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Factors Affecting the Academic Performance through Cloud Computing Adoption

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Abstract: Cloud computing is an emerging field that is revolutionizing the way we access and use computer infrastructure and services. This paper investigates how cloud computing adoption enhances the academic performance of the students through knowledge management practices and by using TAM as a theoretical base. For this purpose, the data was collected from 628 university students through an online questionnaire. This study uses SmartPLS software which is a powerful statistical tool used for the analysis of structural equation modeling, its data and model validation. The study explores the factors that affect cloud computing adoption in higher educational institutions. The findings indicate that knowledge application, knowledge storage, knowledge creativity and discovery and learnability have positive association with perceived usefulness and perceived ease-of-use. Moreover, perceived usefulness and perceived ease-of-use have positive and significant influence on cloud computing adoption which in turn, positively predicts the academic performance of the students. The findings offer educational institutions and cloud computing service providers with a better understanding to adapt cloud computing and suggests that educational institutions may promote the adoption of cloud computing in education to enhance the academic performance of the students.

Keywords: Cloud computing; academic performance; knowledge management practices; TAM; Smart PLS, Pakistan.

Introduction

Technological advancement has brought about the development of new information technology systems which has accelerated the economic development and productivity across the world in the last two decades (Avgerou, 2010). Cloud computing is an innovative technological paradigm that provides a stable and on-demand access of network. In the recent years, cloud computing exposed a significant potential for providing excellent facilities of education to the students with greater flexibility in a cost-effective manner. The term cloud computing is defined as “a computer technology that provides access to computing resources including storage, control and application through the use of internet (Arpaci, 2016). There are potential benefits in higher education institutions for adopting cloud

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computing. Some cloud vendors offer programs for students of higher educational institutions such as Microsoft Live@edu, Google Apps and IBM Cloud Academy (Alshwaier, Youssef, & Emam, 2012). Microsoft Live has now been transformed into Microsoft Office 365 and includes Word, Excel, PowerPoint, Outlook, Publisher, OneNote, and Access. Students go through a shared collaboration in the cloud and can easily share their documents with peers and work together on different projects. Google also provides educational programs through Google Apps for educational purpose such as Google Docs. IBM Cloud Academy is a community cloud computing program that provides best practices and consultation services to higher educational institutes in addition to cloud solutions. These solutions contain collaboration solutions, integration solutions and virtual desktop solutions. According to Batista, Ferreira, Segura, Leite Filho, and Peixoto (2017), the adoption of cloud services in higher educational institutions can successfully increase the capacity of institutions to deliver facilities and meet learning requirements of students without putting the resources into the building's IT infrastructure. These services provide various opportunities to students and teachers to complete their tasks quickly by accessing, storing, revising, and retrieving files from various locations and devices. Cloud computing also affects the academic performance of students by allowing students to share their study materials, enabling access to study the documents, and also providing opportunity for interaction over the internet (Arpaci, 2017).

The use of cloud computing in institutions of higher learning has provided several benefits to the universities. The first benefit of cloud computing is its cost effectiveness; thus, efficient where the resources are minimal. Second, there are positive experiences of using cloud computing as derived by academicians. Third, cloud computing increases the productivity of IT staff. Hence, cloud computing has a number of advantages for students as well but the distinct advantage is the ability to transfer knowledge at any time from one place to another. The accessibility of data and management of storing data from anywhere helps students in achieving their study needs (Carr, 2003). Knowledge management practices and personal characteristics are the important predictors of adoption of technology and the theory of technology acceptance states that the motivational factors of learning encourages students to adopt innovative and interactive technology in order to meet their personal and academic needs. Therefore, adopting cloud computing represents an opportunity for educational institutions to access high-end technologies. Many studies have investigated the outcomes and antecedents of adoption of cloud computing in educational institutes (Thomas, 2011; Arpaci, 2017). The study of Batista et al. (2017) indicates that the performance of service system can be maintained through the cloud environment.

