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- The study investigates adoption of cloud computing to achieve knowledge management
- Structural equation modeling was used to validate the research model
- The perceived usefulness is associated with expectations for knowledge management
- Innovativeness and training & education are associated with ease of use perceptions

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Antecedents and consequences of cloud computing adoption in education to achieve knowledge management

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ABSTRACT

The effective management of knowledge is critical to achieve high academic performance, effectiveness, and efficiency. Adoption of cloud computing in education has the potential to enhance the management of knowledge. This study aims to investigate the antecedents and consequences of cloud computing adoption in education to achieve knowledge management. Thereby, this study implemented the cloud computing in an authentic learning environment to support knowledge management practices and provided participants with training and education. Pre-tests and post-tests were administered on the first and last week of the 14-week intervention. This study examined the causal relationship between the expectations for knowledge management practices and the perceived usefulness of cloud computing services. Further, the causal relationships among innovativeness, training and education, and perceived ease of use were examined in the study. Survey data collected from 221 undergraduate students were analyzed by using structural equation modeling to validate the research model. The results indicate that the perceived usefulness is significantly associated with the expectations for knowledge creation and discovery, storage, and sharing. Amongst others, the expectations for knowledge storage and sharing have a stronger relationship with the perceived usefulness. Further, innovativeness and training & education are significantly associated with the ease of use perceptions. The findings suggested that educational institutions may promote adoption of cloud computing in education by increasing the awareness of knowledge management practices.

Keywords: Cloud computing, knowledge management, media in education

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1. Introduction

Cloud computing is “a distributed computing technology that provides dynamically scalable computing resources including storage, computation power, and applications delivered as a service over the Internet” (Arapaci, 2016; Stanoevska-Slabeva, Wozniak, & Ristol, 2010). Cloud computing has several advantages such as location independence, cost effectiveness, maintenance, and scalability (Shon, Cho, Han, & Choi, 2014).

Cloud computing services such as Google Drive, Dropbox, SkyDrive, and iCloud can be easily integrated into the educational settings. These services may provide students to store files, share the files, revise and access the files synchronized among various devices. Cloud computing services may also provide easier and quicker information retrieval and discovery, allow students to store and share documents, offer a more flexible environment by enabling ubiquitous access to materials, and facilitate interaction among students and instructors. Thereby, these services can support knowledge management practices, including knowledge creation or retrieval, storage, transfer, and application.

The effective management of knowledge is critical to achieve high academic performance, effectiveness, and efficiency. The unique advantages provided by cloud computing services, especially, the ability to exchange documents anytime and anywhere may enable students meet urgent educational needs. Therefore, adoption of cloud computing in education has the potential to enhance the management of knowledge. To this end, understanding the antecedents and consequences of cloud computing adoption in education to achieve knowledge management is important from a practical standpoint.

2. Literature Review

2.1. Definition and Characteristics of Knowledge

There is a hierarchical relationship among data, information, and knowledge. Maglitta (1996) defines data as being “raw numbers and facts”, information as being “processed data”, and knowledge as being “information made actionable.” Nonaka (1994) suggests that knowledge is “a justified true belief”, and defines knowledge as “a dynamic human process of justifying personal beliefs as part of an aspiration for the truth” (Nonaka, 1994, p.15).

Knowledge is dynamic, aesthetic, subjective, and process-relational (Nonaka, Toyama, & Hirata, 2008). Knowledge is created by people through the continuous interaction of tacit and explicit knowledge. “Tacit knowledge is highly personal and hard to formalize, making it difficult to communicate or to share with others. Subjective insights, intuitions, and hunches fall into this category of knowledge. Furthermore, tacit knowledge is deeply rooted in an individual’s action and experience, as well as in the ideals, values, or emotions he or she embraces” (Nonaka & Takeuchi, 1995, p.8). In contrast to tacit knowledge, explicit knowledge is less subjective and can be expressed in numbers and words.

Nonaka (1994) suggests a spiral model with four modes “Socialization, Externalization, Combination, Internalization” of knowledge creation and conversion. In the SECI model, socialization refers to “the conversion of tacit knowledge to new tacit knowledge through social interactions and shared experience” (i.e., apprenticeship) (Nonaka, 1994). The combination refers to “the creation of new explicit knowledge by categorizing, merging, reclassifying, and synthesizing existing explicit knowledge” (i.e., literature survey reports) (Nonaka, 1994). Externalization refers to “converting tacit knowledge to new explicit knowledge” (i.e., articulation of the best practice) (Nonaka, 1994). Internalization refers to “the creation of new tacit knowledge

from explicit knowledge” (i.e., learning from reading or a discussion) (Nonaka, 1994). In this model, “knowledge follows a cycle in which implicit knowledge is extracted to become explicit knowledge, and explicit knowledge is re-internalized into implicit knowledge” (Nonaka, 1994, p.19).

