IJSCET

International Journal of Sustainable Construction Engineering and Technology

Cloud Computing Adoption Factors Affecting Academic Performance in UAE Public Universities

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Abstract: Cloud computing helps in reducing costs and providing accessibility, reliability, and flexibility especially in educational sector. This able to provide the best educational resources and facilities to all level of students effectively and efficiently. It also seen as a creative technological innovation that provides stable and on-demand access to the available network. Hence, this study aimed to measure the cloud computing adoption factors affecting the academic performance in UAE university. The factors are clustered into five groups namely, knowledge sharing; knowledge application; learnability; perceived self-efficacy; and perceived enjoyment. A questionnaire survey was conducted with the university students to gauge their opinions on the level of significant of each factor affecting the academic performance using 5-points Likert scale. Out of 400 questionnaire sets distributed using random sampling, 382 valid responses were extracted as the collected data. This data was analysed descriptively. The results of the analysis found that that cloud computing adoption factors in perceived self-efficacy group are ranked first in term of its significance in affecting academic performance. The second rank is factors in learnability group; the third is perceived enjoyment; the fourth rank is knowledge application and finally, the fifth rank is knowledge sharing. The impact of this research will be felt simultaneously in the IT and education sectors, particularly through assisting students in utilising cloud computing to store and exchange information for both their academic and personal lives.

Keywords: Cloud computing, adoption factor, academic performance

1. Introduction

UAE's education systems are among the top 20 in the world for quality. (World Economic Forum 2018). For continuous improvement, the UAE government's educational system adopted cloud computing technologies for its higher education. The technology able to facilitate the development of the overall higher education process; at national and international level initiative to improve the worldwide education industry. In today's economy of globalisation, the significance of cloud computing to the organisation has been extensively addressed. Executing cloud services has several benefits that can be applied by higher education institutions to improve the standard of instruction, learning, and research (Al-Zoube et al 2010, Laisheng & Zhengxia, 2011).

With this technology, higher education institutions able to make the necessary adjustments that will simplify the teaching and learning process, perhaps enhancing student performance (Hashim& Othmen, 2014). According to Kalagiakos & Karampelas (2011), cloud computing technology has various benefits for users, including being more adaptable, accessible, and portable. For instance, college students are encouraged and motivated to use technology and social networking in their academic programme. In Ashari and Eydgani (2015) study, it mentioned that the success of cloud computing in higher education depends on both institution support and student readiness to utilise the technology.

For Marchisotti et al. (2019) study stated that several studies have recently focused on the technology itself. Other studies, however, focus more on cloud computing technology from a business-related perspective and less on the perspective of higher education (Schneckenberg et al., 2019; Hao&Helo, 2017). Additionally, Senyo et al. (2018) and Thomas (2011), who conducted extensive reviews of the literature in relation to cloud computing usage, methodologies, obstacles, and benefits, suggest more research on the subject. It is crucial particularly in the field of education. Moreover, there are not many research on cloud computing adoption from the standpoint of UAE public universities that have been reported (Tashkandi & Al-Jabri, 2015).

Recent research and studies have attempted to examine students' academic performance in order to ascertain the causes of their variations in performance (Raza, Qazi, &Umer, 2017; Raza, Umer, Qazi, &Makhdoom, 2018). According to earlier research, using cloud computing may help kids perform better academically (Sadeeq et al., 2021; Alamri & Qureshi, 2015). Study by Cao and Tian (2020) has argued an urgent to look at the decline in academic performance among UAE university students and cloud computing may able to address this issue. Although higher education in the UAE is aware of the need for cloud computing, it is unclear what aspects, such as perceived usability and convenience of use, will encourage public university students to use cloud computing. However, some of the interested educational institutions in integrating cloud computing's capabilities lack of attention and understanding regarding how best to execute changes, particularly those related to cloud computing. Consequently, knowing the position of educational institutions notably universities in relation with the good adoption of cloud computing among student are an urgent research subject. Therefore, it is necessary to pinpoint the elements influencing students at public universities in the United Arab Emirates to adopt cloud computing.

While there have not been enough studies on cloud computing, there also not enough studies that focus on how educational institutions are using cloud computing to boost students' academic performance. Especially, research on the use of cloud computing on students' academic achievement, particularly in public universities, in the UAE. Based on the foregoing debate, this study attempts to pinpoint the variables influencing students' adoption of cloud computing in public colleges in the United Arab Emirates.

