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CLOUD COMPUTING ROLE IN PRESERVING INFORMATION WITHIN LOCAL LIBRARIES IN JORDAN: THE MEDIATING IMPACT OF IT INFRASTRUCTURE

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Abstract- *Current study aimed at examining the influence of cloud computing components (clients, data centers and distributed servers) in preserving information within university libraries through the mediating influence of IT infrastructure. Researcher employed the quantitative approach through depending on a 5 liker scale questionnaire with 29 items. Questionnaire was distributed on (162) employees within private universities in Jordan. Results of study indicated a positive influence of cloud computing on preserving library information and confirmed the mediating influence of IT infrastructure on that process. Study also revealed that "clients" as a component of cloud computing plays a role in presenting a better cloud computing experience for university libraries in a way that depends on how beneficial and supporting the used devices are. Study recommended the need to take advantage of cloud computing in higher education.*

Keywords: Cloud Computing, Google, Data Centers, Server, Virtual Storage

INTRODUCTION

The age of the Internet and information technology contributed to the increase the amount of information and data, reaching a stage in which it became difficult to control this information by traditional methods, this matter led to the accumulation of information, data and files in computers, and the need for new and spacious storage places that could contain this vast amount of information and at the same time its cost is reasonable and its performance is high, in addition to allowing users to access this information anywhere and anytime easily (Abdelaziz et al, 2018; Madni et al, 2017).

With the continuing costs of storing and dealing with the huge amount of information, and the need of individuals and institutions (educational and commercial) for an easy way to preserve this data, the challenge of preserving and retrieving data and information appeared, which led specialists to reach what is known today as cloud computing (CC) (Ibtihal and Hassan, 2020). The primary goal of this idea was to facilitate the task of saving data and to retrieve it for users in a more effective and efficient manner, in addition to providing the required protection for data and accessing it at anytime and anywhere (Dang et al, 2019).

AIM AND OBJECTIVES

Based on above argument, current study aimed at examining the impact of cloud computing in preserving university libraries information and data through the mediating influence of IT infrastructure; study in that sense tried to reach the aim through the following set of objectives:

- Identify the definition of cloud computing, its components and importance
- Highlight the uses of cloud computing within university libraries work
- Examine the relationship between IT infrastructure and an efficient outcome of cloud computing

CONCEPTUAL LITERATURE REVIEW

Cloud Computing

Cloud computing, as a term, is a technology that depends on processing and storing computer data through a server that can be accessed through the Internet, and thus technological programs are transformed from products to services (Rajabion et al, 2019). According to Butt et al (2019), cloud computing refers to the area in which data can be stored in a huge amount in a computerized way that results in doubling the number of external customers, in other words, it is a technological model that works to provide applications and software in the form of a service provided to many users of the Internet.

Chaturvedi and Gupta (2020) noted that the idea of cloud computing emerged in the early 1960's through the research of 'John McCarthy' and 'Joseph Carl', and was confined in its beginnings to financial transactions and inventory operations. In 1979 the term (cloud computing) appeared and was used directly by 'Chellappa Ramnath'. In fact, the real development of the concept of cloud computing began in 1999 with the emergence of "SalesForce" and the possibility of submitting applications electronically as it was a pioneer in the concept of electronic application submission.

In 2002, AMAZON appeared and registered its first cloud, which contained the services provided by the site and was then known as 'Amazon web service', and in 2006 Amazon developed its second cloud under the name 'AC2' as a commercial service through the Internet, and with the access of the world to 2009, the huge cloud appeared, which is known today as 'Google', which is one of the most famous electronic clouds known today (Varghese, 2019).

Components of Cloud Computing

Cloud computing is a complex concept in itself, and it cannot be summed up in a simple and brief part, except that it is recognized that cloud computing consists of basic systems such as the front end, the network used such as SAAS, PAAS and IAAS, but there are basic components of cloud computing represented in Simple three-part which are (Clients, Data Centers and Distributed Servers).