2.2. Knowledge Management

As aforementioned, knowledge is a “justified true belief” that increases and individual’s or organization’s capacity for taking effective action (Alavi & Leidner, 1999, p. 14). Thus, managing knowledge enables effectiveness and efficiency in decision making and provides insight in problem solving, dynamic learning, and strategic planning (Davenport & Prusak, 1998). Further, knowledge management helps leveraging the intellectual assets, including skills, experiences, and innovation (Duffy, 2000). Knowledge management is the practices that help capture, organize, and store expertise to transfer or share with others (Turban, Sharda, & Delen, 2011). Similarly, Mitchell (2003) defines knowledge management as being a systematic process that includes capture, creation, store, and share of the knowledge and learning.

Knowledge management systems are the information technologies, information systems, or mechanisms that support knowledge management (Alavi & Leidner, 1999). Turban, Sharda, and Delen (2011) suggested the information technologies can be employed to enhance knowledge management processes of knowledge acquisition, generation, storage, transfer, and application. In the same vein, Mitchell (2003) suggests that technology can be used as an enabler to the management of knowledge. However, Duffy (2000) argues that effective implementation of the information technologies in knowledge management requires user training. Therefore, the present study suggests the integration of cloud computing services to the knowledge management processes of creation, retrieval, storage, sharing, and application. The implementation of cloud

computing services to the knowledge management supported with training and education throughout the study.

2.3. Technology Acceptance Model

The TAM is a widely applied framework to explain user acceptance and use of a technology or system. However, it has limited explanatory power in explaining the acceptance and use of various systems. Thus, Davis (1989) suggested additional factors to be included in the original TAM. Accordingly, prior studies extended the TAM by including external factors relevant to their domains. For example, Venkatesh et al. (2003) proposed a unified model, “Unified Theory of Acceptance and Use of Technology”, based on the TAM by including two additional constructs; “social influence and facilitating conditions.” Ros et al. (2015) extended the TAM to better explain students’ acceptance and intention to use third-generation learning management systems (LMS). They found that the intention to use LMS is determined by the container and gadget design. In a similar study, Sánchez and Hueros (2010) extended the TAM with technical support and perceived self-efficacy to explain use of Moodle by university students. The results showed that technical support has a significant effect on the perceived usefulness and perceived ease of use.

Jeong (2009) extended the TAM to investigate secretaries’ acceptance of information systems and Internet use in an office situation. The results indicated that the employer pressure, computer self-efficacy, organizational support, and job relevancy have a significant effect on the perceived usefulness. Further, the computer self-efficacy and organizational support have a significant effect on the ease of use perceptions. In another study, Egea and González (2011) extended the TAM with trust and risk related factors to better explain physicians’ acceptance of electronic health care records systems. Their results suggested the attitudinal factors and cognitive instrumental processes

have significant effects on the intentions to use. Further, perceptions of institutional trust have significant effects on the physicians' attitudes, perceived usefulness, and perceived ease of use.

Benamati, Fuller, Serva, and Baroudi (2010) extended the TAM to explain use of e-commerce environments by university students. Their results suggested that trust beliefs, including ability, benevolence, and integrity have significant effects on the trusting attitude, which has a significant impact on the intention to use e-commerce environments. Melas, Zampetakis, Dimopoulou, and Moustakis (2011) extended the TAM to explain acceptance of clinical information systems by including two factors relevant to clinicians; self-reported ICT feature demand and self-reported ICT knowledge. The results suggested that medical professionals' ICT knowledge has a positively significant impact on the perceived ease of use. While, the ICT feature demand has a significant but negative impact on the perceived usefulness.

The acceptance and use of cloud computing services have also recently received increasing attention. For example, Arpaci (2016) investigated the mobile cloud computing services adoption based on the TAM. His results indicated that the perceived usefulness, and trust have positive and significant impact on the adoption. In another study, Shin (2013) aimed to understand the adoption of cloud computing by governmental institutions based on the TAM. The results suggested the perceived usefulness and perceived ease of use were significant antecedents of the cloud computing adoption. Jou and Wang (2013) extended the TAM to compare motivation and achievement in use of cloud computing among college students with different backgrounds. The results showed that the students with a vocational high-school background have higher motivations. More recently, Sharma, Al-Badi, Govindaluri, and Al-Kharusi (2016) investigated the motivators of the cloud computing adoption by extending the TAM. Their findings suggested that trust, computer self-efficacy, and job opportunity were significant predictors of the cloud computing adoption.

On the other hand, few studies have been conducted linking cloud computing with knowledge management. For example, Rezaei, Karimi, and Hosseini (2016) and Sultan (2013) suggest that the cloud computing is a suitable platform to set up knowledge management systems. Razmerita, Phillips-Wren, and Jain (2015) claim that using cloud computing is an innovative way of knowledge management. Anupan, Nilsook, & Wannapiroon (2015) and Stantchev, Prieto-González, and Tamm (2015) suggest that cloud computing has significantly enhanced the way of management of knowledge. This study aims to contribute the literature by focusing on the antecedents and consequences of cloud computing adoption in education to achieve knowledge management.

