



Cloud computing services adoption among higher education faculties: development of a standardized questionnaire

Zoleixa Asadi¹ · Mohammadhiwa Abdekhoda^{2,3}  · Haidar Nadrian⁴

Received: 11 March 2019 / Accepted: 16 May 2019 / Published online: 15 July 2019
© Springer Science+Business Media, LLC, part of Springer Nature 2019

Abstract

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources including networks, servers, applications, and services. Our aim in this study was to develop and validate an instrument to investigate the determinants of cloud computing services (CCSs) based on Theory of Planned Behavior (TPB). A total of 240 faculty members in a medical university participated in this cross-sectional study. The development of the Theory of Planned Behavior-Cloud Computing Services use Questionnaire (TPB-CCSQ) began with a comprehensive review of literature. Content and construct validity, feasibility, as well as reliability were assessed. Exploratory factor analysis indicated an optimal reduced solution with 30 items and 5 factors. The factors identified included Attitude toward CCSs use, Perceived Privacy/Security, Perceived Behavioral Control, Intention to use CCSs and Subjective Norms. The measurement model was found to be with a good fit to the data in the assumed model, and all sub-scales were found to be significant within an acceptable range. Our findings demonstrated validity, reliability, simplicity and functionality of the TPB-CCSQ. Information technology researchers, community agencies and educational organizations delivering CCSs may apply this instrument as a practical and useful tool to investigate the cognitive determinants of CCSs.

Keywords Cloud computing services · Theory of planned behavior · Instrumentation · Human behavior

1 Introduction

Technology is considered as an enabler or a vehicle to disseminate knowledge (Oye et al. 2014). Technology is of little value unless it is accepted and used (Oye et al.

✉ Mohammadhiwa Abdekhoda
Abdekhodam@tbzmed.ac.ir; Hiwaabdekhoda@gmail.com

2014). The acceptance of a technology by individuals leads to application of the technology (Amoako-Gyampah and Salam 2004). A new human noteworthy technology, which needs to be accepted and applied by users, is cloud computing services (CCSs). The National Institute of Standards and Technology (NIST) defined Cloud Computing (CC) as “a model for providing a provisioned and on-demand computing resources which includes networks, servers, storage, applications, and services” (Alharthi et al. 2015). CC is generally regarded as one of the most important internet-based models in the present and future societies (Shawish and Salama 2014). CC is a supersede choice instead of adding new technology, and is a verified model for access to ubiquitous networks in societies (Mell and Grance 2009).

Data from the leading information technology (IT) research firms and the U.S. government have indicated CC as a critical topic throughout the world (Shiau and Chau 2014a). Evidence suggest that a high percentage of internet users apply CC services; thus, CC has become a popular issue. Based on Gartner investigations, it is predicted that the CCSs will grow up to \$216 Billion by 2020 (Naveen Mishra 2017). Similarly, Forrester forecasted that the global CC market will grow from \$40.7 billion in 2011 to more than \$241 billion in 2020 (Dignan 2011; Pourmajidi et al. 2017). The public cloud market is expected to grow 17.3% from \$175.8 billion in 2018 to \$206.2 billion in 2019; the market rate of growth will be 21%, up from \$145.3 billion in 2017 (Hippold 2018). Forrester research has reported the universal CC mart (Fig. 1).

1.1 Background and literature review

CCSs have been widely used in education. Educators and students store and share their data widely in the cloud (Sultan 2010). Higher education is identified as learning

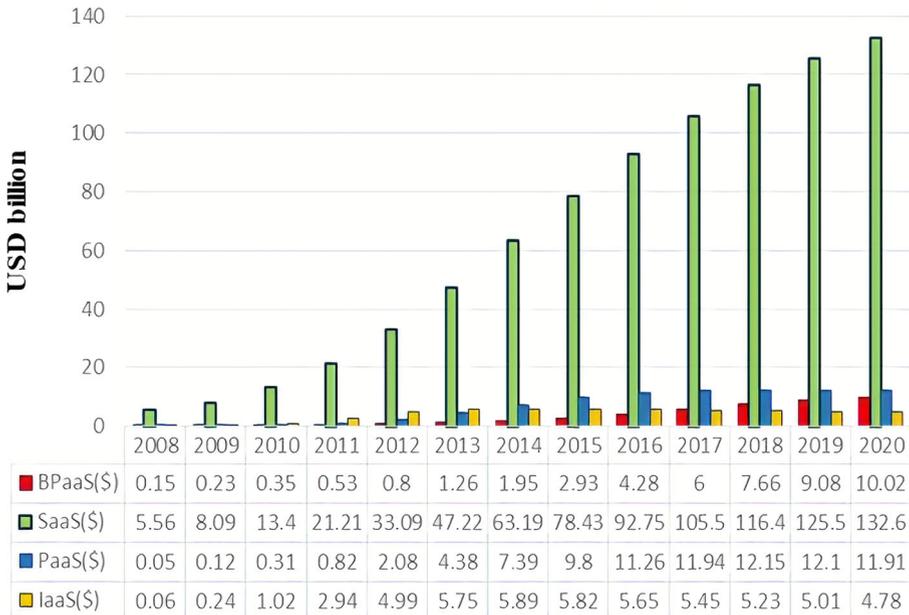


Fig. 1 Forecast: Global Public Cloud Mart. Source: Forrester Research, Inc.

organization and impressed by social factor, inclination, attitude, trend, and technology. For many years education, study and doing assignment was automatically documented and paper based, while CC could be an alternative way.

Research in CC has been growing since the time when proliferation of cloud-based computing solved many problems of organizations and individuals. Cloud-based services can offer users and academic institutions cost savings and access to scalable computing power (Alharthi et al. 2015; Buyya et al. 2010). Educational organizations have applied CC as it reduced the costs and increased the efficiency (Alshuwaier et al. 2012). The foremost-perceived benefit of CC for education is the ability to support learning processes including self-learning, peer-to-peer learning, classroom learning, distance learning, virtual laboratories, assessment systems and instructing the students with special needs (Aljenaat et al. 2011; Ding et al. 2012; Jiao et al. 2011; Pyzik 2012).