According to Hurwitz and Kirsch (2020); Kumar and Kumar (2019); and Karim and Soomro (2020) these simple components have specific goals and roles in securing the results of cloud computing, which are:

Clients

The concept of Clients as a component of cloud computing represents local networks such as regular and old LANs, private or public computers, mobile devices, smart phones, tablets, or any large data and information engines interacting with users in order to transfer their data and information to the cloud.

Data Centers

Datacenter is, in its simple concept, a group of servers that contain the required applications or programs that can be accessed or interacted with through the Internet.

Currently, the world is seeking to use what is known as a 'virtual server', that is, the ability to run virtual servers through a single physical server.

Distributed Servers

Servers distribution in the case of cloud computing is by placing servers in different locations, as it is not necessary for the servers to be in the same location, on the contrary, they are in different geographical locations, for the user, these servers operate as if they are next to each other.

Model and Hypotheses

Current study aimed at examining the influence of employing cloud computing in preserving libraries' information through the mediating impact of IT infrastructure. Researcher gathered all adopted variables in the following model:

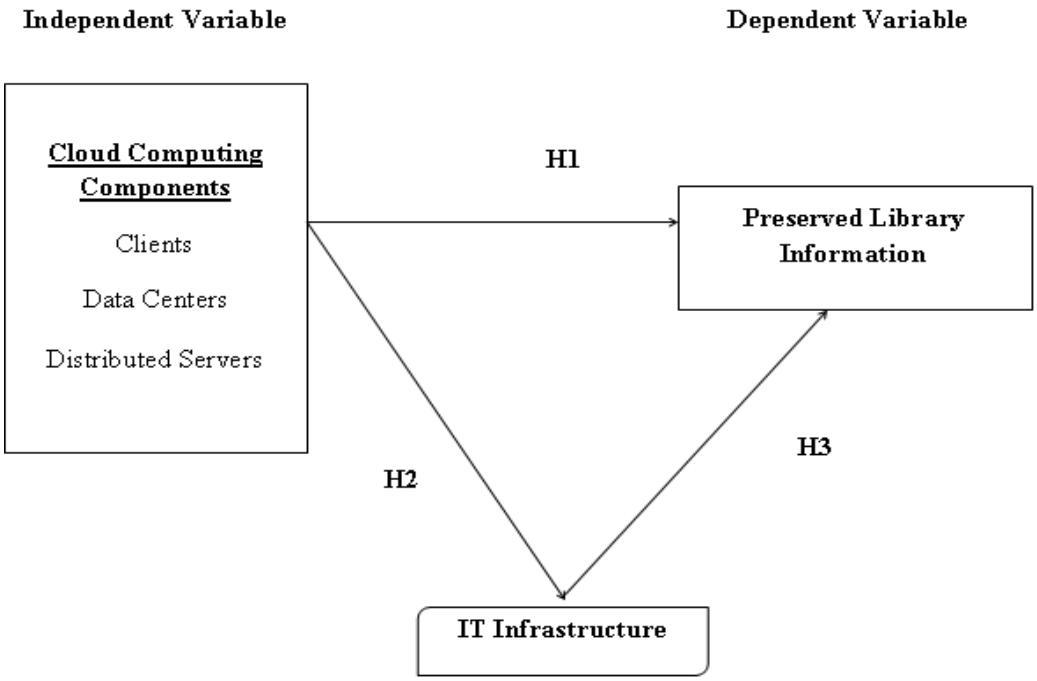

Figure 1: Study Model

From the model above, Researcher was able to synthesize the following set of hypotheses which were followed by their development process later on:

H1: Cloud computing components help in preserving library information

H2: Cloud computing success is influenced by well-built IT infrastructure

H3: Cloud computing help in preserving library information through the mediating influence of IT infrastructure

Sanchati and Kulkarni (2011) aimed at examining how libraries in universities employ cloud computing in order to face problems and solve them. The study indicated that **data centers** provided by cloud computing helped university libraries in managing their data and maintaining the ability to control applications and data stores that contain sensitive and private information regarding users. The study confirmed that the cloud computing **IT infrastructure** in universities in general and especially their libraries faces many challenges, and for this, maintaining the infrastructure of the web-based library is one of the most important solutions that libraries need to do in order to ensure an effective cloud service for users.