3. Theoretical Background and Hypotheses

The present study adopted the TAM as an initial theoretical framework. The TAM, based on the Theory of Reasoned Action (TRA, Fishbein & Ajzen, 1975), suggests that two theoretical constructs; perceived ease of use and perceived usefulness are significant factors in predicting the variance in users' attitudes toward using a system. On the other hand, the TRA suggests that "behaviors are predicted by intentions and that intentions are jointly determined by attitudes toward the behavior" (Davis, Bagozzi, & Warshaw, 1989). The proposed model extends the TAM by adding external factors, which are considered to be significant in predicting cloud computing adoption to achieve knowledge management.

Figure 1 presents the proposed research model, which suggests the continued use intention is predicted by attitudes, whereas attitudes are predicted by perceived usefulness and ease of use. It also suggests that the perceived usefulness is predicted by the perceived ease of use and the expectations for knowledge management practices, including knowledge creation and discovery,

knowledge sharing, knowledge storage, knowledge application. While, ease of use perceptions are predicted by innovativeness and training and education.

[Figure 1 will be about here]

3.1. *Attitudes and Continued Use Intentions*

Attitude toward using a new system can be defined as “an individual’s overall affective reaction to use the system” (Davis, 1989). However, continued use intentions can be defined as “the degree of an individual’s belief that he or she will continue to use the system” (Venkatesh et al., 2003). Ajzen’s (1991) theory of planned behavior suggests that the more favorable students’ attitudes towards using cloud computing services, the greater their continued use intentions would be. Therefore, it is hypothesized that positive attitudes toward cloud computing services are significantly associated with the continued use intentions (H1).

3.2. *Perceived Ease of Use*

Perceived ease of use can be defined as “the degree to which an individual believes that using a system is free from effort” (Davis, 1989). This variable is similar to the notion of “complexity” in the Diffusions of Innovation Theory (DOI, Rogers, 2010) and “effort expectancy” in the UTAUT. The easier it is to perform the key functionalities of cloud computing services, the lower the level of task complexity and the more positive attitudes towards using these services (H2) and the quicker and easier perceptions of advantages provided by the services (H3).

3.3. *Perceived Usefulness*

Perceived usefulness can be defined as “the degree to which a student believes that using a system would enhance his or her academic success and performance” (Davis, 1989). This construct is identical to several other constructs, including “relative advantage” in the DOI (Rogers, 2010) and

“performance expectancy” in the UTAUT (Venkatesh et al., 2003). The functionalities of cloud computing services such as file sharing and storage may provide students effective management of knowledge. Therefore, perceived usefulness is significantly associated with the students’ attitudes towards using cloud computing services (H4).

3.4. Knowledge Creation and Discovery

Through an individual’s cognitive process as well as collaborative and social processes the knowledge is created, enlarged, amplified, shared, and justified (Nonaka, 1994). The modes of knowledge creation identified in the SECI model by Nonaka (1994). Since developing new knowledge or replacing the existing knowledge is one of the main benefits of cloud computing services, these services may enhance the interactions between tacit and explicit 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 higher the expectations for knowledge creation and discovery, the higher the perceived usefulness would be (H5).

3.5. Knowledge Storage

Individuals create and acquire knowledge; however, they may forget some of what they learn. Thus, knowledge storage constitutes an important aspect of effective knowledge management (Alavi & Leidner, 2001). Advanced computer storage technology such as cloud storage and synchronization services can be effective tools in storing and accessing written information, documents, and files. On the other hand, the expectations of the students for knowledge storage may affect the perceived usefulness of cloud computing services. Therefore, it is hypothesized that the higher the expectations for knowledge storage, the higher the perceived usefulness would be (H6).

3.6. Knowledge Sharing

Knowledge sharing is exchanging experiences and knowledge with peers in classes, teams, or communities (Wang & Noe, 2010). Knowledge sharing occurs at various levels; “between individuals, from individuals to groups, from individuals to explicit sources, between groups, across groups, and from the group to the organization” (Alavi & Leidner, 2001). Cloud computing services can facilitate knowledge sharing among students and teachers. On the other hand, the expectations of the students for knowledge sharing may positively affect the perceived usefulness of cloud computing services. Accordingly, it is hypothesized that the higher the expectations for knowledge sharing, the higher the perceived usefulness would be (H7).

3.7. Knowledge Application

“The source of competitive advantage resides in the application of knowledge rather than knowledge itself” (Alavi & Leidner, 2001). Cloud computing services may reduce the need for coordination and communication, specifically, in group projects where students work simultaneously on the same document. Thereby, these services enable more efficient management of knowledge through timely and flexible routing of files and documents. On the other hand, the expectations of the students for knowledge application may have positive effects on the perceived usefulness of cloud computing services. Therefore, it is hypothesized that the higher the expectations for knowledge application, the higher the perceived usefulness would be (H8).