In the present era, technology is replacing many things. Similarly, students are highly motivated towards the use of technology and social networking sites. Many prior researches studied the students' academic achievement in order to determine the reasons behind their performances (Raza, Qazi, & Umer, 2017; Raza, Umer, Qazi, & Makhdoom, 2018). Although, few studies related to cloud computing have been conducted, yet there is a lack of empirical studies focusing on the adoption of cloud computing by educational institutions for enhancing students' academic performance. As stated by Marston, Li, Bandyopadhyay, Zhang, and Ghalsasi (2011), several researches have been conducted

currently on the technology itself; therefore, there is a need to understand cloud computing from a business perspective. It is acknowledged that managers at higher level still lack the required knowledge about cloud computing system and are using the traditional systems. Similarly, numerous institutions are interested to incorporate the capabilities of cloud computing but lack understanding and knowledge about where to anticipate and implement the changes. Therefore, understanding the position of educational institutions with respect to adoption of cloud computing is an important research area. Hence, the objective of this research is to identify the factors that affects the academic performance of students through adoption of cloud computing. The major contribution of this research is to theoretically and empirically investigate the factors that affect the decision to introduce cloud computing services in the educational setting.

Literature Review

Theoretical Background

Technology Acceptance Model

The present study adopted TAM as the theoretical base based on [Senyo, Addae, and Boateng \(2018\)](#) call for examining the association of cloud computing and academic performance of the students in order to advance the theory in information system area. The Technology Acceptance Model originates from reasoned action theory (TRA) of [Fishbein and Ajzen \(1977\)](#) and was developed by [Davis \(1989\)](#) which consists of core variables of user motivation (i.e., perceived usefulness and perceived ease of use). Technology acceptance model deals more specifically with the forecast of the acceptability of an information system. The purpose of this model is to predict the agreeableness of a tool and to recognize the modification which must be brought to the framework to make it acceptable to the users. This model recommends that the acceptability of an information system is controlled by two main factors (perceived ease of use and perceived usefulness). Perceived ease of use refers to the degree to which an individual believes that the use of a system will be easy. Perceived usefulness is defined as being the degree to which an individual believes that the use of a system will improve his performance. The implications showed that the TAM model remains a good choice for explaining teacher's adoption of digital technology in the educational system ([Davis, Bagozzi, & Warshaw, 1989](#)). This study gives a better understanding of how students are investing their attributes in using their social media for collaborative learning and in examining factors influencing their use through the theory of technology acceptance model (TAM) and improve collaborative learning that will improve the students' academic performance among students ([Al-Rahmi, Othman, & Musa, 2014](#)). In the current study, we posit that knowledge management practices and student's personal resources are the main predictors of adoption of cloud computing in view of TAM which will improve students' academic performance.

Hypothesis Development

Cloud Computing Adoption

Performance can be derived from cloud computing services as predicted by researchers (Venters & Whitley, 2012; Priyadarshinee, Raut, Jha, & Gardas, 2017). Cloud computing enables students to perform various tasks that improve their overall performance by accessing data servers from anywhere at any time. Trust is the only factor that effects significantly to the adoption of cloud computing services in order to measure performance. Batista et al. (2017) states that cloud environment helps in maintaining service system performance. Zafar, Mueen, Awedh, and Balubaid (2014) in their study concludes that game-based learning in education increases the motivation and academic performance of students. Therefore, in order to increase the academic performance of students, educators should encourage students to adopt new innovative technology to obtain better results (Luo, Zhang, Bose, Li, & Chung, 2018). Therefore, we propose the following hypothesis:

H₁: Cloud computing adoption has a significant effect on academic performance of students.

Knowledge Application

Alavi and Leidner (2001) states that the source of competitive advantage exists in the application of knowledge rather than the knowledge itself. Knowledge application permits students to analyze big data for determining the personalized preferences (Rosu, Dragoi, & Guran, 2009). The services of cloud computing may reduce the need for communication and coordination in projects where students work on the same content. Thereby, these services support proper management of knowledge by updating documents and files flexibly, timely and routinely (Arpaci, 2017). On the other hand, students' expectations for knowledge application have positive effect on the perceived usefulness of services of cloud computing. Therefore, it is hypothesized that the greater the expectations for knowledge application, the greater will be perceived usefulness and perceived ease of use. Therefore, we predict that:

H₂: Knowledge application has a significant effect on perceived usefulness.

H₃ : Knowledge application has a significant effect on perceived ease of use.