Arora et al (2011) pointed out that the concept of cloud computing provided a lot of assistance in the field of office management through various cloud applications, which enabled users to easily access the digital library and deal with a lot of information and data that would organize the supply of information parallel between the digital library and the physical library down to the stages of harmonizing the contents of the cloud with the actual library contents. This matter was achieved by cloud computing through **data centers** and **distributed servers**. On the other hand, Pandey and Kushwaha (2015) stated that libraries adopt cloud computing applications due to the latter's ability to manage their own **data centers**, which gives them more control over the foundations of data preservation and retrieval, all of this depends on the effectiveness of libraries in providing the necessary technical support for the technological infrastructure, especially for the digital library which through users can access and interact with various applications and with the data in them.

Kumar (2015) also argued that in the field of universities, the cloud computing in the university library is used as a means to deal with the conditions of e-learning on the grounds that cloud computing is a product that serves modern e-learning, and this has given the advantage to libraries by keeping their information in a safe and easy-to-access place, and thus users (teachers and students) have open access to information, as well as interacting with users using cell phones, computers, and other portable devices.

According to Aoyama et al (2019), the idea of cloud computing in libraries depends on a mechanism adopted by the library through a sophisticated data center that provides large storage areas for the library, in addition to providing the library with applications that provide many services to users. Shahidinejad and Ghobaei- Arani (2020) added that the storage concept is seen as the backbone of the idea of cloud computing in libraries and storage is based on the availability of technology and its infrastructure, which would allow users to create their own spaces on the cloud and treat it as their own information control center without interference from any third party. It is worth noting that cloud computing was able to provide a lot of benefit to libraries of all sizes and contributed to linking the library with employees regardless of their location and the start of their work through storage services, messaging, and storage spaces that may be available (El-Attar et al, 2019).

METHODS

In order to reach main aim of current study and realize the previously mentioned hypotheses; researcher employed the quantitative approach depending on a questionnaire. The questionnaire consisted mainly of two sections; the first presented the demographic variables of study sample, while the other presented statements related to variables of study – *figure 1* – based on dependent and independent variables. The questionnaire was built on liker 5 scale and consisted in its final version of 29 statements.

Population of study consisted of all library employees within (18) private universities in Jordan. Initially, the questionnaire was distributed on a convenient sample of (200) employees, after application process; researcher was able to retrieve (162) properly filled questionnaire which gave a statistical response ration of (81%) as accepted.

Cronbach's Alpha was employed in order to verify the study reliability. The alpha value = 0.949, which is an excellent ratio, being higher than the acceptable percentage 0.60. (Sekaran & Bougie, 2016)

ANALYSIS AND DISCUSSION

Demographic Results

Table (1) presented results of sample characteristics according to demographics (age, gender, qualification and experience), results of indicated that majority of sample was (males) forming (69.1%) of total sample compared to (females) who formed (30.9%) of the sample. As for the age range, study indicated that majority of respondents were with age range of (29-35 years old) forming (41.4%) of sample, in addition to that, demographic results indicated that (MA) holders were the majority of respondents forming (76.5%) of total sample with experience of (more than 7 years) forming (42.6%) of total sample.