3.8. Innovativeness

Innovation can be defined as the development or adoption of new behaviors or ideas that may pertain to a technology, service, product, system, or practice (Amabile 1988; Damanpour & Wischnevsky, 2006). Innovativeness is defined as “the degree to which an individual is relatively earlier in adopting new ideas than the other members of a system” (Rogers, 2010, p. 22). This

suggest that being open to new ideas and frequently exploring new products determine the level of personal innovativeness. Arpaci (2015) and Liu, Li, and Carlsson (2010) found that personal innovativeness is significantly associated with the perceived ease of use of mobile learning. In another study, Thong (1999) identified innovativeness of the CEO is significantly related to the information systems adoption in businesses. Accordingly, innovativeness is significantly associated with the perceived ease of use (H9).

3.9. Training and Education

Students' technical skills and knowledge gained from training and education on cloud computing services may play a significant role in the ease of use of these services. In previous TAM studies in educational settings, the impact of internal ICT support/training has been found important to understand technology acceptance (i.e. Tondeur, Van Keer, van Braak, & Valcke, 2008). If the students believe that they are already adept at using the key features of these services during the training program, they would be aware and less concerned with the adverse learning curve effect. Therefore, training and education are significantly associated with the perceived ease of use (H10).

4. Method

4.1. Research Design

To make this study ecologically valid, the study was conducted in the authentic learning environment during regularly scheduled IT classes that lasted 14 weeks. At the start of the study, each participant was administered a paper based pretest consisting of 40 questions to measure the conceptual knowledge in cloud computing and knowledge management. The training program introduced the participants to the fundamentals of knowledge management, knowledge management systems, and cloud computing.

The training program allowed the participants to transfer the theoretical knowledge acquired into the practical field. The participants have created an account for a cloud computing service, Dropbox. This cloud storage and synchronization service provided the participants a free space to manage their files and documents. They were given a topic to investigate in external databases and store the documents and files using the cloud storage and synchronization service. Thereby, the participants have experienced use of the cloud storage and synchronization services for the group projects, where they work collaboratively on the same documents. During their project, they have extensively shared documents and knowledge with group members. At the end of the intervention, the participants were completed the posttest that was identical to the pretest. Finally, an online survey was administered to the participants by using an Internet based surveying system, Qualtrics.

4.2. Sample

The target population for this research is undergraduate students. From this population, a total of 221 students from a public university in Turkey were participated in this study. The participants' ages ranged from 17 to 29 years (mean=19.54, $SD=1.92$). 68.3% of the participants were freshmen, 13.6% were juniors, and 18.1% were seniors. Further, 148 (%67) participants were women. All participants have received a pre-test and post-test and trained by the researcher. The participants had little previous knowledge about cloud computing services prior to participating. This limited prior knowledge was verified through the analysis of the participants' pretest scores that reflected their low prior knowledge.

4.3. Instrument

The questionnaire items were carefully designed in an attempt to obtain face and content validity. A preliminary questionnaire was prepared by using questionnaire the items that had been tested in prior studies. In preparing the candidate items, the prior studies on knowledge management and

technology adoption were reviewed. The preliminary instrument items were tailored to the use of cloud computing services for knowledge management. A pilot study was conducted with this questionnaire to further improve the content validity. Based on the results, some items were eliminated or rephrased to minimize ambiguities. The main study was conducted by using the questionnaire items, which were finalized based on the pilot study.

A scale developed by Davis (1989) was used to measure the perceived ease of use and usefulness. In addition, the items measuring attitudes and continued use intentions were adapted from the TPB (Ajzen, 1991). The items measuring knowledge creation, storage, sharing, and application, innovativeness, and training and education were adapted from the relevant literature (Pee & Kankanhalli, 2009; Wang & Qualls, 2007; Becerra-Fernandez, Gonzalez, & Sabherwal, 2004; Alavi & Leidner, 2001). Thus, the instrument has a total of 33 items, including 3 items for knowledge creation, 3 items for knowledge storage, 3 items for knowledge sharing, 3 items for knowledge application, 3 items for training and education, 4 items for innovativeness, 3 items for perceived ease of use, 5 items for perceived usefulness, 3 items for attitudes, and 3 items for continued use intentions. The participants were asked to rate their level of agreement by using a five-point Likert scale ranging from “strongly disagree” to “strongly agree.”

5. Results

5.1. Pretest-posttest Results

A paired samples *t*-test was employed to compare the participants' learning before and after the intervention. The mean posttest score ($M=77$, $SD=1.8$) was significantly higher than the mean pretest score ($M=59$, $SD=1.7$), ($t=-11.64$, $p<.001$). This implies the participants had significant learning by participating in the instruction.