2. Cloud Computing

Namasudra (2018) defined cloud computing in his study as "pay-as-you-go computing resources and scalable infrastructure that primarily provided cutting-edge information technology (IT) services to generate a significant amount of space and data availability." According to Zhou et al. (2018), cloud computing is an IT pillar and web architype that allows users to access significant IT resources (hardware and software) via cloud servers accessible via web solutions. They also claimed that cloud computing provides users with a variety of services based on their needs. Cloud computing, according to Rashid and Chaturvedi (2019), is also a set of accessible web services that prioritises data and information access and storage. It is a web-based tool for storing and retrieving data and information via the Internet. Rashid and Chaturvedi (2019) stated in their study that cloud computing is a system that primarily consists of the three services infrastructure as a service (IaaS), software as a service (SaaS), and platform as a service (PaaS) (PaaS). Figure 1 depicts the various types (forms) of cloud computing services.
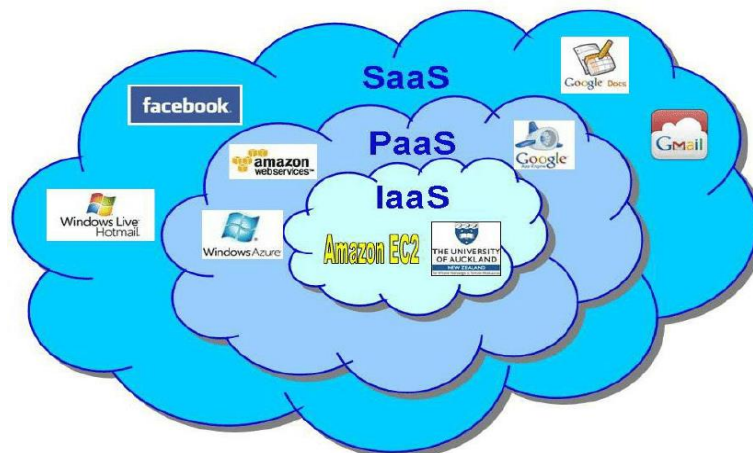

Fig. 1 - Forms of cloud computing services (Rashid & Chaturvedi, 2019)

1. **Infrastructure as a service (IaaS):** One or more cloud servers are used by this type of cloud service to make a variety of virtualized computing resources, such as CPU, Memory, OS, and Application Software, available through the service provider (s). The main goal of this service was to transform readily available physical resources into equivalent logical resources that users (customers) may adopt and dynamically use through already established web providers.

2. **Software as a Service (SaaS):** With this service, the cloud computing provider can offer the application software while also taking on the responsibility of maintaining its functionality, compatibility, and up-to-dateness with other resources and connected systems. Users are free to utilise these programmes with their own resources and can access them through a variety of devices, including PCs and smart phones.
3. **Platform as a Service (PaaS):** This service is regarded as the most advanced and comprehensive one and integrates system software (the operating system) and other resources (infrastructure). PaaS services cover the planning, creation, and hosting of both software and physical infrastructure.

2.1 Related Studies on Cloud Computing

To ascertain how the introduction of cloud computing affects various organisational difficulties, numerous studies were conducted. Businesses are reluctant to use the cloud because of its dubious benefits (Smith & Sommerville, 2011). Even though numerous studies (Liu et al., 2018) were conducted to emphasise its impact on manufacturing, marketing, organisational valuation, and organisational agility (Ooi et al., 2018).

A study by Darwish et al. (2019) also suggested using cloud computing technology for a smart gateway to improve the efficiency and quality of the healthcare system. According to a recent study by Khayer et al. (2020), cloud services increase an enterprise's varied long-term capabilities and capacities, which has a major favourable impact on company performance. The goal of the study was to ascertain how adopting and using cloud computing would affect small businesses' organisational effectiveness (small and medium enterprises).

According to Arvanitis et al. (2019), cloud computing helps businesses transform their current business model into a more lucrative and creative one by boosting IT capabilities and by bringing important competitive advantage features. Similarly, Kumar, Samalia [9] investigated how SMEs in India used cloud computing and discovered that perceived benefits, top management support, competitive pressure, and perceived anxieties all had a major impact on the adoption of cloud technology.

3. Factors Affecting the Adoption of Cloud Computing in Academic Sector

In recent research released by the UNESCO Institute of Statistics (2019), it was found that university administrations and governments around the world have made significant investments in integrating constantly-evolving information technology into their overall educational systems. The most crucial elements influencing the adoption of such technology must be considered because cloud computing is one of the major new technologies employed in various areas.

