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The Extent to Which the Determinants Explain the Usage of Cloud Computing

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ABSTRACT The paper aims to determine the extent to which the constructs of Technology Acceptance Model, explain the usage of Cloud computing. Forty-eight males and sixty-eight females were assessed using a 4-point scale based on four main variables of behavioural intention. The data were analysed using the multiple regression analysis. From the Durbin Watson test the R^2 value of 0.066 was obtained for social influence, which means that social influence accounted for only 7 percent of the variance in behavioural intention scores. Learner demographics accounted for 17 percent of the variance, and experience accounted for 35 percent of the variance. These results show that secondary school learners are keen in trying out Internet devices for learning regardless of their social factors, demographics and experience in using Internet technology. There was a relative influence noted in terms of experience (resulting from persistent use) as a moderating factor towards the adoption of Cloud computing.

INTRODUCTION

The advent of Cloud Computing as a radical IT innovation, has transformed how IT resources are acquired, provides an opportunity for Information Technology (IT) innovation research to go beyond the dominant paradigm (Oredo and Njihia 2015). While in the dominant paradigm, organizations must have certain characteristics (innovator profile) in order to innovate with technology successfully. Cloud Computing can be viewed as a way to deliver IT enabled services in the form of software platform and infrastructure using Internet technologies (Gangwar 2015).

The development in information and communications technologies (ICTs) such as smart mobile devices and social media offer new opportunities that can be utilized in education. The annual Horizon Report (Johnson et al. 2010) identifies emerging technologies in education. Some technologies listed in the yearly Horizon report are mobile computing, simple augmented reality, electronic books, gesture based computing, visual data analysis, cloud computing, the personal web, semantic-aware applications and smart objects. However, the use of new technologies in education is still lagging behind. Kirbey et al. (2006) predict that in spite of the fact that technology changes very rapidly, almost all of the tools that will be used in teaching and learning in 2020 already exist today.

Implementing emerging technologies in education faces many challenges. Korpelainen et al. (2010) explain in their paper, that a successful adoption is fundamental to a productive use of a system. Adoption is the key stone which contributes to a wide use of the technology in any organisation. Understanding the user adoption of new technologies, and the ability to use this information in the implementation process, can improve the use of new technologies in education. The adoption of a new technology is not a simple process; it includes many factors which influence the intention to use and different phases the user experiences.

The major benefit for any end-user is that, Cloud computing can be used simply whenever one needs it (Kunze et al. 2008). It is a pay-as-you-go system. To begin with, the user school has no physical room necessary for all the hardware to install. Furthermore, there are no maintenance costs for all the hardware (Velte et al. 2009). Besides the hardware, the applications provide benefits. The Cloud is filled with applications that are ready to use, and more important the data used in this application is always accessible from anywhere in the world (Vecchiola et al. 2009).

There is no direct benefit but what is important is that, the data centres are usually placed at strategic chosen places that lower the costs of maintenance. This would be beneficial for low

wages countries (Vecchiola et al. 2009). When a school is expecting a peak in its IT use, they simply acquire more IT services from the Cloud. This is also the beauty of it because it is very simple. When schools have invested in Cloud computing, the users can also expect a certain degree of security (Velte et al. 2009).

Cloud computing allows schools to scale down or upgrade their resource use as the market or industry conditions shift, and thus endows schools with a "high degree of strategic flexibility" (Jlelaty and Monzer 2012:16). Space savings result from lower physical space requirements since the adoption of Cloud computing translates to less floor space or fewer racks to accommodate machines, servers, and other hardware (Behrend et al. 2011).

Research Objective

The study set out to investigate the determinants of Cloud computing adoption and use among high school learners in the East London district, in the Eastern Cape. To achieve the stated aim, the following objective was addressed:

To establish how much of the determinants explain the usage of Cloud computing.

Literature Review and Theoretical Framework

The Technology Acceptance Model (TAM) is an adaptation of the Theory of Reasoned Action that is specific for modelling user acceptance of information system (Davis 1989). User acceptance in TAM is controlled by two key beliefs, perceived usefulness and perceived ease of use. Explanation for perceived usefulness is the extent to which a person believes that using a particular technology will enhance her/his job performance. Alternatively, perceived ease of use is defined as the degree to which a person believes that using a technology will be free from effort (Davis 1989).