5.2. Instrument Validity and Reliability

The data set was examined for the adequacy of factor analysis through with Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity (Bartlett, 1951; Kaiser, 1970). Table 1 shows the suitability of the data set for the factor analysis. Both the KMO and Bartlett's test of sphericity results verified the sampling adequacy of the data set for factorability.

[Table 1 will be about here]

An exploratory factor analysis was employed by using principal components extraction to examine the construct validity of the scale. The KMO measure of sampling adequacy is well above the accepted level of .50 and Bartlett's test of sphericity suggested the measures for the constructs are interdependent (Leech, Barrett, & Morgan, 2005). Further, each measurement item has a communality value above .52 and a factor loading above .72; both are higher than the acceptable level of .40 (Field, 2005). The corrected item total correlation coefficients ranged from .42 to .89, suggesting the homogeneity of the measurement items (Scherer, Wiebe, Luther, & Adams, 1988).

The AVE (average variance extracted) values exceed .50 (Hair, Anderson, Tatham, & Black, 2006), suggesting the adequate convergent validity of the constructs. Discriminant validity was checked using the correlation matrix of the latent variables. The results identified that the square root of the AVE values are greater than the inter-construct correlations (Fornell & Larcker, 1981). Thus, discriminant validity was satisfactory for the constructs. Finally, the reliability analysis results suggested the instrument has a satisfactory internal consistency in that the Cronbach's alpha values ranged from .67 to .93 (Creswell, 2005). The internal consistency reliability measures, results of principal component analysis, and the convergent validity measures (AVE and CR, Composite Reliability) were provided in Table 2.

[Table 2 will be about here]

5.3. Common Method Bias

Harman's one factor test was employed to check common-method bias by using a common latent factor in "Analysis of Moment Structures" AMOS (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Results of the confirmatory factor analysis (CFA) indicated the one factor model do not fit the data; [$\chi^2/df=3.63$, GFI=.55, AGFI=.49, NFI=.55, IFI=.63, SRMR=.29, RMR=.22, NNFI=.60, CFI=.68, RMSEA=.109]. The results suggested the common-method bias is not a threat to the validity of the model.

5.4. The Structural Model

The structural equation modeling analysis was conducted using AMOS to validate the research model. The structural model produced acceptable fit indices: [$\chi^2/df=1.98$, GFI=.85, AGFI=.81, NNFI=.88, NFI=.82, CFI=.90, IFI=.90, RMSEA=.067]. Value of the Chi-square/df is 1.98; according to Kline (2005), a ratio of less than three is acceptable, while a ratio of less than two is good. Results of the CFA suggested that the scales used in the present study form an adequate measurement model, therefore, provided the evidences for construct validity of the measures.

5.5. Hypothesis Testing

The hypothesized relationships were tested by path analysis using structural equation modeling. Except for the path coefficients between the "knowledge application" to "perceived usefulness" being rejected (H8), the rest hypotheses were accepted. Figure 2 shows the results of the analysis, including the standardized path coefficients along with significance levels and the *R*-squared values with respected error terms. The paths specified in the model account for 56% of the variance continued use intentions.

[Figure 2 will be about here]

A summary of the hypothesis testing results is as follows:

H1. Attitudes toward using cloud computing services are significantly associated with the continued use intentions ($\beta=.75$; $t=9.04$; $p<.001$).

H2. Perceived ease of use is significantly associated with the attitudes toward using cloud computing services ($\beta=.23$; $t=3.14$; $p<.01$).

H3. Perceived ease of use is significantly associated with the perceived usefulness ($\beta=.42$; $t=5.80$; $p<.001$).

H4. Perceived usefulness is significantly associated with the attitudes toward using cloud computing services ($\beta=.59$; $t=6.74$; $p<.001$).

H5. The higher the expectations for knowledge creation and discovery, the higher the perceived usefulness would be ($\beta=.18$; $t=2.60$; $p<.05$).

H6. The higher the expectations for knowledge storage, the higher the perceived usefulness would be ($\beta=.27$; $t=3.91$; $p<.001$).

H7. The higher the expectations for knowledge sharing, the higher the perceived usefulness would be ($\beta=.55$; $t=5.97$; $p<.001$).

H8. The higher the expectations for knowledge application, the higher the perceived usefulness would be ($\beta=-.11$; $t=-1.72$; $p>.05$).

H9. Innovativeness is significantly associated with the perceived ease of use ($\beta=.48$; $t=5.88$; $p<.001$).

H10. Training and education are significantly associated with the perceived ease of use of cloud computing services ($\beta=.18$; $t=2.43$; $p<.05$).

6. Discussion and Conclusion

6.1. Discussion

This study hypothesized that the perceived ease of use and the expectations for knowledge management practices are significantly associated with the perceived usefulness, which in turn significantly associated with the attitudes towards using cloud computing services. The results indicated that the perceived ease of use and the expectations for knowledge creation and discovery, storage, and sharing are significantly associated with the perceived usefulness, and therefore, provided support for these hypotheses.