Al-Harethi and Garfan (2018) investigated the factors that contribute to negative perceptions and lack of awareness among university students regarding cloud-based applications. In their study, they proposed a research framework for adoption that considered external factors such as self-efficacy, motivation, exposure, perceived trust, and cost of usage. Similarly, Raza et al. (2020) conducted an online survey of 628 university students to examine the reasons behind their use of cloud computing. Their study found that the adoption of cloud computing was influenced by several factors, including knowledge application, storage, innovation, discovery, and learnability. The authors emphasized the importance of understanding these factors to encourage wider adoption and use of cloud-based applications in higher education. Overall, both studies highlight the importance of considering external factors and characteristics that influence the adoption of cloud computing among university students.

In a recent study by Arpaci (2019), data collected from 308 undergraduate university students in India was used to develop a structural model that focused on understanding human behavioural intentions towards new technologies, including cloud computing. The study found that information management techniques used by students in conjunction with new technologies accurately predicted their behavioural intentions. Another study by Al-Rahmi and Zeki (2016) proposed a framework for social media adoption in e-learning the Quran and Hadith. The study viewed social media as a platform for exchanging and preserving knowledge and information, and emphasized the importance of promoting students' social interaction and collaborative learning. The study identified knowledge sharing and learnability as factors that significantly impact collaborative e-learning of the Quran and Hadith through the use of social media.

In 2019, Okcu et al. examined the factors that influence the adoption of big data technology tools and strategy. Their research identified job relevance, big data dimensions, compatibility, self-efficacy, complexity, and anxiety as crucial adoption factors. The study found that perceived usefulness has a greater direct impact on behavioural intention, leading to the presentation of an all-encompassing technology acceptance model (TAM) that includes perceived usefulness and perceived ease of use factors/variables for adoption.

3.1 Knowledge Sharing

When using technology in an educational setting, students typically apply knowledge sharing in making decisions or to resolve and cope with potential academic challenges. Thus, there is a clear connection between cloud computing and features of knowledge management (knowledge sharing and knowledge application). Additionally, such technology opens up learning possibilities by minimising potential drawbacks or consequences. Developing cloud computing capacity is a crucial task for boosting competitive advantage since it is rapidly changing how students use

and implement their knowledge and is also becoming a more essential component for gaining the most benefits from shared information and knowledge. Since users may efficiently exchange and synchronise information, sharing knowledge creates a key component of effective knowledge management (Alavi & Leidner, 2001). As a result, users can successfully influence how beneficial a given technology is considered. Students' expectations will be raised regarding how sharing knowledge via cloud computing may change how they view the value of these services. Therefore, the perceived value of cloud computing increases as student expectations for knowledge sharing increase. Furthermore, distributing knowledge among trustworthy parties utilising cloud computing servers can improve the knowledge's reliability and quality (Alavi & Leidner, 2001; Arpaci, 2019; Alavi&Leidner, 2001).

3.2 Knowledge Application

Education stakeholders are currently implementing a variety of technological solutions in educational institutions to get significant knowledge application and availability benefits (Sarrab, et al., 2018). Professionals in the educational process are interested in implementing digitalization through a variety of methods to enhance student performance by putting their expertise to use in various areas of the educational process (Caniato et al., 2016). According to Johnson and Bharadwaj's definition from 2005, digitization is the process of using information technology to make all or some information processes, available knowledge, and knowledge feasible usable. Alavi and Leidner (2001) stated that knowledge application, not knowledge itself, is the main pillar of competitive advantage. The acceptance and application of e-learning in several fields, and particularly in education, transformed traditional learning into a more modern strategy (Arkorful&Abaidoo, 2015). Arkorful and Abaidoo (2015) mentioned that e-learning increases knowledge effectiveness by facilitating access to a sizable amount of information during the educational process. Sung et al. (2016) did a study to examine the impact of mobile application on student performance. They looked at how using mobile devices for learning affected students' learning outcomes and discovered that this impact was of a modest means size. According to Higgins and Crawford (2019), using educational technology in the classroom improves the performance, motivation, and attitudes of arithmetic students. Although cloud computing emphasises the fact that it reduces communication channels, it is also seen as an effective tool for knowledge management because it allows for flexible, rapid, and routine document and file updating (Arpaci 2017).