Due to the rapid growth of science and mass production of information, understanding the mode of applying CC services and its determinants seems to be necessary. Identifying the factors contributed to the acceptance or rejection of CCSs may be helpful in advancing scientific and commercial goals of the associated organizations and institutions. With a better understanding on the mode of CCSs and their determinants, the stakeholders and decision-makers in different universities and educational organizations may also be able to plan for CCSs promotion programs with the hope to better facilitate the development of science throughout the world.

Research on CC is conducted in different fields, like technical topics (Kumari and Nath 2015), CC acceptance (Clarke 2010), IT (Aharony 2015), and cloud-based applications (Bhattacharjee and Park 2014; Menard et al. 2014). A majority of CCSs adoption researches is also conducted in particular regions, including the US and Turkey (Ratten 2015), Israel (Aharony 2015), England (Alshamaila et al. 2013), Taiwan (Lin and Chen 2012; Wang et al. 2010), Ireland (Carcary et al. 2014), and India (Gangwar et al. 2015).

Nowadays, the importance of CC is obvious. The Google company, as the most valuable brand throughout the world in 2017 (Cox 2017), announced its CC platform (GCP) as a project with free accessibility. Users can download 15 Google CCSs, including 30 GB of compute engine per month, five GB of storage cloud storage per month, Pub / Sub with a capacity of 10 GB per month, and cloud function with a capacity of two million callings per month, and meet their needs through these services by GCP.

1.2 Theoretical framework

In order to examine the mode of CCSs and its determinants, there is a need to apply, develop and/or extend theoretical frameworks. Such frameworks may help researchers in systematic and logical investigation of the behavior and its determinants (Glanz et al. 2008). There are several theoretical approaches used to evaluate the associated factors of CCSs including the innovation diffusion theory (IDT) (Sahin 2006), the theory of reasoned action (TRA) (Shiau and Chau 2016), the theory of planned behavior (TPB), the extended theory of planned behavior (ETPB) (Baek 2007), the technology acceptance model (TAM) (Abdekhoda et al. 2014; Abdekhoda et al. 2016; Shroff and Keyes 2017), the technology organization environment model (TOE) (Priyadarshinee et al. 2017), the motivational model (MM) (Davis et al. 1992), the model of PC utilization (MPCU) (Thompson et al. 1991), the decomposed theory of planned behavior (DTPB) (Shih and Fang 2004), the combined TAM and TPB (C-TAM-TPB) (Safeena et al. 2013), the technology acceptance

model 2(TAM2) (Venkatesh and Davis 2000), and the unified theory of acceptance and use of technology (UTAUT) (Abdekhoda and Salih 2017; Sattari et al. 2017).

1.2.1 Theoretical framework

The TPB is a framework that has been widely used in investigating the determinants of various behaviors (Ali et al. 2011a, b; Garrison et al. 2018; Shiau and Chau 2014b). This theory includes the following constructs: behavior, behavioral intention, attitude toward the behavior, subjective norms, and perceived behavior control. Behavioral intention is the “token of a person’s readiness to do a behavior” (Fishbein and Ajzen 1991, p. 39). Ajzen (1991) suggested this construct as the main agent of the theory that foretells the behavior directly. It, in turn, is determined by attitudes toward the behavior (shows the degree of positive or negative value towards performing a behavior), subjective norms (perception on social pressure to perform a behavior or not) and perceived behavioral control (the perception of ease or difficulty of performing a behavior) (Ajzen 1991) (Fig. 2).

1.3 Aims

Lease (2005) announced that the greatest problem with the adoption of CCSs is not technological, but attitudinal (Lease 2005). Therefore, investigating the cognitive

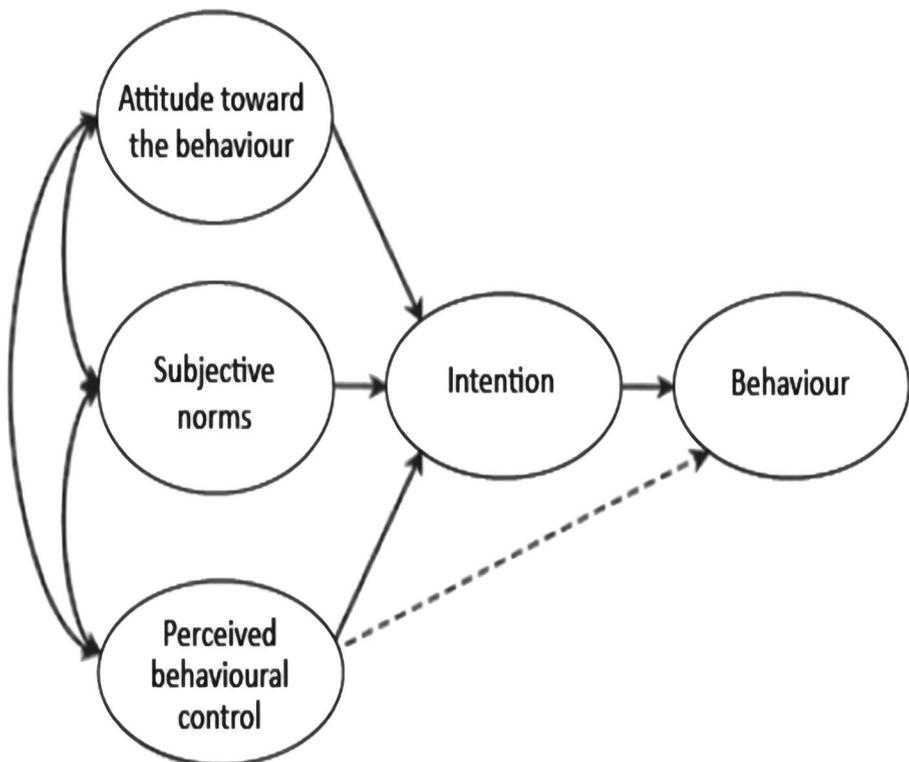


Fig. 2 Theory of Planned Behavior. Source: Ajzen, I. (1991). Theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 182

determinants of the behavior, especially in a developing country like Iran, may guide the future researchers in finding a better understanding on the cognitive barriers and facilitators of CCSs. To our knowledge, however, there is no valid and reliable instrument to assess the behavior and its determinants in the literature. Considering the important role of perceived privacy and security in using CCSs (Hussein and Khalid 2016; González-Martínez et al. 2015), we chose to use these concepts as two individual constructs added to the TPB. Therefore, we decided to develop a novel TPB-based instrument and to assess its psychometric properties with the hope to provide the researchers in the field with a valid and reliable instrument. Our aim in the present study was to develop and validate the Theory of Planned Behavior- Cloud Computing Services use Questionnaire (TPB-CCSQ) to investigate the determinants of CCSs based on TPB among faculty members in an Iranian medical university.