Table (1): Participants' Characteristics According to Demographics

Gender			
		Frequency	Percent
Valid	Male	112	69.1
	Female	50	30.9
Age			
		Frequency	Percent
Valid	22-28	29	17.9
	29-35	67	41.4
	36-41	45	27.8
	+42	21	13.0
Qualification			
		Frequency	Percent
Valid	BA	27	16.7
	MA	124	76.5
	PhD	11	6.8
Experience			
		Frequency	Percent
Valid	1-3	51	31.5
	4-6	42	25.9
	+7	69	42.6

Questionnaire Analysis

Table (2) below presented analysis of participants' answers to study questions; it appeared through analysis that respondents had positive attitudes towards statements of study as all of them scored higher than mean of scale 3.00. Going deeper into analysis, it was seen that the most positively answered statement was articulated "*With cloud computing, capacity in libraries can be easily increased without spending much*" scoring a mean of (3.59/5.00) compared to the least positively answered statement articulated "*Servers perform as they are close to each other even though they are in different locations*" and scoring a mean of (3.19/5.00).

In the following table (3), mean and standard deviation was calculated for study variables as a whole. Results also indicated that all variables scored higher than mean of scale 3.00 referring that all variables were positively received by respondents.

Table (2): Descriptive Statistic of Questionnaire Statements

	Mean	Std. Deviation
Cloud Computing Components		
Clients		
Devices are all up to date and browsing through them is accessible	3.52	1.398
All devices support cloud computing technology	3.47	1.281
LANs and WANs are available and accessible all the times	3.41	1.178
All networks are active and can be accessed whenever needed	3.44	1.195
There is a chance to log into the network using mobile devices, laptops, desktops and PCs	3.42	1.135
Data Centers		
Utilizing data centers in libraries increase knowledge of users through constant access	3.28	1.171
Data centers streamlines the process of managing dozens of virtual servers on multiple physical servers is available	3.22	.959
The network architect supports end users	3.19	.907
Data centers assists in big data analysis	3.30	.926
Data centers can maintains huge storage, backup, and recovery	3.46	.947
Distributed Servers		
Distributed centers help in utilizing the digital library	3.34	.998
Subscriptions are always accessible through different ports	3.38	1.003
Servers are always open for entry and browse	3.40	.949
Any server can be logged in from any location	3.20	1.157
Servers perform as they are close to each other even though they are in different locations	3.19	1.186
Library Information		
With multiple users of libraries, there is much complexity in organizing and maintaining	3.53	1.132
Libraries- virtual/ actual – must work efficiently and quickly	3.48	1.053
Libraries' information storage much meet mission and vision of library	3.41	1.079
Cloud solutions are quintessential to meet with progressing demands of libraries	3.38	1.003
With cloud computing, capacity in libraries can be easily increased without spending much	3.59	.916
Control over confidential information is crucial for every library	3.36	.910
Cloud allows having entire visibility and command over library information.	3.30	1.164
IT Infrastructure		
IT industry has brought the concept of virtualizing servers	3.30	1.098
Any software might be installed through the utilization of various instances of virtual servers	3.50	1.035
IT is the fundamental aspect of cloud computing	3.25	.985
Well-built architecture an help in increasing efficiency of cloud computing	3.30	1.098
IT Supports application and web servers and manage networking resources	3.50	1.035
IT increases performance on computing	3.25	.985

Table (3): Descriptive Statistics of Study Variables

	Mean	Std. Deviation
Cloud Computing Components		
Clients	3.4519	1.03781
Data Centers	3.2914	.81784
Distributed Servers	3.3000	.88078
Library Information	3.4365	.85392
IT Infrastructure	3.3498	.95647

Hypothesis testing:

Before starting structural analysis, the proposed study model must be validated by a set of indicators to check the suitability of the model of this study, as follows:

Table (4): Fit Model

Indicator	AGFI	$\frac{X^2}{df}$	GFI	RMSEA	CFI	NFI
Value Recommended	**> 0.8**	**< 5**	**> 0.90**	**≤0.10**	**> 0.9**	**> 0.9**
References	(Miles and Shevlin, 1998).	(Tabachnick and Fidell, 2007)	(Miles and Shevlin, 1998).	(MacCallum et al, 1996)	(Hu and Bentler, 1999).	(Hu and Bentler, 1999).
Value of Model	0.908	2.442	0.975	0.095	0.957	0.907

Results in table (4) showed that above indicators have passed the values recommended by the relevant references; this led to the hypothesis testing using structural equation modeling analysis (SEM), in that sense, hypotheses would be accepted in case p-value scored less than 0.05 as in the following table (5).