Knowledge Creation and Discovery

Nonaka, Toyama, and Hirata (2008) states that knowledge is created, enlarged, improved, shared, and justified through an individual's cognitive, collaborative and social process. Development of new knowledge or replacement of the existing knowledge is one of the main benefits of cloud computing services as these services may enhance the interaction between implicit and explicit knowledge. Knowledge is created when solutions are developed and experience is acquired. In addition, creation of knowledge can increase the credibility and quality of knowledge. On the other hand, the expectations of the students

for knowledge creation may significantly affect the perceived usefulness of cloud computing services. Therefore, it is hypothesized that the greater the expectations regarding knowledge creation and discovery, the greater the perceived usefulness and perceived ease of use will be. Therefore, we predict that:

H₄ : Knowledge creation and discovery has a significant effect on perceived ease of use.

H₅ : Knowledge creation and discovery has a significant effect on perceived usefulness.

Knowledge Storage

Individuals generate and obtain knowledge; however, sometimes they forget what they learn. Thus, storing knowledge creates an important aspect of effective management of knowledge (Alavi & Leidner, 2001). The advanced computer storage technology namely cloud storage and synchronization services can be effective tools in storing and retrieving written information, documents and files. The expectations of students for storing knowledge may affect the perceived usefulness of cloud computing services. Therefore, it is hypothesized that the higher the expectations of knowledge storage, the higher will be perceived usefulness and perceived ease of use. Therefore, we predict that:

H₆ : Knowledge storage has a significant effect on perceived ease of use.

H₇ : Knowledge storage has a significant effect on perceived usefulness.

Learnability

Learnability is one of the most important factor in KIP framework (McIver, Lengnick-Hall, Lengnick-Hall, & Ramachandran, 2013). McIver and Lepisto (2017) defined learnability as the difficulty level faced by students that try to attain information and knowledge related to their work. According to the study of Eagleton (2015) the use of technology for the purpose of teaching and learning minimizes the potential issues of learnability and provides valuable information to students. Zbick, Nake, Milrad, and Jansen (2015) in their study concludes that mobile learning helps in solving issues of learnability and improves the usability of technology enhanced learning for promoting knowledge management practices among the students. Cloud computing helps in overcoming the learnability by facilitating teachers and students in acquiring information without any difficulty. Therefore, we hypothesized that learnability will affect the perceived usefulness. Thus, we propose the hypothesis:

H₈ : Learnability has a significant effect on perceived ease of use.

H₉ : Learnability has a significant effect on perceived usefulness.

Perceived Ease of Use

Perceived ease-of-use can be defined as the degree to which a student believes that he or she can easily use the system without any extra effort (Davis, 1989). Perceived ease-of-use is the significant predictor of technology acceptance model. Perceived ease-of-use triggers the adoption of new technology by the students (Featherman & Pavlou, 2003). The easier it is to perform and use the key functionalities of cloud computing services, the lower will be the level of complexity and the more students will be intended to adopt cloud computing services (Shiau & Chau, 2016). Therefore, we hypothesize and propose that:

H₁₀: Perceived ease-of-use has a significant effect on cloud computing adoption.

Perceived Usefulness

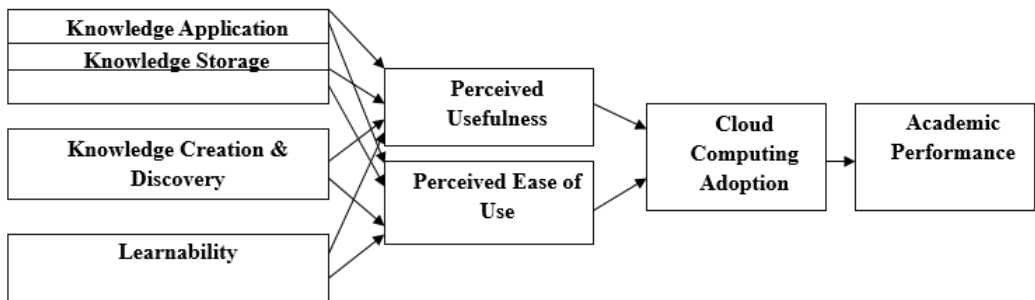
Perceived usefulness is defined as the degree to which an individual believes that the adoption and usage of new technology would enhance his or her academic performance and success. Sharma, Joshi, and Sharma (2016) proved the hypothesis that perceived usefulness relates to adoption of internet services. Cloud computing services provides opportunity to students to save their materials so that they can access them easily from anywhere at any time and can share with one another for knowledge creation and to enhance their academic performance (Abdullah & Ward, 2016). Therefore, students adopt cloud computing for storing, sharing and accessing information. Therefore, we hypothesized that perceived usefulness relates to adoption of cloud computing. Thus, we propose that:

H₁₁: Perceived usefulness has a significant effect on adoption of cloud computing.