2 Materials and methods

2.1 Study design, setting and participants

This was a cross-sectional study conducted in 2017 on 260 faculty members in Tabriz University of Medical Sciences, Iran. Sample size estimation was based on Cochran's formula among 807 faculty members within the university. Among all respondents, 240 accepted our invitation to participate in the study (Response Rate = 91.95%). The faculty members who were familiar with CC and had the history of CCSs use were included in the study. The study lasted from August to October 2017.

2.2 Instrumentation

In order to develop the TPB-CCSQ, we conducted a comprehensive review of the literature to create an item pool (Lu et al. 2009; Taylor and Todd 1995; Winston 2015). The three most popular databases and one search engines)PubMed/MEDLINE, Science Direct, Scopus and Google Scholar(were searched with special keywords of CC, CC application, Theory of Planned Behavior, Instrumentation and perception on CC. A researcher linked to the study crosschecked the derived data.

In total, 42 items were generated and categorized into seven subscales to develop the instrument based on the TPB constructs: CCSs use behavior (1 item), Intention toward CCSs use (4 items), Attitude towards CCSs Use (9 items), Subjective Norms (6 items), Perceived Behavioral Control (9 items), Perceived Privacy (6 items), and Perceived Security (7 items) toward CCSs. Considering the nature of CCSs behavior and the important role of privacy and security in using CCSs (Hamzah et al. 2017; Orehovački et al. 2017), we chose to extend the model and to add two new subscales to the questionnaire; perceived privacy and perceived security in using CCSs.

For all constructs, except for CCSs use behavior, the items were rated on a five-point Likert-type scale ranged from 0 to 4 (0 = totally disagree through 4 = totally agree). The higher scores indicated more intention and positive attitude towards, and perceived behavioral control over CCSs use. Also, the higher the scores the more perceived privacy and security toward applying CSSs were concluded.

The CCSs use behavior was measured applying a one-item scale: *During the previous six months, how many of CCSs (like Google Drive, Skype, Google Mail, Research Gate, E-Learning, Dropbox, LinkedIn and so on) have you applied in your professional works?* A 4-point scaling (never (0), 1–3 items (1), 4–6 items (2), and more than 7 items (3)) was used as response format. The participants were asked to put a check in the box that corresponded to each item. The higher was the respondents' total score, the higher CCSs application was concluded.

A demographic data form was also developed to investigate the demographic characteristics of the participants, which included the following items: age, gender, last academic degree, and academic rank.

2.3 Statistical analysis

To conduct all statistical analyses, we used the Statistical Package for Social Sciences (SPSS) v. 17 for Windows (SPSS Inc., Chicago, IL), and AMOS software v. 22. We also used the measures of central tendency and variability to summarize and organize the data. In order to fill in the irregular missing values throughout data, and to approve the normality of data distribution, we applied linear interpolation and One-Sample Kolmogorov-Smirnov tests, respectively.

2.3.1 Content validity

In order to conduct qualitative content validity, an expert panel including 10 scholars in the fields of biomedical informatics, health information management, health information technology, computer engineering, and health education appraised the TBP-CCSQ. They evaluated the grammar and wording of the items, as well as item allocation and scaling of the scales. The expert panel checked all items and decided whether a series of items may, adequately, cover the target construct. To assess quantitative content validity of the scale, Content Validity Ratio (CVR) and Content Validity Index (CVI) (Nunnally 1994) were measured.

A 3-point rating scale (essential, useful but not essential, and unessential) was used to assess CVRs (Nunnally 1994). In order to estimate CVIs, 30 scholars were asked to comment independently on the necessity, relevance, clarity and simplicity of the items. The relevance of the items was assessed using a four-point rating scale: a) not relevant; b) slightly relevant; c) relevant; and d) completely relevant. Considering the number of members in the expert panel, CVI values of 0.79 or more was considered satisfactory for each statement (Nunnally 1994).

2.3.2 Face validity

Ambiguity, relevancy and difficulty of each item (Lawshe 1975) was qualitatively assessed by the same expert panel. Quantitative face validity of the items was conducted, and the importance of each item was scored based on a 5-point rating scale. Then, the impact score of each item was assessed. The impact of each item was calculated by multiplying the frequency of an item by its mean importance [Impact Score = Frequency (%) × importance]. The impact score of 1.5 or higher was considered to be acceptable, as recommended previously (Goldberg et al. 1997).

2.3.3 Reliability

We evaluated internal consistency of the instrument applying the Cronbach's alpha coefficient and test–retest reliability coefficient tests. Intra-class correlation coefficients (ICC) with 95% confidence intervals (CI) were calculated; an $ICC \geq 0.70$ was also considered as acceptable. Pearson's correlation coefficient was used to assess the associations between the factors. The Cronbach's alpha coefficient of 0.7 or above was thought to be satisfactory (Babazadeh et al. 2016).

2.3.4 Construct validity

Based on a randomized split of data in the sample, Exploratory Factor Analysis (EFA) was conducted to assess factor structure of the questionnaire. A sample of 120 participants was selected using the randomization function on SPSS v. 17. Principal axis factoring (PAF) with direct oblimin rotation was performed to extract the factors. Cattell's Scree test was also used to determine the number of factors to be extracted. To evaluate model sufficiency, Bartlett's test of Sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy were used. Factor loading values ≥ 0.3 were considered as significant (Kline 2005).