Table (5): Result of path coefficients of direct relationships

			Direct effect	**Indirect effect**	**C.R.**	**P**	**decision**
IT	<---	Cloud computing	0.586		6.523	***	accept
Information	<---	Cloud computing	0.337	0.381	4.555	***	accept
Information	<---	IT	0.651		8.417	***	accept

Results of path coefficients indicated that following:

H1: Cloud computing components help in preserving library information

As in table (5) above, it was seen that (C.R. = 8.417; P < 0.05; = 0.000), this meant that Cloud computing components help in preserving library information.

H2: Cloud computing success is influenced by well-built IT infrastructure

Also according to table (5); (C.R. = 6.523; P < 0.05; = 0.000) leading to the acceptance of 2nd hypothesis and indicating that Cloud computing success is influenced by well-built IT infrastructure.

H3: Cloud computing help in preserving library information through the mediating influence of IT infrastructure

Table (5) referred to the acceptance of 3rd hypothesis as (C.R. = 4.555; P < 0.05; = 0.000) which meant Cloud computing help in preserving library information through the mediating influence of IT infrastructure.

Table (6): Pearson Correlation

		Clients	Centers	Servers	Library Information
Clients	Pearson Correlation	**1**			
	Sig. (2-tailed)				
	N	162			
Data Centers	Pearson Correlation	**.524****	1		
	Sig. (2-tailed)	.000			
	N	162	162		
Distributed Servers	Pearson Correlation	**.347****	.597**	1	
	Sig. (2-tailed)	.000	.000		
	N	162	162	162	
Library Information	Pearson Correlation	.387**	.533**	.603**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	162	162	162	162

****. Correlation is significant at the 0.01 level (2-tailed).**

DISCUSSION

Current study aimed at examining the influence of cloud computing on preserving library information through the mediating role of IT infrastructure. Utilizing a questionnaire on library employees within private Jordanian universities; results indicated that cloud computing usage within libraries is essential and plays a huge role in preserving and sustaining well-built library services through a well-built IT infrastructure. Study was able to reach following findings:

- Participants appeared to have high level of awareness regarding cloud computing and its uses within the library given that they managed to go through the questionnaire easily with full understanding of the concepts employed
- All hypotheses were accepted and their appeared an influence of cloud computing in preserving library information that is attributed to IT infrastructure.
- Among cloud computing components; clients – **scoring a mean of 3.45/5.00** - appeared to be the most influential which refers to the importance of devices and electronics that a library employ in order to take the maximum benefits of cloud computing.

The study proved that cloud computing in the field of university libraries is one of the most important tools that contribute to preserving and retrieving information when needed at anytime and anywhere using various types of devices such as personal computers, laptops and smart phones. The study also found that library employees rely heavily on cloud computing applications in order to facilitate students' access to the university electronic library, and more use of cloud computing appeared in the field of university libraries during the COVID 19 pandemic due to the suspension of university attendance and the continuation of distance studies.

Thanks to cloud computing, the university library was able to provide services to students through the university's website, in which all the necessary information, search engines and data were available, in addition to a large number of shared computer resources such as servers, software applications and storage applications via computers or any devices via internet without the need for the user to be aware of where these resources are located, how to manage them, or how to maintain them, for they are resources (in the cloud).

The study also found that cloud computing in university libraries has greatly contributed to providing employees with access to adjustable computing resources such as networks, storage servers, and applications, which can be provided and deployed with minimal effort when administered and without the need to interact with the service provider. As for the IT infrastructure, it was seen through study that the importance of the IT infrastructure in cloud computing stems from its use in providing service, including personal computers, the Internet, storage spaces for information, and the continuity of maintenance and updating of servers by specialists.