Methodology

Research Model

Figure 1
Conceptual Framework



The conceptual model of present study is demonstrated in Figure 1. The model includes knowledge application, knowledge storage, knowledge creation and discovery, and learnability. In addition, perceived usefulness, perceived ease of use, cloud computing adoption, and academic performance are used as research variables.

Data Collection and Instrumentation

Total 643 respondents participated and after data screening 15 responses were deleted because of incomplete or missing values. The final sample size used in the study was 628. The sample size is based on reporting of many researchers who stated that three or more items per variable and a sample size of 100 is enough for convergence. According to [Anderson and Gerbing \(1984\)](#), the sample size of 150 is sufficient for a convergent and proper solution. For SEM technique, [Churchill Jr \(1979\)](#) reported that it can perform well even on the samples of 50-100. So, the sample size of our study is enough to perform the estimations.

The data collection was performed by mean of questionnaire based on 5-point Likert scale from strongly disagree (1) to strongly agree (5). The questions of knowledge application, learnability, perceived usefulness, perceive ease of use, cloud computing adoption, an academic performance were adapted from [Ali, Gongbing, and Mehreen \(2018\)](#) and items of remaining variables were adapted from [Arpaci \(2017\)](#).

Data Analysis and Results

Structural equation modeling (SEM) is a technique used to assess the theory's validity with the help of statistical facts ([Ringle, Wende, & Will, 2005](#)). The two methods which are usually used are; (i) covariance based and (ii) variance based. The present study comprised of the variance based method i.e., Partial least square (PLS) is employed to evaluate the hypothetical model. The PLS-SEM is performed with the SmartPLS 3.2.9 software ([Ringle, Wende, Becker, et al., 2015](#)) and a bootstrap resampling of 5000 subsamples was used ([Hair, Ringle, & Sarstedt, 2011](#); [Raza & Shah, 2017](#)). PLS (SEM) is considered suitable for several research situations and complicated models. The estimation was based on the guidelines of [Anderson and Gerbing \(1988\)](#) and done in two steps. In step one, the reliability and validity of the model have been assessed and in step two the assessment of structured model and hypotheses were tested.

Demographics

The details of demographic profiles are presented in Table 1. As seen from the demographic characteristics, that 256 (55.41%) respondents were male and remaining i.e. 371 (44.59%) were females. In addition, age bracket reveals that 176 (28.08%) students come under the age bracket of 18-22. Further, the highest participants were of 23-27 years old i.e. 342 (54.46%) respondents. Also, there were 109 students i.e. 17.39% who lie under the age group of more than 27 years old. Lastly, education bracket shows that 376 (59.87%)

students were undergraduate, 197 (31.37%) students were graduate, and remaining 55 students were post-graduate.

Table 1
Demographic Profile

Demographic items	Frequency	Percentage
Age		
18-22	176	28.08
23-27	342	54.46
Above 27	109	17.36
Gender		
Male	256	55.41
Female	371	44.59
Education		
Undergraduate	376	59.87
Graduate	197	31.37
Post Graduate	55	8.76

Table 2
Measurement Model Results

	Items	Loadings	Cronbach's Alpha	Composite reliability	Average variance extracted
AP	AP1	0.764	0.840	0.850	0.569
	AP2	0.691			
	AP3	0.674			
	AP4	0.669			
	AP5	0.720			
	AP6	0.663			
CCA	CCA1	0.885	0.847	0.907	0.766
	CCA2	0.876			
	CCA3	0.864			
KA	KA1	0.880	0.852	0.910	0.772
	KA2	0.881			
	KA3	0.875			
KCD	KCD1	0.828	0.775	0.870	0.690
	KCD2	0.846			
	KCD3	0.817			
KS	KS1	0.877	0.844	0.905	0.761
	KS2	0.880			
	KS3	0.861			
L	L1	0.689	0.874	0.900	0.529
	L2	0.755			
	L3	0.747			
	L4	0.734			
	L5	0.708			
	L6	0.726			
	L7	0.772			
	L8	0.786			
PEU	PEU1	0.869	0.851	0.910	0.770
	PEU2	0.889			
	PEU3	0.875			
PU	PU1	0.790	0.870	0.906	0.658
	PU2	0.828			
	PU3	0.837			
	PU4	0.787			
	PU5	0.812			

Notes: CCA= Cloud Computing Adoption, AP= Academic Performance, KA= Knowledge Application, KS=Knowledge Storage, KCD= Knowledge Creation & Discovery, L=Learnability, PU=Perceived Usefulness, PEU=Perceived Ease of Use.