Thereafter, Confirmatory Factor Analysis (CFA) with robust maximum likelihood was also conducted on the remaining 120 respondents of the larger overall sample to evaluate the fit between the EFA extracted model and the observed data. The CFA model with the robust maximum likelihood was used to estimate the model parameters. The absolute fit of the model to data was evaluated using the χ^2 statistic, comparative fit index (CFI), Tucker-Lewis Index (TLI), and the root mean square error of approximation (RMSEA). The model was considered acceptable if χ^2/df was between 1 and 5, TLI was more than 0.9, CFI was greater than 0.8, and RMSEA was < 0.05 (good fit) or between 0.05 and 0.08 (adequate fit). The level of significance was considered to be 0.05, a priori.

3 Results

3.1 Sample characteristics

Among all 240 respondents, 145 were male (60.4%). The age of participants was ranged from 27 to 68 years (Mean = 43.4; Standard Deviation = 8.5). A majority of the participants were assistant professor ($n = 131$, 54.8%) and had Ph.D. degree ($n = 117$, 48.7%). The duration of working as a faculty member was ranged from 10 to 401 months (Mean = 164.1 months; SD = 112.8 months).

3.2 Content validity

Based on the recommendations of the expert panel and after measuring CVI and CVR, 10 out of 42 items were revised following the quantitative results and qualitative recommendations. For quantitative evaluation of the content validity, CVI (ranged between 0.8 and 1) and CVR (ranged between 0.6 and 1) showed satisfactory results for each item and consequently for the CCSQ.

As the expert panel recommended, we removed 7 items from the initial 42 items of the instrument and therefore, the TPB-CCSQ with 35 items was included in the CVR and CVI process. The Impact Score and the CVR value for all TPB-CCSQ items were more than 1.5 and 0.62 (Lawshe 1975), respectively, and therefore no item was deleted; however, in qualitative content validity, some modifications were made on the wording and phrasing of some items. Eventually, 35 items remained (Table 1).

3.3 Factor structure

In EFA, we found the Kaiser-Meyer-Olkin measure of sampling adequacy (Bartlett's test of sphericity) for the scale to be 0.874 (Approx. $\chi^2(496) = 4181.60$; $P < 0.001$). The number of items, CVIs, CVRs, mean and SD, range, skewness and kurtosis as well as ceiling and floor effects of the factors are presented in Table 1.

Six factors were extracted with eigenvalues more than 1, by which, in total 63.34% of all variance between the items was explained. Cattell's scree test indicated that between 4 and 7 factors may be extracted. Visual inspection and the hyperplane count were considered to determine the simple structure and the best solution, respectively. So, multiple runs of factor analysis, varying the number of factors, were conducted and finally, the five factor solution distinguished as the clearest pattern of loading. Five items were deleted from the analysis due to low communalities (less than 0.2) (1 item from attitude, subjective norms and perceived behavioral control and 2 items from privacy). After deleting these items, EFA was reiterated to obtain the best solution. This final solution explained 59.23% of all variance (Table 2). Table 2 shows the rotated factor pattern coefficient for this solution as well as some related information.

The measurement model (Fig. 3) was found to be with a good fit to the data in the assumed model, and all the scales were found to be significant within an acceptable range ($\chi^2[393] = 710.178$, $p < 0.001$, CFI = 0.916, NFI = 0.831, TLI = 0.907, RMSEA = 0.058[(0.051–0.065)]).

3.4 Reliability

As there is shown in Table 2, Cronbach's alpha and ICCs for all the five factors were acceptable (more than 0.7). Bivariate correlations for all the factors are indicated in Table 3. Statistically significant correlations were found between all factors. The highest and the lowest correlations were observed between the factors 1 and 5 ($r = 0.567$) and between the factors 2 and 5 ($r = 0.209$), respectively.

4 Discussion

In this study, we aimed to develop and validate the TPB-CCSQ to investigate the cognitive determinants of CCSs among faculty members in a medical university in Tabriz, Iran. With a good level of cost-benefit (Chandra and Borah 2012), CCSs has a significant role in advancing educational goals, like solving E-learning problems (El-Ala and Awad 2012), practicing the scholarship of teaching and learning (Thomas 2011), and public health education (Botts et al. 2010). However, there is a great lack of

Table 1 Summary of psychometric properties of TPB-CCSQ

Scale	Number of items before EFA	CVIs	CVRs	Number of items after EFA	Range of scale after EFA	Mean (SD)	Kurtosis	Skewness	Floor effect %	Ceiling effect %
Attitude toward CCSs	7	0.94	0.78	6	0–24	12.08 (3.5)	–.26	–.08	0	0
Subjective Norms	6	0.92	0.79	5	0–20	9.36 (3.5)	–.04	.16	0.8	0
Perceived Behavioral Control	8	0.93	0.77	7	0–28	10.26 (3.8)	–.14	–.17	0.8	0
Perceived Privacy	5	0.99	1	–	0–20	–	–	–	–	–
Perceived Security	6	0.98	0.9	–	0–24	–	–	–	–	–
Perceived Privacy/Security	–	–	–	9	0–36	9.04 (5.9)	–.15	.55	6.3	.4
Intention	3	0.98	0.78	3	0–12	5.6 (2.3)	–.56	–.09	4.6	0

Table 2 Factors and factor loading for each test item

Item	Item description	F1	F2	F3	F4	F5
Att5	CCSs use increases the effectiveness of my works.	.867	.303			.365
Att6	CCSs use can be useful for me to advance my scientific goals.	.831	.308			.301
Att3	CCSs use increases productivity in my works.	.803			.312	.372
Att2	CCSs use increases the possibility of success in my works.	.764			.309	.398
Att7	CCSs use can be useful for me to advance my lifespan goals.	.722			.319	.314
Att4	CCSs use is expected to increase my flexibility in using new technologies	.635				.327
Secur4			.851			
Secur5	I feel security while transferring my information through CCSs		.820			
Secur6	The security systems applied in CCSs are strong enough to protect my information.		.804			
Secur1			.784		.369	
Priv3	I feel security while retrieving and backing up my private information.		.725	.360	.362	
Priv2			.709			
Secur2	I trust CCSs.		.549	.372		
Priv1	I have control over my information booked in CCSs.		.548		.404	
Secur3	I believe that my scientific documents booked in CCSs will remain private.		.447			
PBC3				.757	.314	
PBC6	CCSs are always well implemented.			.673		
PBC5	I book my scientific/research documents in CCSs.			.653	.340	
PBC1	The internet hackers cannot access my booked data on the Internet.	.321		.618		
PBC2	I have the necessary resources to use CCSs.			.606		
Inten2	I have the needed knowledge to use CCSs.		.386		.869	
Inten3	It is possible for me to use CCSs.				.784	
Inten1	Considering the needed resources, opportunities and knowledge, it is easy for me to use CCSs.				.778	
SN3		.407				.760
SN2	I'm sure that I can use CCSs whenever I want.	.432				.733
SN1	I have decided to use CCSs for storing/sharing my information more than before	.356				.676