3.3 Learnability

The use of particular cutting-edge technology in the educational and learning process reduces potential learnability concerns and gives pupils useful information. In addition, Zbick et al. (2015) claimed in their study that learning on a mobile device enhances learnability by resolving potential concerns and problems and increases usefulness. By enabling teachers and students to easily obtain knowledge, cloud computing aids in overcoming the learnability (Priyadarshinee et al., 2017). Learnability was described by Sharma et al. (2020) as the degree of difficulty people encounter while trying to find knowledge and expertise relevant to a particular work or project. Numerous studies have examined learnability in relation to technological acceptability. Zbick et al. (2015), for instance, concluded that mobile learning helps address learnability difficulties and makes it more beneficial. Cloud computing offers opportunities for teachers and students to learn new information and skills. Learning is therefore a key indicator of knowledge management, which produces knowledge by utilising creative and new technologies (Raza& Khan,2021).

3.4 Perceived Self-Efficacy

Featherman and Pavlou (2003) have found that the adoption of new technology by students is influenced by their perceived ease-of-use. The easier it is for students to perform and use the primary capabilities of cloud computing, the lower the level of complexity, and the greater their intention to use cloud computing services. This finding is consistent with Abdel-Maksoud's (2018) research, which found that students' intention to use cloud computing is higher when they perceive it as easy to use. The quality of a system can be determined by its ease of use, including not only how easy it is to learn the system but also how easy it is for users to complete tasks or jobs using the system instead of doing them manually (Aryani et al., 2018). Therefore, improving one's understanding of how to use cloud computing will influence their perception of the technology's simplicity, which directly affects their intention to adopt it. Tahar et al. (2020) found that consumers' attitudes are important determinants of perceived ease of use and self-efficacy, which have a significant impact on customers' intention to adopt new technology.

3.5 Perceived Enjoyment

According to Featherman and Pavlou (2003), the adoption of new technology by students is influenced by their perceived ease-of-use. If the primary functions of cloud computing services are easy to use, the level of complexity will be lower, and the students' intention to use them will be greater. Previous research has extensively explored the impact of perceived satisfaction on technology adoption (Davis et al., 1992). Sun and Zhang (2006) investigated the correlation between perceived fun and perceived usability, and found that perceived enjoyment is a crucial step towards perceived usability (Alalwan et al., 2018). Anderson et al. (2008) found that perceived enjoyment is a significant predictor of

perceived ease of use. Al-Gahtani (2014) also found a strong link between perceived ease of use and satisfaction in an e-learning context. Therefore, it is suggested that when students find using cloud computing applications enjoyable, their perception of how easy these applications are to use will also improve. This can result in higher adoption rates among students in higher education.

4. Data Collection

Data of this study was collected using structured questionnaire survey among the university students in two major UAE universities in Dubai which are Zayed University and the higher college of Technology University. The students have already used cloud computing within their educational or learning process and performed well. A questionnaire was designed based on the identified cloud computing adoption factors in the literature review process.

The designed questionnaire consisted of two parts where in part A it consisted the respondent demography. In part B, it consisted of list of the factors affecting academic performance in UAE public universities. These factors are clustered into five groups namely, knowledge sharing; knowledge application; learnability; perceived self-efficacy; and perceived enjoyment. Each of the factor has 5-points Likert scale which symbolised the degree of significant of the factor in affecting the academic performance of the student/respondent.

The questionnaire was distributed using random sampling technique and the sample size of the respondents was acquired through Krejie. & Morgan, (1970) table. A total of 400 sets of questionnaires was distributed, however, 385 sets were valid and used for further analysis.

5. Results of Data Analysis

The demography of the respondents is as in table 1

Table 1 - Respondents' demography

Items	Category	Frequency	%
Gender	Male	214	50.0
	Female	168	43.9
	Total	**382**	**100.0**
Age (years)	19-20	88	23.0
	21-22	120	31.4
	23-24	154	40.3
	Over 25	20	5.2
	Total	**382**	**100.0**
Nationality	Emirati	209	54.7
	Non-Emirati	173	45.3
	Total	**382**	**100.0**
Educational level	PhD	37	9.7
	Degree	277	72.5
	Master	68	17.8
	Total	**382**	**100.0**

Table 1 displays a summary of the respondents' demographics. In terms of gender and age, 214 male and 168 female respondents, representing 50 percent male and 43.9 percent female, respectively participated in this study. In terms of respondents' ages, those over 25 made up only 5.2 percent, those between 23 and 24 years old made-up 40.3 percent, those between 21 and 22 years old made-up 31.4 percent, and those between 19 and 20 years old made up 23 percent of the sample. In addition, natives from the United Arab Emirates make up 54,7% of the responses, while non-Emiratis make up 45,3%. In addition, persons with bachelor's degrees made up most respondents (72.5%), followed by those with PhDs (9.7%) and master's degrees (17.8%).