However, the results indicated that there is no causal relationship between the expectations for knowledge application and perceived usefulness. This suggests that the students do not expect to use knowledge in decision making or to solve problems in the school setting. In other words, contrary to the organizational level, knowledge application have limited applicability at the individual level. This implies that organizations more effectively apply knowledge for decision making. For example, decision support systems and enterprise applications help organizations applying knowledge in the decision making process (Laudon & Laudon, 2012).

Confirming the TAM, the results indicated the attitudes are significantly associated with the continued use intentions. The results also indicated that training and education are significantly associated with the perceived ease of use, which has a significant effect on the attitudes towards using cloud computing services. This implies that the expectations for training and education are significantly associated with their ease of use perceptions. Further, the results also indicated that

innovativeness is significantly associated with the ease of use perceptions. This implies that level of personal innovativeness has a positive correlation with the perceived ease of use of a new technology.

The present study focused on the advantages of cloud computing services. On the other hand, previous studies reported notable disadvantages of the cloud computing services. For example, Chu, Zhu, Han, Liu, Xu, & Zhou (2013) identified several weaknesses and security concerns for the cloud computing services, such as potential data leakage, unauthorized secret URL sharing, non-dead URL, uncertain identities, and no privacy on sharing. In another study, Shin (2015) found that user intentions toward adoption of cloud computing services are affected by the perceived values such as security, access, availability, and reliability. Similarly, Paquette, Jaeger, and Wilson (2010) identified some important risks associated with use of the cloud computing services as the continuity, reliability, security, safety, privacy, data confidentiality, and legal jurisdiction.

Rong, Nguyen, and Jaatun (2013) reported possible security challenges in cloud services such as interoperability among clouds, resource location, privacy, security, trust, and authentication. Gupta, Seetharaman, and Raj (2013) investigated the adoption of cloud services by SMEs. The results suggested the key determining factors as ease of use, privacy, security, convenience, and cost reduction. In another study, Marston et al. (2011) identified some strengths (i.e., cost reduction, scalability, and immediate access), weaknesses (i.e., data location, service quality, and availability), opportunities (i.e., effectiveness), and threats (i.e., security and reliability) of cloud services from an organizational perspective. González-Martínez et al. (2015) reported the benefits of cloud services for the educational institutions as availability, flexibility, scalability, and cost savings. However, they reported some important risks of cloud services as reliability, privacy, security, interoperability, performance, and licensing.

6.2. *Implications for Research and Practice*

This study has several research implications. First, the research model, which extends the TAM, explains a substantial variance in continued use intentions (56%). Second, the TAM provides very general information on the students' adoption of cloud computing services to achieve knowledge management, whereas the proposed model delivers more specific information by situational variables such as knowledge creation and discovery, storage, sharing, and application.

This study has also several practical implications for educational institutions and academics. First, the students are expected to effectively use cloud computing services for knowledge management, however, the findings suggested that most of them were not aware of such services before the intervention. This implies that academics should direct and scaffold students in effective use of cloud computing services. Second, academics should employ new pedagogies that focus on interactive systems for inquiry-based pedagogies and collaborative workspaces. By this, the advantages of use of cloud computing services in education such as allowing students ubiquitous access to up to date knowledge and providing platforms for sharing reference materials can be fully exploited. Educational institutions may also utilize the advantages of cloud computing services in designing collaborative learning environments in which students and academics can share and enrich teaching materials.

6.3. *Conclusion*

Cloud computing services provide students access and synchronize their digital reference materials any time, from anywhere, and using any device. Thereby, integration of cloud computing services into the educational settings may promote students' academic performance, effectiveness, and efficiency by facilitating knowledge management. Therefore, this study investigated antecedents and consequences of cloud computing adoption in education to achieve knowledge management.

This study has several limitations. First, the sample size is limited and a larger sample size is required to further generalize. Second, the prior knowledge and experience of the students may have an effect on the outcomes of the study and act as a moderator. In a future study, a multi-group analysis that differentiates the participants with regards to their prior knowledge and experience with cloud computing services may lead to improved insights. Third, focusing only on the students' adoption mindset but neglecting academics' readiness is a limitation as this is a critical point in technology integration in education. Therefore, future research should focus on how academics think about the real process of integrating such services into the educational system, as this integration needs to be addressed with regard to various educational aspects, including curriculum and pedagogy, institutional readiness, change management, and instructor competencies. To achieve such an integration, not only the students are expected to be supportive of the new learning methodologies; academics and universities also need to be equipped with the acquired skills and literacy to deliver on promises of the emerging technologies.