Table 2 (continued)

Item	Item description	F1	F2	F3	F4	F5
SN4		.483				.628
SN6	From the next month, I am going to use CCSs-based virtual education for my learning/educating processes					.534
PBC4	From the next month, I am going to use CCSs for storing/sharing my information.				.306	.351
	From the viewpoints of my important others (my dean, peers) I should use CCSs					
	From the viewpoints of information technology specialists I should use CCSs					
	From the viewpoints of those who impact my performance I should use CCSs					
	Considering the necessity of using new educational technologies, the scientific community expects me to use CCSs.					
	My university stakeholders, totally, expect me to use CCSs for storing/sharing information.					
	Infrastructural and technical barriers cannot inhibit me to use CCSs					
	Initial Eigenvalues	8.73	3.76	2.6	1.93	1.85
	Extraction sums of squares	25.99	10.47	6.59	4.64	4.36
	Percent of variance explained	27.29	11.76	8.14	6.03	5.79
	Cronbach α	.91	.89	.82	.78	.76
	ICC (95% CI)	.94	.91	.89	.94	.90
		(.91–.97)	(.89–.93)	(.86–.92)	(.92–.97)	(.88–.93)

Bold entries are the highest commonalities

Extraction Method: Principal Axis Factoring. Rotation Method: Oblimin with Kaiser Normalization; Factor1 = Attitude; Factor2 = Privacy/Security; Factor 3 = Perceived Behavioral Control; Factor 4 = Intention; Factor 5 = Subjective Norms

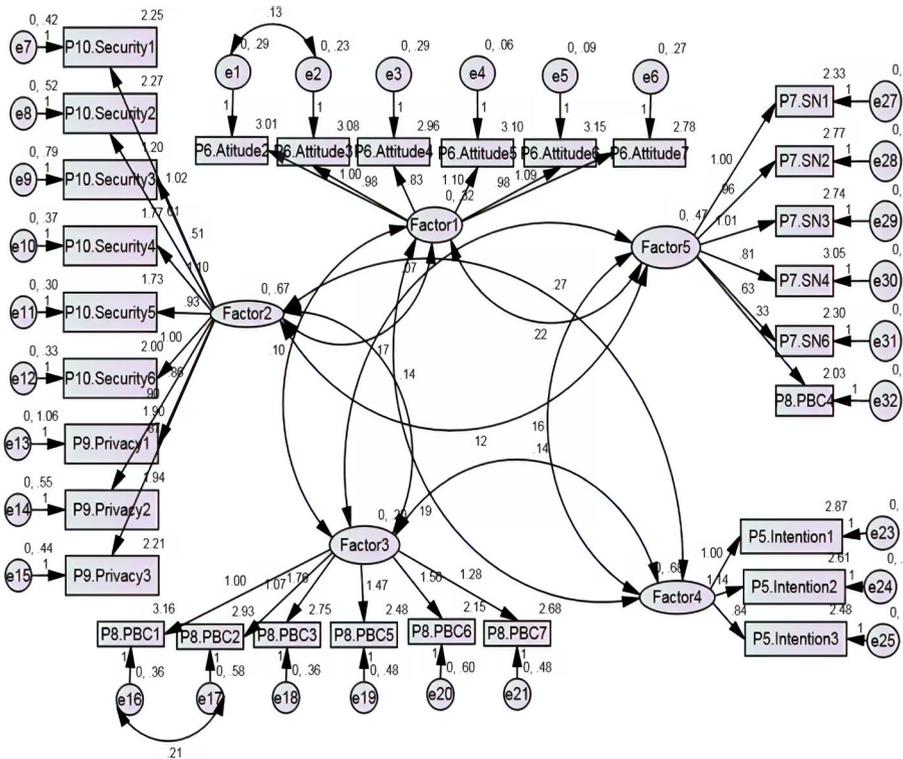


Fig. 3 CFA-based relations between the items and the factors and between the factors. All the relations between the factors and the items and between the factors were statistically significant (All $P < 0.05$). Factor1 = Attitude; Factor2 = Privacy/Security; Factor 3 = Perceived Behavioral Control; Factor4 = Intention; Factor 5 = Subjective Norms. Fit indices: χ^2 [393] = 710.178, $p < 0.001$, CFI = 0.916, NFI = 0.831, TLI = 0.907, RMSEA [90% CI] = 0.058[0.051-0.065]

valid and reliable instruments to assess CCSs use and its determinants in the literature. Such efforts to develop valid and reliable tools may be helpful in.

Our findings indicated the TPB-CCSQ as a valid and reliable instrument to investigate the cognitive factors related to CCSQ in educational and scientific settings. In order to confirm various sub-scales within the scale, and to assess the factor loadings at the level of whole scale, an initial comprehensive principal component analysis with

Table 3 Pearson correlation coefficients between with the factors and Intention among the participants ($n = 260$)

Structures	1	2	3	4	5
1.Attitude	1				
2. Privacy/Security	.369	1			
3.Percieved Behavioral Control	.408	.382	1		
4. Intention	.410	.404	.382	1	
5. subjective Norms	.567	.209	.228	.282	1

Correlation is significant at the 0.01 level (two-tailed)

satisfactory results was performed. Although the factor-confirmation process resulted in removal of five items, due to low communalities, from the scale, no essential content was removed from the scale. As recommended by DeVon et al. (Devon et al. 2007), we tried to keep the instrument as succinct as possible without need for supplementary content. The factor structure we found was so clear to define the determinants of CCSs use. The first two factors were, particularly so strong that explained together more than 39% of the total variance. Factor 1 refers to attitude toward using CCSs and factor 2 refers to perceived privacy/security in using CCSs. After removing the five items, the scale was shortened, which led us to an enhanced and reliable version of the TPB-CCSQ with five sub-scales and 30 items.

