	Accepted
Regulatory Policy	Regulatory Policy has no positive significant effect on the cloud computing adoption at university.	4.947 ^a	3	0.176	Accepted
Technological Awareness	Awareness has a positive significant effect on the cloud computing adoption at university.	13.362 ^a	4	0.01	Rejected

13. Reliability Test

The coefficient of Cronbach's Alpha indicates reliability and internal consistency set of scale. Cronbach's Alpha for 25 items is 0.732, which is greater. It indicates that items are closely related and high level of internal consistency.

Table 4. Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items
0.732	0.664	25

14. Findings

14.1. Technology

Most of the respondents agreed with the relative advantage and it is an important component for the university to adopt cloud services. The respondents agreed that cloud computing services are compatible and there is no complexity to adopt cloud computing at the university. The respondents are neutral and disagreed that there is data security concern or leakage of confidential data for the cloud adoption at the university.

14.2. Organization

In organizational context, most of the respondents are agreed that top management understands and supportive for the adoption of cloud computing services. There are IT skills and technological readiness to adopt cloud computing services at the university.

14.3. Environment

In environmental context, most of the respondents agreed that there is lack of security rules & policies that exit facilitate the adoption of cloud services, and the other component most of the respondents disagreed and also are neutral that they are not aware about the cloud computing benefits/services.

The second objective suggested by the TOE framework which was Relative Advantage, IT Skills, and Cloud Awareness found positive significance; whereas the Compatibility, Data Security, Complexity, Top Management, Technological Readiness, and Regulatory Policy, were found no positive significance that affects cloud computing adoption by the university.

15. CONCLUSION

Cloud computing delivers resources and services on demand including cloud storage, cloud applications, and power processing to the universities. Cloud computing is known in the institutions due to its benefits which increased accessibility to reduced IT infrastructure costs and other academics online activities. Cloud has constructive characteristics such as easy access, large data storage, distance learning, cost effectiveness, and pay-per-use. According to literature the utilization of cloud computing resources & services is seen in universities; the private sector universities are using more than public sector universities [4]. The TOE framework and TAM model is used to determine the parameters such as relative advantages, compatibility, complexity, data privacy, top management, IT skills, technological readiness, regulatory policy, and technological awareness of cloud computing adoption by university. We have conducted a survey in a Lasbela University of Agriculture Water & Marine Sciences and its campuses to analyze parameters with which its adoption can enhance the learning outcomes in university. About 40 participants have participated and marked their valuable remarks in this research. Wherein, most of the respondents view that the technological, organizational, & environmental determinants are suitable to use and adopt cloud computing service and resources for the university. The hypothesis results showed that, compatibility, data security concerned, complexity, top management, technological readiness, and regularity policy has no positive significant effect and whereas the relative advantages, IT skills, and technological awareness have a positive effect on cloud computing adoption at university. The respondent's statistics indicate that university should adopt and use cloud resources & services to fulfill its online distance learning and academic activities. It is an essential trending technology for the students and faculties, and it facilitates faculties and students a better understanding of learning.

16. Future Recommendation

According to this research University should adopt cloud computing services because university infrastructure and environment are compatible to adopt cloud computing. Management and Faculty members should use the cloud computing services in the university. Faculty members and scholars should adopt cloud computing as a digital or online research tool. Faculties should be provided training and seminars about the relative advantages and usage of cloud computing. Students should be motivated and provide awareness towards of the cloud computing technology. Top management should understand the importance of technology readiness and utilization of the cloud computing services. These services will convert the old traditional learning method into a digital technological learning method, which can reduce the time cost and hardcopy expenses. It is one of the trending technologies to help in educational sectors towards the betterment of the quality of distance and online learning.

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