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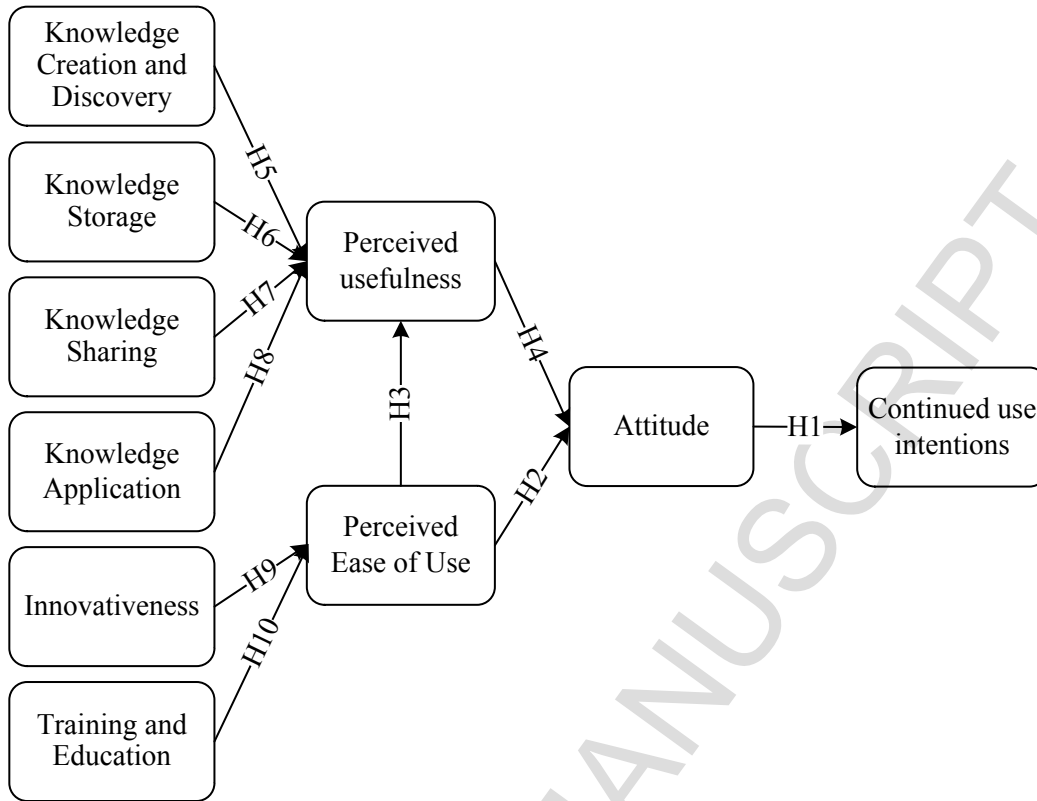
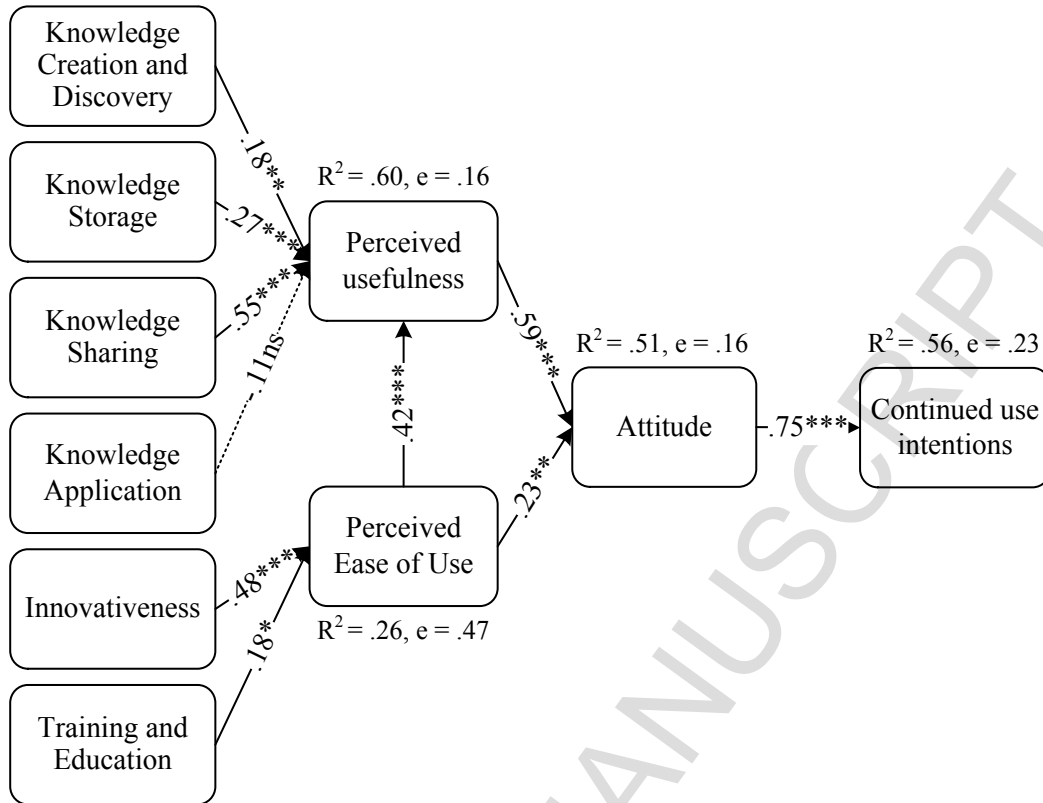