Perceived privacy and security are not formal constructs of TPB. Several previous studies, however, have suggested perceptions of privacy and security as important determinants for CCSs use (Hussein and Khalid 2016; González-Martínez et al. 2015). Therefore, we decided to extend the theory and incorporate, for the first time, these two concepts as two distinct determinants of CCSs use to provide a better coverage on the cognitive determinants of the behavior. After factor analysis, we found that the items of these two constructs were loaded on one factor (Factor 2). So, we named the factor as perceived security/privacy.

In reliability analysis, both internal consistency and test-retest reliability of the TPB-CCSQ were shown to be satisfactory. The Cronbach's α coefficient and ICCs for all factors were more than .75 and .88, respectively, which indicate the reliability of the instrument. In several previous studies (Moradzadeh et al. 2017; Nadrian et al. 2014; Toopchian et al. 2017; Yari et al. 2014) these two indices have been applied to confirm the reliability of instruments. Moreover, the simplicity and clarity of the instrument were ensured by the face and content validity conducted in the study. The relevancy of the items to the factors was also confirmed with CVI.

The results of our study showed a small difference between the total variance explained in six (63.2%) and five (59.2%) factors solutions. On the other hand, after declining the number of factors to five, the total variance explained by each factor was increased in all factors. In the five factor solution, we also found a clearer pattern of item loading. Therefore, it may be approved that the five factor solution was the best solution in the present study.

As Gorsuch (Gorsuch 1983) suggested, we presented the correlations between the factors in the present study, which may help future researchers in comparing their results with those of our study. Gorsuch interpreted the correlation between a factor and its associated factor scores like alpha which shows the stability of each factor.

The results of the study indicated no ceiling or floor effects for the TPB-CCSQ. Floor and ceiling effects are matter of concern when more than 15% of the study participants achieve the lowest and highest possible scores, respectively (Mchorney and Tarlov 1995). This finding confirms the feasibility of the instrument.

In the present study, the extracted factors altogether explained about 59% of total variance between the items, which may be considered as an evidence for applicability of TPB. In other words, TPB may be applied as a theoretical framework to determine the cognitive determinants of CCSs behavior in educational and academic fields.

4.1 Limitation

In order to estimate the participants' use of CCSs, we relied on the self-reported data, which may be considered as a limitation for the study. Also, a true picture of CCSs use

may not be reflected by respondents, as a result of social desirability for providing positive responses. All respondents in our study were from a particular setting—faculty members in an Iranian medical university. Therefore, further researches are suggested among different populations in different educational settings to confirm scale validity and reliability. We specifically developed the TPB-CCSQ for faculty members in medical universities. However, with some minor changes, the scale may be applied to assess cognitive determinants of CCSs use in different populations.

4.2 Conclusion

Our findings in the present study demonstrated validity, reliability, simplicity and functionality of the TPB-CCSQ. To the best of our knowledge, this tool is the only TPB-based scale developed to investigate the cognitive determinants of CCSs use in educational settings. We can therefore recommend this instrument to information technology researchers, community agencies and educational organizations delivering CCSs as a practical and useful tool to capture the cognitive determinants of CCSs among higher education faculty members. Such investigations may provide decision makers and stakeholders in educational settings with finest available information prior to designing interventional programs aiming at CCSs use promotion. Further studies in different educational settings are recommended to compare the dimensions of instrument in different communities.

Acknowledgements The authors acknowledge all participants collaborated in this study. This study was supported by TUOMS.

Compliance with ethical standards

Ethical approval The ethics committee of the Tabriz University of Medical Sciences reviewed and approved the study protocol (Ethics code: TBZMED.REC.1396.324). All the study participants were informed about the aim of the study and were assured of the privacy of the records. All participants signed a consent form.

Conflict of interest The authors declare that there is no conflict of interest.

References

- Abdekhoda, M., Ahmadi, M., Dehnad, A., & Hosseini, A. (2014). Information technology acceptance in health information management. *Methods of Information in Medicine*, 53, 14–20.
- Abdekhoda, M., Ahmadi, M., Dehnad, A., Noruzi, A., & Gohari, M. (2016). Applying electronic medical records in health care. *Applied clinical informatics*, 7, 341–354.
- Abdekhoda, M., & Salih, K. M. (2017). Determinant factors in applying picture archiving and communication systems (PACS) in healthcare. *Perspectives in Health Information Management*, 14.
- Aharony, N. (2015). An exploratory study on factors affecting the adoption of cloud computing by information professionals. *The Electronic Library*, 33, 308–323.
- Ajzen, I. (1991). *The theory of planned behavior: Organizational behavior and decision processes*. Massachusetts: Academic Press. Inc.