The collected data generated from the questionnaire survey was tested for its reliability on answers given by the respondents. Reliability of the collected data is determined using Cronbach's alpha, which serves to identify the level of quality of the data generated through questionnaire survey. According to Pallant (2011), the Cronbach alpha coefficient ought to be higher than 0.7. This is significant considering the validity of the information gathered. In other words, the Cronbach alpha coefficient has been used to assess the internal consistency of the data collected, which should be consistent with the study's goal. The result of this reliability tests is as in table 2.

Table 2 - Result of the reliability test

No	Name of Group	Code	Numbers of Factors	Alpha Coefficient Value
1	Knowledge Sharing	KS	4	0.735
2	Knowledge application	KL	11	0.867
3	Learnability	LB	6	0.765
4	Perceived Self-efficacy	PSE	6	0.800
5	Perceived Enjoyment	PE	3	0.900

Table 2 shows that all the five groups of cloud computing adoption factors attained alpha Cronbach values more than 0.7 which indicate that the collected data has internal consistency. The data was then used for ranking the groups of the factors. Mean score for each factor in the respective group are average to become mean score for the groups. The rank of the groups is based on the mean score of individual groups as compared to the overall groups as demonstrated in table 3.

Table 3 - Result of ranking of factors' group

No	Name of Group	Mean	Ranking
1	Knowledge Sharing	3.16	**5**
2	Knowledge application	3.18	**4**
3	Learnability	3.22	**2**
4	Perceived Self-efficacy	3.30	**1**
5	Perceived Enjoyment	3.20	**3**

Table 3 shows that cloud computing adoption factors in perceived self-efficacy group are ranked first in term of its significance in affecting academic performance. The second rank is factors in learnability group; the third is perceived enjoyment; the fourth rank is knowledge application and finally, the fifth rank is knowledge sharing. The elaboration of these factors is as follow;

1. **Perceived self-efficacy** According to the respondents, perceived self-efficacy is the most critical factor in academic performance. It helps students recognize their abilities and motivations, which improve with age and experience. An example of this is computer self-efficacy, which refers to one's proficiency in using computers (Ballen et al., 2017).

2. **Learnability** is a crucial variable to consider when implementing new strategies or technologies (Cengiz & Bakrtaş, 2020). It refers to the level of difficulty individuals encounter when searching for knowledge and expertise related to a particular task. Several studies have examined learnability in relation to technology acceptance, with mobile learning being shown to alleviate learnability difficulties (Zbick et al., 2015).

3. **Perceived enjoyment** is a significant factor that affects academic performance. This finding is consistent with Sudono et al. (2020), who defined perceived enjoyment as the degree to which the adoption and use of a particular system is enjoyable in its own right, regardless of any negative effects. Therefore, cloud computing is a fun and easy technology for young students to access and use smart devices to access their study materials.

4. **Knowledge application** helps students analyze massive data to determine personalized preferences. It is the main driver of competitive advantage (Alavi & Leidner, 2001) and has transformed traditional learning into a more modern approach, particularly in e-learning (Arkorful & Abaidoo, 2015). Sung et al. (2016) found that mobile learning had a moderate positive effect on student performance. Higgins and Crawford (2019) also showed that using educational technology in the classroom improves the performance, motivation, and attitudes of arithmetic students. Cloud computing is seen as an effective tool for knowledge management because it enables flexible, rapid, and routine updating of documents and files (Arpaci 2017).

5. **Knowledge sharing** is a crucial factor that influences perceived usefulness through various programs such as training sessions, seminars, and other knowledge-sharing initiatives. It is considered a cornerstone for achieving academic excellence (Alavi & Leidner, 2001). Students can study big data capabilities to determine

their adapted preferences using their knowledge. Cloud computing's ability to facilitate mutual communication among students reduces the need for direct communication channels.

6. Conclusion

This study examines the impact of cloud computing adoption factors on the academic performance of university students in the United Arab Emirates. The research employed a quantitative approach, gathering data through a structured questionnaire survey administered to students at a selected university. The collected data was statistically analysed and the factors were ranked based on the mean score of a 5-point Likert scale used by respondents to assess the significance of each factor in influencing academic performance. The results showed that perceived self-efficacy is the most significant factor affecting academic performance, followed by factors in the learnability group, perceived enjoyment, knowledge application, and knowledge sharing. The study provides valuable insights into the role of cloud computing in enhancing university students' academic performance and contributes to ongoing efforts to improve student achievement. Its findings have important implications for the IT and education sectors, as it highlights the potential of cloud computing to support students in storing and sharing information both for academic and personal purposes.

Acknowledgment

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