Figure 1: The research model



* $p < .05$, ** $p < .01$, *** $p < .001$, Chi-Square = 591.09, DF = 298, Chi-Square/DF = 1.98

Figure 2: The hypothesis testing results

Table 1: The suitability of the data for factor analysis

	KMO	Chi-Square	Sig.
Continued use intentions	.72	281.29	.001
Attitude	.71	318.67	.001
Perceived ease of use	.71	234.09	.001
Perceived usefulness	.85	677.41	.001
Knowledge creation and discovery	.69	145.14	.001
Knowledge storage	.69	186.80	.001
Knowledge sharing	.63	87.29	.001
Knowledge application	.67	148.24	.001
Innovativeness	.77	272.36	.001
Training and education	.63	138.86	.001

Table 2: Validity and reliability evidence

Construct	Item	Internal reliability					Convergent validity	
		Cronbach's alpha	Item-total correlation	Factor loading	Communality	Total variance explained	CR	AVE
Knowledge creation and discovery	KC1: Students should make documentation and reports regarding their courses.	.74	.55	.80	.64	65.99	.68	.51
	KC2: Class activities promoting knowledge creation such as proposal writing and project development should be given more attention.		.58	.82	.67			
	KC3: Students should be encouraged to produce publications from their project and research reports.		.57	.82	.67			
Knowledge storage	KSt1: There should be an easily accessible archive to store documents and reports.	.77	.57	.80	.64	69.46	.80	.57
	KSt2: Documents and reports should be organized to be accessed anytime and anyplace.		.67	.87	.75			
	KSt3: Documents and reports should be stored in retrievable form.		.61	.83	.70			
Knowledge sharing	KSh1: Digital platforms are necessary to share knowledge.	.67	.50	.86	.74	73.66	.67	.51
	KSh2: Students should use formal networks/media for information exchange with peers.		.51	.86	.74			
	KSh3: There should be collaboration based on the competency of students.		.42	.72	.52			
Knowledge application	KA1: Previous experiences and knowledge should be used to tackle any problems.	.74	.56	.81	.65	65.83	.77	.53
	KA2: Previous experiences and knowledge should be used in the decision making process.		.62	.85	.72			

	KA3: Previous experiences and knowledge should be employed in problem solving.		.52	.78	.60			
Innovativeness	In1: Well-managed knowledge due to cloud computing services enhance my innovativeness.	.80	.57	.76	.57	62.69	.82	.53
	In2: I welcome new ideas.		.65	.82	.66			
	In3: I frequently explore new products.		.66	.82	.68			
	In4: I often buy new products first.		.59	.77	.60			
Training and education	TE1: A formal education program is needed to introduce use of cloud services for knowledge management.	.72	.51	.78	.60	63.78	.67	.51
	TE2: The training helped me to develop skills in using cloud computing services to achieve knowledge management.		.64	.87	.75			
	TE3: The training taught me how to use cloud computing services for the management of knowledge.		.47	.75	.56			
Perceived ease of use	PEU1: Learning to use cloud computing services would be easy for me.	.93	.84	.84	.71	73.52	.84	.64
	PEU2: My interaction with cloud computing services would be clear and understandable.		.89	.88	.77			
	PEU3: It would be easy for me to become skillful at using cloud computing services for knowledge management.		.85	.85	.72			
Perceived usefulness	PU1: Using cloud computing services would improve my academic performance.	.90	.70	.80	.64	71.67	.84	.63
	PU2: Using cloud computing services would increase the efficiency of my studies and work.		.74	.83	.69			
	PU3: Using cloud computing services would make it easier to manage knowledge.		.80	.88	.77			

	PU4: Using cloud computing services in knowledge management would increase my productivity.		.78	.87	.76			
	PU5: Using cloud computing services would enable me to accomplish tasks more quickly.		.75	.85	.72			
Attitude	AT1: Using cloud computing services for educational purposes is a good idea.	.86	.67	.84	.71	78.16	.87	.70
	AT2: Using cloud computing services for educational purposes is fun.		.75	.89	.80			
	AT3: Using cloud computing services to manage knowledge is pleasant.		.79	.91	.83			
Continued use intentions	IU1: I intend to use cloud computing services for educational purposes in the future.	.85	.67	.85	.72	76.61	.87	.68
	IU2: I predict that I would continue to use cloud computing services for educational purposes.		.74	.89	.80			
	IU3: I plan to use cloud computing services to manage knowledge in the future.		.73	.88	.78			