- Alharthi, A., Yahya, F., Walters, R. J. & Wills, G. (2015). An overview of cloud services adoption challenges in higher education institutions.
- Ali, M., Haidar, N., Ali, M. M., & Maryam, A. (2011a). Determinants of seat belt use among drivers in Sabzevar, Iran: A comparison of theory of planned behavior and health belief model. *Traffic Injury Prevention, 12*, 104–109.
- Ali, M., Saeed, M. M. S., Ali, M. M., & Haidar, N. (2011b). Determinants of helmet use behaviour among employed motorcycle riders in Yazd, Iran based on theory of planned behaviour. *Injury, 42*, 864–869.
- Aljenna, E., Al-Anzi, F., & Alshayji, M. (2011). Towards an efficient e-learning system based on cloud computing. In *Proceedings of the second Kuwait conference on e-services and e-systems* (p. 13). ACM.
- Alshamaila, Y., Papagiannidis, S., & Li, F. (2013). Cloud computing adoption by SMEs in the north east of England: A multi-perspective framework. *Journal of Enterprise Information Management, 26*, 250–275.
- Alshuwaier, F. A., Alshuwaier, A. A., & Areshey, A. M. (2012). Applications of cloud computing in education. Computing and networking technology (ICCNT). In *8th international conference on, 2012. IEEE* (pp. 26–33).
- Amoako-Gyampah, K., & Salam, A. F. (2004). An extension of the technology acceptance model in an ERP implementation environment. *Information & Management, 41*, 731–745.
- Babazadeh, T., Nadrian, H., Banayejeddi, M., & Rezapour, B. (2016). Determinants of skin cancer preventive behaviors among rural farmers in Iran: An application of protection motivation theory. *Journal of Cancer Education, 1*–9.
- Baek, J.-D. (2007). *The effect of individual, organizational, and health care system factors on Physicians' information technology use*. University of South Carolina.
- Bhattacharjee, A., & Park, S. C. (2014). Why end-users move to the cloud: A migration-theoretic analysis. *European Journal of Information Systems, 23*, 357–372.
- Botts, N., Thoms, B., Noamani, A., & Horan, T. A. (2010). *Cloud computing architectures for the underserved: Public health cyberinfrastructures through a network of healthatms*. 2010 43rd Hawaii international conference on system sciences (pp. 1–10). IEEE.
- Buyya, R., Broberg, J., & Goscinski, A. M. (2010). *Cloud computing: Principles and paradigms*. John Wiley & Sons.
- Carcary, M., Doherty, E., & Conway, G. (2014). The adoption of cloud computing by Irish SMEs—an exploratory study. *Electronic Journal of Information Systems Evaluation, 17*, 3.
- Chandra, D. G. & Borah, M. D. Cost benefit analysis of cloud computing in education. 2012 International Conference on Computing, Communication and Applications (ICCCA), 2012. IEEE, 1–6.
- Clarke, R. (2010). *Computing clouds on the horizon? Benefits and risks from the User's perspective*. *Bled eConference* (Vol. 2).
- Cox, J. (2017). *The world's most valuable brands revealed* [Online]. INDEPENDENT. Available: <https://www.independent.co.uk/news/business/news/worlds-most-valuable-brands-facebook-google-apple-amazon-a7556571.html>. Accessed 2017.
- Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1992). Extrinsic and intrinsic motivation to use computers in the workplace. *Journal of Applied Social Psychology, 22*, 1111–1132.
- Devon, H. A., Block, M. E., Moyle-Wright, P., Ernst, D. M., Hayden, S. J., Lazzara, D. J., Savoy, S. M., & Kostas-Polston, E. (2007). A psychometric toolbox for testing validity and reliability. *Journal of Nursing Scholarship, 39*, 155–164.
- Dignan, L. (2011). *Virtualization* [Online]. Available: <https://www.zdnet.com/article/cloud-computing-market-241-billion-in-2020/> [Accessed].
- Ding, Q., Li, X., Liu, Y. & Shi, Z. Research on remote collaborative engineering practices for Master of Software Engineering based on cloud computing environment. 2012 IEEE 25th conference on software engineering education and training (CSEE&T), 2012. IEEE, 110–114.
- El-Ala, N. A., & Awad, W. (2012). *Cloud computing for solving E-learning problems*. *Editorial Preface* (p. 3).
- Gangwar, H., Date, H., & Ramaswamy, R. (2015). Understanding determinants of cloud computing adoption using an integrated TAM-TOE model. *Journal of Enterprise Information Management, 28*, 107–130.
- Garrison, G., Rebman, J. R., M. C., & Kim, S. H. (2018). An identification of factors motivating individuals' use of cloud-based services. *Journal of Computer Information Systems, 58*, 19–29.
- Glanz, K., Rimer, B. K., & Viswanath, K. (2008). *Health behavior and health education: Theory, research, and practice*. John Wiley & Sons.
- Goldberg, D. P., R. G., Sartorius, N., Ustun, T. B., Piccinelli, M., Gureje, O., & Rutter, C. (1997). The validity of two versions of the GHQ in the WHO study of mental illness in general health care. *Psychological Medicine, 27*, 191–197.
- González-Martínez JA, B.-L. M., Gómez-Sánchez E, Cano-Parra R. 2015 Cloud computing and education: A state-of-the-art survey. *Computers & Education, 80*, 132–151.