It is interesting to note that, TAM2 was extended from TAM by including subjective norm as an additional predictor of intention (Venkatesh and Morris 2000). Subjective norm involves an individual's belief that people who are important to her/him think she/he should perform the behaviour in question as defined by Fishbein and Ajzen (1975). Venkatesh and Morris (2000) in their research constructed the basis for the integration of gender as potential key in understanding the role of social influence in initial technology adoption decision including sustained usage of new technology. Although social influence did not from part of the research questions, it was hypothesised that, social influence has a positive role to play in Cloud computing usage.

The Technology Acceptance Model is indeed a very popular model for explaining and predicting system use (Chuttur 2009). Several social psychology researchers have replicated Davis (1989), original model, to show the relationship between ease of use of a system, perceived usefulness of a system and the actual system use. Venkatesh and Davis (2000) introduced a unified model by introducing social influence as a factor that can influence the perceptions of the user.

The enjoyment and satisfaction derived from using a technology, has been shown to play an important role in determining technology acceptance and use (Brown and Venkatesh 2005). In information systems research, such perceptions (conceptualised as perceived enjoyment) has been found to influence technology acceptance and use directly (van der Heijden 2004). In the consumer context, perceived enjoyment derived has also been found to be an important determinant of technology acceptance and use (Brown and Venkatesh 2005).

RESEARCH METHODOLOGY

The paper is quantitative and used a survey as a method of collecting, processing and analysing data. A descriptive study was used to outline and present circumstances and relationships concerning the research problem. This involved collecting data in order to address the research objectives. The reported ICT literacy levels were analysed and correlated with each other. The socio-demographic characteristics of the learners included gender, age, grade, residential area, the kind of Internet devices they have, and major subjects studied.

The paper targeted a population of one thousand and twenty high school learners in the Eastern Cape Province of South Africa, because learners are at the forefront of Cloud computing technology. For the purpose of this paper, random sampling was used to examine the determinants of Cloud computing adoption and use by high school learners. A total of 286 question-

naires were distributed to high school learners and a total of n = 116 useful responses were received, yielding 40.6 percent response rate.

An instrument which gives trustworthy and dependable results is considered reliable (Saunders et al. 2007).

The Cronbach's Alpha test was used to test the reliability of the research instruments in order to confirm that they concur with the paper-objectives (Bell 2005). Responses from the pilot study were analysed for accuracy of meaning and objectivity. An instrument which measures accurately what the researcher expects to measure is valid. A pilot survey was used to test instruments against criterion and content validity benchmarks. There was a need to test the content validity of the research instruments as this ascertained that the items produced the relevant responses from the sample (Mugenda and Mugenda 2003).

The responses of the learners were analysed using Beta coefficients from the regression analysis to determine the extent to which the determinants explain the usage of Cloud computing.

The respondents were informed that participation in the study was voluntary and that failure to participate in the study or a withdrawal of consent would not result in any penalty. After informing the respondents of the purpose of the study, the type of information needed and how the information would be used; the respondents voluntarily confirmed orally to participate. Confidentiality was ensured by not divulging the respondents' information to anyone who was not directly involved in the study. Anonymity of respondents was ensured by not revealing their identity. The researcher ensured that all the findings were presented honestly without making up any data to support a particular finding. The researchers also adhered to the institutional guidelines on conducting research.

RESULTS

To address the research question in this paper, the standardised beta coefficient from multiple linear regression model was used to determine how much of the determinants explain the usage of Cloud computing. The determinants under question here were performance expectancy, effort expectancy, social influence, and facilitating conditions.

Performance Expectancy

In Table 1, the Y intercept of the raw score model was labelled as the constant and had a value of 2.117. Of primary interest, here were the raw Beta (β) and standardized Beta coefficients, and their significance levels determined by t tests. With no exception, all of the sub-variables were statistically insignificant, but performance expectancy had a better value than other constructs.