Cloud Computing Components Have the ability to Preserve Libraries' Data and Information

Among the three main components of cloud computing, study was able to find out that the most influential component was (clients) which scored a mean of 3.45/5.00 and referring that devices, computers and software are extremely important in the process of cloud computing merging within library work. The study proved that librarians were and still benefit from cloud computing applications, as it was found through the application that many libraries deal with programs installed on remote servers and through them many office operations such as adding files, removing them, updating them and indexing them for the beneficiaries without the need for this software to be physically present on the computers used in the library.

This is in line with what was stated by Hurwitz and Kirsch (2020) confirming that cloud computing contributed to the service of public and university libraries in many practices, including electronic lending services from the cloud library, as it is an integrated system within the infrastructure of the library. In addition, it was indicated by Kumar and Kumar (2019) – agreeing with current study – stating that the possibility of cloud computing in serving university libraries through its programs such as SAAS, where software applications or data of the library are hosted on the Internet, which would facilitate access to content of the library by many external individuals.

The relationship between cloud computing and IT infrastructure

Although the study demonstrated the effect of cloud computing on the preservation and flow of information and data in university libraries, the principle of IT infrastructure represented the greatest idea in this context. It was found that IT infrastructure is one of the most important requirements for adopting cloud computing in university libraries, given that the principle of cloud computing is based on the complete and permanent availability of service and the presence of technology that guarantees access to the cloud, in addition to that IT infrastructure includes answers to many inquiries, which include the extent of data security, accessibility, and who can access it, as well as protection from hacking programs that harm the cloud, which leads to the loss of existing data and information. Also, it was found that IT infrastructure has a significant impact on the ability to meet the needs of educational organizations - university libraries - and the idea that these huge organizations are at the mercy of technology that may disrupt or fail to meet the requirements, and then also reach the stage of losing information and data.

According to the results of the study, it can be said that cloud computing is very beneficial to libraries by helping to save costs and make new services available. In addition, the number of libraries that benefit from cloud computing is increasing - especially university libraries - which helped the library move to provide its services remotely which added a major change in the policy of libraries.

CONCLUSION AND RECOMMENDATIONS

In the end, the whole idea was reached that cloud computing acts as an environment for users to help them by providing interactive solutions to deal with work, files and data in their huge sizes, and it has also proven effective in reducing the chances of data and files being lost or damaged in devices. This led to an increase in the ability of libraries to possess great capabilities to provide service at anytime and anywhere by providing servers, improving work and preserving existing data.

The concept of cloud computing in the field of university libraries increases the possibility of users accessing services easily in order to complete work in a flexible manner without limits and no time or space restrictions.Cloud computing also has an advantage not found in personal computers, which is collaboration. Resources in the cloud can be accessed and shared from anywhere, provided they are connected to the Internet. Cloud computing is also characterized by ease of use, as many educational institutions around the world have confirmed that cloud computing is a very attractive system to use, and is integrated in educational use.

Implications of current study might appear managerial in its nature, current study would be of great help in examining the undeniable role of cloud computing in increasing efficiency of e-libraries especially among university students, in addition to that, current study may grab attention of librarians and specialists in increasing training of library employees on how to tackle cloud computing applications within the library.

Based on above analysis, discussion and conclusion; current study recommends the following:

- Theories supporting cloud computing in education stem from the 'constructivist theory philosophy'; so when the learner uses cloud systems and applications, they must feel as if they own the education system, which drives them towards continuous activity within the system in order to build their knowledge instead of gaining it logically.

- A report issued by Google shows the increasing demand for the cloud computing system in the educational sectors, so the study recommends the need to take advantage of cloud computing in higher education.

- There must be a common understanding between the educational system and the cloud service providers about the quality of services, priorities, responsibilities, and guarantees, and many cloud service providers may not provide good levels of these agreements, which contradicts the basic requirements for the transformation of large organizations to cloud computing services.

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