- Gorsuch, R. 1983. Factor analysis.
- Hamzah, N. H., Mahmud, M., Zukri, S. M., Yaacob, W. F. W. & Yacob, J. The Awareness and Challenges of Cloud Computing Adoption on Tertiary Education in Malaysia. *Journal of Physics: Conference Series*, 2017. IOP Publishing, 012014.
- Hippold, S. 2018. *Gartner Forecasts Worldwide Public Cloud Revenue* [Online]. September 12, 2018. Available: <https://www.gartner.com/en/newsroom/press-releases/2018-09-12-gartner-forecasts-worldwide-public-cloud-revenue-to-grow-17-percent-in-2019> [Accessed].
- Hussein, N. H., & Khalid, A. (2016). A survey of cloud computing security challenges and solutions. *International Journal of Computer Science and Information Security*, 14, 52.
- Jiao, B., Wang, H., An, S., & Fang, H. (2011). Research on distance collaborative activities for teacher education based on online video and cloud computing environment. *6th International Conference on Computer Science & Education (ICCSE), 2011. IEEE*, 180–185.
- Kline, R. (2005). *Principles and practice of structural equation modeling*. New York: 2nd The Guilford Press.
- Kumari, M., & Nath, R. (2015). Security concerns and countermeasures in cloud computing paradigm. *Fifth International Conference on Advanced Computing & Communication Technologies (ACCT), 2015. IEEE*, 534–540.
- Lawshe, C. (1975). A qualitative approach to content. *Personnel Psychology*, 28, 63–575.
- Lease, D. R. 2005. Factors influencing the adoption of biometric security technologies by decision making information technology and security managers.
- Lin, A., & Chen, N.-C. (2012). Cloud computing as an innovation: Perception, attitude, and adoption. *International Journal of Information Management*, 32, 533–540.
- Lu, Y., Zhou, T., & Wang, B. (2009). Exploring Chinese users' acceptance of instant messaging using the theory of planned behavior, the technology acceptance model, and the flow theory. *Computers in Human Behavior*, 25, 29–39.
- Mchomey, C. A., & Tarlov, A. R. (1995). Individual-patient monitoring in clinical practice: Are available health status surveys adequate? *Quality of Life Research*, 4, 293–307.
- Mell, P., & Grance, T. (2009). *The NIST definition of cloud computing*. *National institute of standards and technology* (Vol. 53, p. 50).
- Menard, P., Gatlin, R., & Warkentin, M. (2014). Threat protection and convenience: Antecedents of cloud-based data backup. *Journal of Computer Information Systems*, 55, 83–91.
- Moradzadeh, R., N. M., Nadrian, H., Behrouzi, F., Keshavarz, T., & Golmohammadi, P. (2017). Validity and reliability of the Farsi version of the ECOS-16 questionnaire for females with osteoporosis. *Eastern Mediterranean Health Journal*, 23, 729–733.
- Nadrian, H., S. N., Taghdisi, M. H., & Shojaezadeh, D. (2014). Urban traffic-related determinants of health questionnaire (UTDHQ): An instrument developed for health impact assessments. *Medical Journal of the Islamic Republic of Iran*, 28, 84–95.
- Naveen Mishra, E. Z., PETR GORODETSKIY (GARTNER WEBINARS) 2017.
- Nunnally J. 1994. *Psychometric Theory*, New York., Mc Graw-Hill Inc.
- Orehovački, T., Etinger, D., & Babić, S. (2017). Perceived security and privacy of cloud computing applications used in educational ecosystem. *40th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), 2017. IEEE*, 717–722.
- Oye, N., Iahad, N., & Rahim, N. A. (2014). The history of UTAUT model and its impact on ICT acceptance and usage by academicians. *Education and Information Technologies*, 19, 251–270.
- Pourmajidi, W., Steinbacher, J., Erwin, T., & Miranskyy, A. (2017). On challenges of cloud monitoring. In *Proceedings of the 27th annual international conference on computer science and software engineering. IBM Corp* (pp. 259–265).
- Priyadarshinee, P., Raut, R. D., Jha, M. K., & Gardas, B. B. (2017). Understanding and predicting the determinants of cloud computing adoption: A two staged hybrid SEM-neural networks approach. *Computers in Human Behavior*, 76, 341–362.
- Pyzik, L. (2012). *Remote teaching and new testing method applied in higher education. Human-Computer Systems Interaction: Backgrounds and Applications 2*. Springer.
- Ratten, V. (2015). Factors influencing consumer purchase intention of cloud computing in the United States and Turkey: The role of performance expectancy, ethical awareness and consumer innovation. *EuroMed Journal of Business*, 10, 80–97.
- Safeena, R., Date, H., Hundewale, N., & Kammani, A. (2013). Combination of TAM and TPB in internet banking adoption. *International Journal of Computer Theory and Engineering*, 5, 146.
- Sahin, I. (2006). Detailed review of Rogers' diffusion of innovations theory and educational technology-related studies based on Rogers' theory. *TOJET: The Turkish Online. Journal of Educational Technology*, 5, 5.

- Shawish, A., & Salama, M. (2014). *Cloud computing: Paradigms and technologies. Inter-cooperative collective intelligence: Techniques and applications*. Springer.
- Shiau, W.-L., & Chau, P. Y. (2014a). To use a tree or a forest in behavioral intention. In *Proceedings of the 18th Pacific Asia conference on information systems (PACIS 2014)*. Association for Information Systems (AIS).
- Shiau, W.-L., & Chau, P. Y. (2014b). To use a tree or a Forest in behavioral intention. *PACIS*, 248.
- Shiau, W.-L., & Chau, P. Y. (2016). Understanding behavioral intention to use a cloud computing classroom: A multiple model comparison approach. *Information & Management*, 53, 355–365.
- Shih, Y.-Y., & Fang, K. (2004). The use of a decomposed theory of planned behavior to study internet banking in Taiwan. *Internet Research*, 14, 213–223.
- Shroff, R. H., & Keyes, C. J. (2017). A proposed framework to understand the intrinsic motivation factors on university students' behavioral intention to use a mobile application for learning. *Journal of Information Technology Education: Research*, 16, 143–168.
- Sultan, N. (2010). Cloud computing for education: A new dawn? *International Journal of Information Management*, 30, 109–116.
- Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research*, 6, 144–176.
- Thomas, P. (2011). Cloud computing: A potential paradigm for practising the scholarship of teaching and learning. *The Electronic Library*, 29, 214–224.
- Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Personal computing: Toward a conceptual model of utilization. *MIS Quarterly*, 15, 125–143.
- Toopchian, A., S, K., Babazadeh, T., Allahverdipour, H., & Nadrian, H. (2017). *Development and psychometric properties of a condom use and its cognitive determinants questionnaire (CUCDQ)*. *Open access Macedonian journal of medical sciences*, 15 (p. 79).
- Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, 46, 186–204.
- Wang, L., Von Laszewski, G., Younge, A., He, X., Kunze, M., Tao, J., & Fu, C. (2010). Cloud computing: A perspective study. *New Generation Computing*, 28, 137–146.
- Winston, T. G. (2015). *An empirical investigation of privacy and security concerns on doctors' and nurses' behavioral intentions to use RFID in hospitals*. Nova Southeastern University.
- Yari, A., H, N., Rashidian, H., Nedjat, S., Esmailnasab, N., Doroudi, R., & Hoursan, H. (2014). Psychometric properties of the Persian version of social capital questionnaire in Iran. *Medical Journal of the Islamic Republic of Iran*, 28, 17–27.

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Affiliations

Zoleixa Asadi¹ · Mohammadhiwa Abdekhoda^{2,3} · Haidar Nadrian⁴

¹ Department of Medical Library and Information Sciences, School of Health Management and Medical Informatics, Tabriz University of Medical Sciences, Tabriz, Iran

² Department of Medical Library and Information Sciences, School of Health Management and Medical Informatics, Tabriz University of Medical Sciences, Tabriz, Iran

³ Iranian Center of Excellence in Health Management (IceHM), School of Management and Medical Informatics, Tabriz University of Medical Sciences, Tabriz, Iran

⁴ Department of Health Education & Promotion, Faculty of Health Sciences, Tabriz University of Medical Sciences, Tabriz, Iran