Measurement Model

The competency of the model is evaluated by the (i) construct reliability (ii) individual item reliability, (iii) convergent validity (iv) discriminant validity.

As seen in table 2, all the variables have Cronbach's alpha and composite reliability, greater than 0.7 which meets the criteria of [Straub \(1989\)](#). The individual reliability of all the variables is greater than 0.7 which is in accordance with the criteria given by [Churchill Jr \(1979\)](#). According to him, each loading should be higher than 0.7 and the loadings. The loading above 0.7 confirms the instrument reliability. The convergent validity was evaluated through average variance extracted (AVE) and all variables have a minimum value of 0.50 which meets the benchmark proposed by [Fornell and Larcker \(1981\)](#).

The discriminant validity was assessed after the convergent validity by using (i) cross loading analysis (2) AVE. Table 3 represents the square root of AVE in the diagonal form and satisfies the criteria of [Fornell and Larcker \(1981\)](#) that AVE should be higher than the correlation between the variables. As seen from table 4 the individual items of each construct are loaded higher in their relevant constructs as compared to the other constructs and the cross loading difference is also higher than the recommended criteria of 0.1 ([Raza & Hanif, 2011](#)). Thus, this explains the discriminant validity adequacy. Furthermore, table 4 shows that the heterotrait - monotrait ratio of correlations (HTMT) shows that none of the HTMT criteria are higher than 0.85 ([Raza, Umer, & Shah, 2017](#)).

Table 3
Fornell-Larcker criterion

	AP	CCA	KA	KCD	KS	L	PEU	PU
AP	0.755							
CCA	0.297	0.875						
KA	0.266	0.610	0.879					
KCD	0.170	0.513	0.598	0.831				
KS	0.265	0.591	0.725	0.692	0.873			
L	0.223	0.657	0.659	0.706	0.711	0.728		
PEU	0.207	0.623	0.608	0.507	0.581	0.684	0.878	
PU	0.178	0.661	0.583	0.568	0.611	0.741	0.743	0.811

Notes: CCA= Cloud Computing Adoption, AP= Academic Performance, KA= Knowledge Application, KS=Knowledge Storage, KCD= Knowledge Creation & Discovery, L=Learnability, PU=Perceived Usefulness, PEU=Perceived Ease of Use. The diagonal elements (bold) represent the square root of AVE (average variance extracted).

Since, the measurement model confirms the convergent and discriminant validity: it confirms the variable distinctiveness and can be used to examine the structural model.

Structural Model

The structural model was analyzed by examining the standardized paths. Each path corresponds to a hypothesis. The results are shown in table 6. Six hypotheses were generated in the research.