Effort Expectancy

In Table 2, the Y intercept of the raw score model was labelled as the constant and had a value of β = 2.115. All of the sub-variables for effort expectancy were statistically insignificant

Table 1: Beta coefficients for performance expectancy[a]

Model	*Unstandardized coefficients*		*Standardized coefficients*	*t*	*Sig.*	*Correlations*		
	B	*Std. error*	*Beta*			*Zero-order*	*Partial*	*Part*
Constant	2.117	.227		9.338	.000			
PE1	.212	.542	.289	.391	.697	-.113	.038	.037
PE2	.933	.724	1.204	1.288	.200	-.085	.125	.121
PE3	-.371	.485	-.435	-.764	.446	-.135	-.074	-.072
PE4	.167	.376	.194	.444	.658	-.121	.043	.042
PE5	-.243	.341	-.298	-.714	.477	-.137	-.070	-.067
PE6	-.319	.543	-.446	-.588	.558	-.129	-.057	-.055
PE7	-.667	.559	-.867	-1.193	.236	-.098	-.116	-.112
PE8	.467	.510	.628	.916	.362	-.080	.089	.086
PE9	-.504	.605	-.697	-.833	.406	-.111	-.081	-.078
PE10	.221	.529	.298	.418	.677	-.124	.041	.039

[1]a. Dependent Variable: I intend to continue using mobile internet in the future

Table 2: Beta coefficients for effort expectancy

Model	*Unstandardized coefficients*		*Standardized coefficients*	*t*	*Sig.*		*Correla-tions*	
	B	*Std. error*	*Beta*			*Zero-order*	*Partial*	*Part*
1 (Constant)	2.115	.211		10.021	.000			
Internet use for learning would be everywhere and useful.	.186	.535	.242	.348	.728	-.101	.034	.033
Mobility enables me to access real-time data.	.212	.340	.217	.625	.533	-.128	.060	.059
I would like to be able to launch a discussion on a learning to rum through Internet devices.	-.226	.334	-.292	-.677	.500	-.109	-.065	-.064
I would like to be able to interact with teachers and classmates both inside and outside class via internet devices.	-.358	.594	-.455	-.602	.548	-.110	-.058	-.057
I would like to be able to engage in class discussion if I could share my thoughts in real-time through mobile devices.	.394	.387	.502	1.018	.311	-.086	.098	.096
It would not require me a lot of mental effort to learn because I am skilled at mobile devices functions.	-.276	.219	-.339	-1.263	.209	-.161	-.121	-.119
It would be easy and clear to interact via mobile devices for learning.	-.012	.028	-.048	-.446	.657	-.102	-.043	-.042
It would be easier for me to ask help from others through mobile devices.	.008	.205	.012	.041	.968	-.107	.004	.004

with p values greater than the significance level of $p < 0.05$. As can be seen in Table 2, by examining the beta weights, 'it would be easier for me to ask help from others through mobile devices' followed by, 'Internet use for learning would be everywhere and useful' made relatively smaller contributions to the prediction model.

Social Influence

The Y intercept of the raw score model was labelled as the constantand had a value of $\beta = 1.438$. The independent variable for social influence was statistically insignificant with $\beta = 0.066$, $t = 0.704$, $p = 0.483$ (Table 3).

DISCUSSION

Limayem et al. (2007) established in both cases of voice mail and email usage, that social influence is an important determinant of perceived ease of use, which in turn had an effect on perceived usefulness. Possibly, strong social pressures to use a system may result in usage itself. This is irrespective of whether individuals perceive the system as being useful or not. Thus, the subjective norm may encourage email usage. Following the crowd may have validity here.

In a Malaysian study conducted by Chan et al. (2015), the extent of learning with smartphones and its value is influenced by learners' friends, families, teachers and the community. Parents' influence is limited, as they generally do not understand the potential of the smartphone for learning. However, familial influence did seemto be strong in terms of very particular uses, rather than in modelling general behaviours: in one case, a participant's mother actively encouraged her daughter to read online newspapers by modelling her smartphone reading for her daughter, and in another case, an unclecompared prices to manage his accounts better.

Friends were usually instrumental in their choices of mobile applications, brands of smartphones and in some cases, reading and writing-habits. The value the community places on learning with smart devices may be a significant influence on learners' perceptions. Participants' patterns of use and motivations are affected by the complex interplay of friends', parents', teachers' and media influences. Beyond these patterns, there are emergent practices that showed participants' use of their smart devices and digital technologies to support academic learning in new and innovative ways (Chan et al. 2015).