Table 4
Loadings and Cross Loadings

	AP	CCA	KA	KCD	KS	L	PEU	PU
AP1	0.764	0.362	0.332	0.262	0.395	0.299	0.261	0.251
AP2	0.691	0.095	0.155	0.075	0.115	0.111	0.117	0.076
AP3	0.674	0.110	0.047	0.002	0.010	0.068	0.043	0.037
AP4	0.669	0.067	0.041	-0.033	-0.007	0.017	0.022	-0.012
AP5	0.72	0.131	0.120	0.055	0.066	0.071	0.088	0.048
AP6	0.663	0.119	0.086	0.006	0.041	0.038	0.067	0.048
CCA1	0.301	0.885	0.606	0.475	0.581	0.623	0.580	0.612
CCA2	0.221	0.876	0.471	0.429	0.481	0.535	0.508	0.561
CCA3	0.251	0.864	0.516	0.441	0.483	0.561	0.542	0.560
KA1	0.206	0.522	0.88	0.507	0.582	0.555	0.530	0.496
KA2	0.242	0.506	0.881	0.546	0.647	0.603	0.515	0.499
KA3	0.252	0.576	0.875	0.523	0.680	0.578	0.556	0.539
KCD1	0.139	0.432	0.506	0.828	0.682	0.604	0.449	0.504
KCD2	0.138	0.419	0.493	0.846	0.550	0.573	0.410	0.444
KCD3	0.147	0.427	0.490	0.817	0.481	0.581	0.401	0.463
KS1	0.213	0.569	0.686	0.570	0.877	0.647	0.564	0.590
KS2	0.227	0.460	0.579	0.607	0.880	0.646	0.483	0.503
KS3	0.257	0.510	0.626	0.642	0.861	0.620	0.464	0.498
L1	0.148	0.449	0.540	0.678	0.564	0.689	0.415	0.502
L2	0.136	0.501	0.520	0.575	0.570	0.755	0.448	0.482
L3	0.180	0.447	0.466	0.529	0.535	0.747	0.512	0.468
L4	0.191	0.44	0.460	0.49	0.522	0.734	0.441	0.48
L5	0.147	0.365	0.438	0.525	0.542	0.708	0.453	0.395
L6	0.181	0.433	0.452	0.525	0.589	0.726	0.471	0.438
L7	0.154	0.556	0.502	0.462	0.528	0.772	0.595	0.715
L8	0.160	0.560	0.453	0.395	0.443	0.786	0.571	0.695
PEU1	0.179	0.546	0.515	0.435	0.469	0.573	0.869	0.664
PEU2	0.157	0.502	0.500	0.421	0.473	0.562	0.889	0.617
PEU3	0.205	0.585	0.580	0.474	0.578	0.656	0.875	0.670
PU1	0.134	0.533	0.458	0.401	0.465	0.593	0.569	0.790
PU2	0.150	0.546	0.462	0.457	0.506	0.596	0.525	0.828
PU3	0.147	0.559	0.486	0.468	0.496	0.615	0.607	0.837
PU4	0.134	0.487	0.461	0.464	0.484	0.554	0.591	0.787
PU5	0.157	0.553	0.497	0.512	0.527	0.643	0.714	0.812

Notes: CCA= Cloud Computing Adoption, AP= Academic Performance, KA= Knowledge Application, KS=Knowledge Storage, KCD= Knowledge Creation & Discovery, L=Learnability, PU=Perceived Usefulness, PEU=Perceived Ease of Use. All self-loading is significant (bold).

Table 5
Heterotrait-Monotrait Ratio (HTMT)

	AP	CCA	KA	KCD	KS	L	PEU	PU
AP								
CCA	0.232							
KA	0.206	0.712						
KCD	0.134	0.631	0.735					
KS	0.174	0.691	0.850	0.522				
L	0.162	0.745	0.761	0.687	0.603			
PEU	0.158	0.728	0.710	0.620	0.676	0.772		
PU	0.123	0.768	0.676	0.689	0.708	0.819	0.593	

Notes: CCA= Cloud Computing Adoption, AP= Academic Performance, KA= Knowledge Application, KS=Knowledge Storage, KCD= Knowledge Creation & Discovery, L=Learnability, PU=Perceived Usefulness, PEU=Perceived Ease of Use.

Table 6
Result of Path Analysis

Hypothesis	Regression Path	Effect type	SRW	Remarks
H1	CCA → AP	Direct Effect	0.306***	Supported
H2	KA → PEU	Direct Effect	0.262***	Supported
H3	KA → PU	Direct Effect	0.128***	Supported
H4	KCD → PEU	Direct Effect	0.371*	Supported
H5	KCD → PU	Direct Effect	0.225*	Supported
H6	KS → PEU	Direct Effect	0.521*	Supported
H7	KS → PU	Direct Effect	0.230**	Supported
H8	L → PEU	Direct Effect	0.502***	Supported
H9	L → PU	Direct Effect	0.588***	Supported
H10	PEU → CCA	Direct Effect	0.292***	Supported
H11	PU → CCA	Direct Effect	0.445***	Supported

Notes: CCA= Cloud Computing Adoption, AP= Academic Performance, KA= Knowledge Application, KS=Knowledge Storage, KCD= Knowledge Creation & Discovery, L=Learnability, PU=Perceived Usefulness, PEU=Perceived Ease of Use.