In another study conducted by Chun (2015) in Hong Kong, participants reported that teacher use of technological resources in classes also influenced their self-directed use of technology for language learning through enhancing their capacity to use, and boosting their confidence in using, the resources for learning. The participants felt that in-class use of technology provided them with useful resources for learning, offered clues on how to use the, and boosted their confidence in being able to use the resources. Furthermore, the participants reported that teachers assigning homework involving the use of technological resources influenced their self-directed use of technology by giving them access to resources and enhancing their understanding of these resources.

From model 7 in Table 4, social influence (SI1) contributed 0.084 of the total variation observed on the behavioural intention to adopt and use Cloud computing. The correlation and the R^2 are (0.290 and 0.084) respectively. The regression equation was not significant with p value (0.214) and the coefficient shows that the independent variable SI1 is not significant. Therefore, social influence had no positive influence on behavioural intention to adopt and use Cloud computing.

In contrast to the above claims, the current paper found the effect of social influence to be insignificant towards Cloud computing adoption and use. From model 8 in Table 4, SI1 contributed only 0.055 of the total variation observed on behavioural intention to adopt and use Cloud

Table 3: Beta coefficients for social influence

Model	*Unstandardized coefficients*		*Standardized coefficients*	*t*	*Sig.*	*Correlations*		
	B	*Std. error*	*Beta*			*Zero-order*	*Partial*	*Part*
1 (Constant)	1.438	.586		2.454	.016			
Social Influence	.212	.301	.066	.704	.483	.066	.066	.066

computing. The correlation and R^2 are (0.234 and 0.055) respectively. The regression equation is not significant with p value (0.500). The coefficient shows that none of the independent variables is significant. Therefore, social influence in certain contexts where technological resources are not available, has no positive influence on the behavioural intention to adopt and use Cloud computing. In New Zealand, Mohammadyari and Singh (2015) conducted a study which also surprisingly showed that, effort expectancy and social influence do not significantly affect continuance intention, and ultimately users' performance.

While facilitating conditions are considered to have a direct effect on Cloud computing usage only. It is also important to note that while other UTAUT based studies like Venkatesh et al. (2003) and Schaper and Pervan (2007) were longitudinal (Kripanont 2006), this study was a cross-sectional survey in which the data was gathered just once over a period of time. Contrary to longitudinal studies that determine behavioural intention and usage in different times (behavioural intention - during technology introduction, and usage during technology implementation), in this paper both behavioural intention and usage of Cloud computing were determined concurrently. This is based on the assumption that since the school in the study had Internet connectivity, some learners from the school are likely to be already using Cloud computing while others are building interest in using such a scholarly communication system.

Within the context of this paper, facilitating conditions include technical support in terms of infrastructure and skills provided to enable the learners' exploitation of Cloud computing. Facilitating conditions include objective factors in implementation contexts such as management support, training and the provision of technological support, all targeting at removing barriers of technology usage (Venkatesh et al. 2003; Schaper and Pervan 2007). Facilitating conditions have been found to impact on the actual usage but not behavioural intention (Suhendra et al. 2009; Zhou et al. 2010). An assessment of the availability or absence of the factors facilitating Cloud computing adoption was done in relation to the existing practice of Internet usage in the study area.

From model 1 in Table 4, the independent variables PE1-10 contributed 0.181 of the total variation observed on learners' behavioural intention to adopt and use Cloud computing. The correlation and R^2 are (0.425 and 0.181) respectively. The regression equation is significant with $p < 0.05$. The coefficient shows that PE1-10 has significant p values (0.000). Here the researcher concludes that PE1-10 has a positive influence on behavioural intention to adopt and use Cloud computing.

This paper investigated the number, and type of Internet device that each learner had. The number of learners with no Internet devices was 11, which was comparably a very small amount, given a total sample of 116 learners. Only two respondents in this paper owned an iPad and the availability of these devices to learners could bring about a big change in how they access educational information. The following figures on Internet device ownership, point to the fact that, there is a lack of infrastructure that is suitable to facilitate e-learning. With reference to the fourth construct of UTAUT (facilitating conditions), learners were in a dire need for appro-

Table 4: Regression analysis summary

Model	*Independent variables*	*Dependent variables*	*R*	*R^2*	*Significance*
1	PE 1-10	BI(1)	.425	.181	.047
2	PE 1-10	BI(2)	.346	.120	.153
3	PE 1-10	BI(3)	.519	.270	.000
4	EE 1-8	BI(1)	.352	.125	.262
5	EE 1-8	BI(2)	.326	.106	.048
6	EE 1-8	BI(5)	.439	.193	.002
7	SI 1	BI(1)	.290	.084	.214
8	SI 1	BI(2)	.234	.055	.500
9	SI 1	BI(3)	.304	.092	.533
10	FC 1	BI(1)	.280	.078	.168
11	FC 1	BI(2)	.259	.067	.251
12	FC 1	BI(3)	.220	.048	.448

priate Internet devices that will facilitate their learning, both in the classroom and outside the classroom.

In Davis' (1989) view, one motivation for many individuals to adopt an innovation is the desire to gain social status or image. Besides that, Venkatesh and Davis (2000) found that effect of subjective norm on image was significant measurement on system usage. Limayem et al. (2007) in their studies on Windows adoption found that post-adoption attitude is only based on instrumentality beliefs of usefulness and perceptions of image enhancement.

Nevertheless, from model 9, in the regression analysis summary, SI1 contributed 0.092 of the total variation observed in the behavioural intention to accept and use ICT. The correlation and R^2 are (0.304 and 0.092) respectively. The regression equation is not significant with p value (0.533). The coefficient shows that independent variables are significant on individual basis. Therefore the conclusion is that, SI1 has no positive influence on the learners' behavioural intention to adopt and use Cloud computing. This is partly the reason why this paper rejected the alternative hypothesis, which states that, social influence plays a positive role on behavioural intention.

Venkatesh and Davis (2000) suggested that, in mandatory contexts social influences tend to have a direct effect on intention; in contrast, social influence in voluntary contexts operates by influencing perceptions about the technology—the mechanisms at play here are internalisation and identification. In mandatory settings, social influence appears to be important only in the early stages of individual experience with the technology, with its role eroding over time and eventually becoming insignificant with sustained usage, a pattern consistent with the observations of Venkatesh and Davis (2000).

The role of social influence in technology acceptance decisions is complex and subject to a wide range of contingent influences. Social influence has an impact on individual behaviour through three mechanisms: compliance, internalisation, and identification (Venkatesh and Davis 2000). While the latter two relate to altering an individual's belief structure and/or causing an individual to respond to potential social status gains, the compliance mechanism causes an individual to alter his or her intention in response to the social pressure, that is, the individual intends to comply with the social influence.

CONCLUSION

An insignificant contribution of all the four determinants (performance expectancy, effort expectancy, social influence, and facilitating conditions) explained the usage of Cloud computing when the standardised beta coefficients were analysed. Moreover, the range of ages used for the high school learners in this paper did not provide enough population segments to study differences caused by the age of the respondents. Hence, this moderating variable may be investigated in future studies, as it did not play a significant role in this paper.

RECOMMENDATIONS

The results of this paper agree with other studies that the four constructs of the Unified Theory of Acceptance and Use of Technology (UTAUT) have significant positive influence and impact on the behavioural intention of the high school learners to adopt and use Cloud computing. However, social influence depends on the context in which the users of technology are situated. For learners who come from disadvantaged backgrounds, social influence might be a non-existent factor. This indicates that secondary school learners must be allowed to use Internet technologies that they believe are easy to use and will improve their school performance. The facilitating conditions such as appropriate hardware, software, training and support should be in place from the side of the school management.

This paper has identified the problems associated with the introduction of learners into Cloud computing technology. A structured mentorship programme is recommended to ensure smooth integration into the system in order to ensure that the educational process proceeds in a stable manner. It is suggested that further developments in Internet learning regarding available resources, hardware and software and the expected developments regarding each of these be the focus of an in-depth study in order to pre-empt future problems and to plan for further stages of the scaffolding process.

NOTE

[1] PE1 = The use of Internet for learning purposes would save me a lot of time. PE2 = The use of Internet for learning purposes would enhance the effectiveness of my learning. PE3 = Mobility enables me to accomplish tasks quickly. PE4 = I know that mobile devices are also mediums for learning. PE5 = Unexpected problems could be fixed at the first time of using Internet devices. PE6 = I would feel more interested in study if I could use Internet devices. PE7 = I would be entertained in my study when using Internet devices. PE8 = Owning an Internet device would ease my learning because it would allow me to study anytime, anyplace. PE9 = I would be more encouraged to learn if I could access materials anytime anywhere via mobile devices PE10 = I would have more desire to use mobile devices as a way for learning.

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