Discussion

This study hypothesized that knowledge management practices were significantly associated with perceived usefulness and perceived ease of use which in turn is significantly associated with the adoption of cloud computing services and students' academic performance. Therefore, all the eleven hypotheses are accepted as all of them depict a positive and significant relationship.

Firstly, the path between cloud computing adoption and academic performance is positive and significant as ($\beta = 0.306, p \leq 0.01$). The second and third hypotheses show a positive and significant relationship as ($\beta = 0.262, p < 0.01$) & ($\beta = 0.128, p < 0.01$). Moving further, the fourth and fifth hypotheses that are knowledge creation and discovery along with perceived ease of use and usefulness depict similar results as ($\beta = 0.371, p < 0.1$) & ($\beta = 0.225, p < 0.1$). Moreover, knowledge storage also has a positive and significant association with perceived ease of use and perceived usefulness as ($\beta = 0.521, p < 0.1$) & ($\beta = 0.230, p < 0.05$). Learnability also has a positive and significant relation with perceived ease of use and perceived usefulness as ($\beta = 0.502, p < 0.01$), ($\beta = 0.588, p < 0.01$). Lastly, perceived ease of use and perceived usefulness both have a positive and significant association with cloud computing application as ($\beta = 0.292, p < 0.01$) & ($\beta = 0.445, p < 0.01$).

The findings of the study highlights that knowledge application, knowledge storage, learnability and knowledge creation has significant and positive effect on perceived usefulness and perceived ease-of-use. The findings of the study were similar to the study of [Arpaci \(2017\)](#); [Priyadarshinee et al. \(2017\)](#). The findings conclude that students use knowledge for making decisions or to settle and cope with their academic problems while using technology in educational settings. The findings also show that perceived usefulness and perceived ease-of-use have significant effect on adoption of cloud computing services. The findings were similar to the study of [Featherman and Pavlou \(2003\)](#); [Sharma et al. \(2016\)](#). Moreover, cloud computing adoption has significant effect on students' academic performance. The findings were similar to the study of [Venters and Whitley \(2012\)](#);

Priyadarshinee et al. (2017). The findings conclude that adopting cloud computing services will boost the academic performance of students in the educational institutions.

Conclusion, Recommendations and Limitations

The goal of this study is to broaden our knowledge and understanding about adoption of cloud computing in educational institutions by exploring several crucial factors that helps students enhance their academic performance by adopting cloud computing services. The present study investigated knowledge application, knowledge storage, knowledge creation and discovery, learnability, perceived-usefulness and perceived ease-of-use as significant predictors of cloud computing adoption and students' academic performance. Cloud computing system provides access to students to retrieve their study material at any time from multiple locations by using any device. Therefore, integrating cloud computing services into educational settings may enhance students' academic performance, effectiveness, productivity, and also efficiency by facilitating knowledge management.

The current study provides several implications for students, teachers, and for academic institutions. Firstly, the findings of the study show that cloud computing has a significant and positive effect on student's academic performance. Therefore, universities should encourage students to adopt cloud computing services because this technique is innovative and free of cost. The academics should direct students to effectively and proactively utilize the services of cloud computing. Secondly, the findings of the study conclude that knowledge application, knowledge storage, knowledge creation and learnability has significant effect on perceived usefulness and perceived ease-of-use which in turn enhances the adoption of cloud computing among students. Therefore, it is recommended to institutions that they implement the new and innovative teaching tools to enhance collaborative learning. Also, academics should employ new pedagogies that focus mainly on interactive system for collaborative workspaces. Through this the students can easily access their updated material and can easily share it with their peers. Cloud computing services enables teachers to build a portfolio of lectures, presentations, and research papers. Students can also maintain a backup of their materials, presentations and research work. Thus, adopting cloud computing in educational institutes will be beneficial for students and will improve their academic performances.

This study has several directions for future researchers. First, the present study was conducted in a single private sector university of Karachi, Pakistan. Therefore, future researches should collect data from different areas or regions to further generalize the findings. Second, the sample size of this study is limited to a smaller sample; therefore, future studies should collect data from a larger sample. Thirdly, this research used cross-sectional data for analysis and the future studies should be done on longitudinal base data to test its effect over a time. Lastly, this study tested the direct effect of several factors on adoption of cloud computing services and the future studies should add mediators and moderators in the current model to verify their effect on cloud computing adoption and students' academic performance.

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