TO USE A TREE OR A FOREST IN BEHAVIORAL INTENTION

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Abstract

Cloud computing is a new technology that has been applied to education and has enabled the development of cloud computing classrooms; however, student behavioral intentions toward cloud computing remain unclear. Most researchers have evaluated, integrated, or compared few (1 to 3) theories to examine user behavioral intentions and few have addressed additional theories or models. In this study, we test, compare, and unify six well-known theories, namely, service quality (SQ), self-efficacy (SE), the motivational model (MM), technology acceptance model (TAM), theory of reason action (TRA)/theory of planned behavior (TPB), and innovation diffusion theory (IDT) in the context of cloud computing classrooms. This empirical study was conducted using an online survey. The data collected from the samples (n=478) were analyzed using structural equation modeling. We independently analyzed each of the six theories, formulating a united model. The analysis yielded three valuable findings. First, comparing the explained variance and degree of freedom (df) difference, yielded the following ranking in explained variance: MM=TAM>IDT>TPB>SE=SQ (equal =; superior to>). Second, comparing the explained variance yielded the following ranking in explained variance: MM>TAM>IDT>TPB>SE=SQ. Third, based on the united model of six theories, some factors significantly affect behavioral intention and others do not. The implications of this study are critical for both researchers and practitioners.

Keywords: behavioral intention, theory of planned behavior (TPB), technology acceptance model (TAM), self-efficacy (SE), service quality (SQ), innovation diffusion theory (IDT)

1 INTRODUCTION

As the Internet develops, cloud computing is becoming increasingly popular, giving users access to software, storage resources, and data access services, and facilitating computation. Well-known companies, such as IBM, Microsoft, Oracle, and Google, provide cloud solutions and applications to customers throughout the world. Users connect to the cloud by using the Internet and can access resources without knowing the details of the computing infrastructure. Increasingly more people are using cloud-based services; thus, cloud computing becomes a popular issue. A Gartner report predicted that worldwide, $677 billion will be spent on cloud services from 2013 to 2016 (van der Meulen & Rivera 2013). Similarly, Forrester forecasted that the global cloud computing market will grow from $40.7 billion in 2011 to more than $241 billion in 2020. The public cloud market is expected to grow from $25.5 billion in 2011 to $159.3 billion in 2020 (Dignan 2011). Moreover, the U.S. Federal Government is expected to demonstrate a compound annual growth rate of approximately 16% in 2013–2018 in the cloud-computing market, reaching the $10 billion landmark by 2018 (Market Research Media 2009). Data from the leading information technology (IT) research firms and U.S. government has indicated that cloud computing is a critical topic throughout the world.

Providing cloud-based IT services can reduce organizational IT costs and eliminate the expense and difficulty of locally installing and maintaining applications (Leavitt 2009). Firms and universities have been driven to adopt cloud computing based on economic factors and the need to streamline and conveniently deliver IT services (Erdogmus 2009; Hicks 2009; Leavitt 2009; Marston et al. 2011; Sultan 2010). Although adopting cloud computing can bean effective measure, it does not guarantee benefits to an organization; cloud services usage can yield advantages to firms or universities. Theorists have attempted to explain and predict use of individual behaviors, determining that behavioral intention is the dominant factor in the use of information systems. People who exhibit a strong behavioral intention exhibit a correspondingly high level of use. Consequently, numerous studies have attempted to explain and predict behavioral intention (Bhattacherjee & Hikmet 2007; Chau & Hu 2002; Premkumar & Bhattacherjee 2008; Shiau & Chau 2012). However, these studies have typically applied only one to three theories to explain behavioral intention (Chau & Hu 2002; Shiau & Chau 2012; Yi et al. 2006). This method is limited, and is similar to looking through a tube to observe and describe the sky. Similarly, in the nineteenth century, the poet John Godfrey Saxe (2013) wrote the poem Elephant and the Blind Men, in which six blind men try to describe an elephant that they can feel, but not see. They conclude that the elephant is like a wall, spear, snake, tree, fan, or rope, depending on where they touch and engage in a heated debate that fails to yield the truth. Only by aggregating their descriptions can a comprehensive picture be formed: the elephant. In this study, the elephant is "behavioral intention" and the "blind people" are the researchers attempting to empirically determine and explain behavioral intentions by using a limited approach.

A well known unified view of user's intentions to use an information system and consequent usage behavior is Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003). Venkatesh et al. (2003) reviewed and integrated constructs from following eight theories and models: theory of reasoned action (TRA), technology acceptance model (TAM), motivational model (MM), theory of planned behavior (TPB), a combined theory of planned behavior/ technology acceptance model (C-TPB-TAM), model of PC utilization (MPCU), innovation diffusion theory (IDT), and social cognitive theory (SCT). In the context of cloud computing classroom, cloud computing service is a focal point and cloud computing efficacy is a critical factor in the initially learning stage. Contrast to UTAUT, we provide an alternative view to look into users' intention, especially in cloud computing service by service quality (SQ) theory and cloud computing efficacy by self-efficacy (SE) theory. The aim of this study is to review and integrate a unified view by many well known theories, namely, TRA/TPB, the TAM, MM, SE, SQ, and IDT. This paper not only examines the effects of individual theory and unified model on college students' intentions to use cloud computing classroom, but also uses a multiple model-comparison approach to empirically verify and facilitate in examining college students' intentions to use cloud computing classroom. The following research questions are addressed: (a) which theories (models) most effectively elucidate behavioral intention in a cloud computing classroom? and (b) what are the critical factors of a unified model determining behavioral intention toward classroom-based cloud computing? The evaluated theories are compared and unified to elucidate behavioral intention. The remainder of the paper is structured as follows: Section 2 introduces the literature review; Section 3 details the research model and hypotheses; Section 4 presents the research methodology; Section 5 presents the data analysis and results; Section 6 provides a discussion, implications, and limitations; and Section 7 offers a conclusion.

2 LITERATURE REVIEW

2.1 Cloud computing

Cloud computing has emerged as a new computational method and service that evolved from distributed, grid, and utility-based computing. Relevant applications, such as Gmail, Facebook, Twitter, YouTube, and Google Apps are proliferating (Armbrust et al. 2010), and increasingly more people use cloud computing services. Thus, cloud computing is a popular topic and global trend; this vital technology comprises three types of service (i.e., SaaS, PaaS, and IaaS), providing diverse services for customers (Armbrust et al. 2010; Marston et al. 2011; Shiau & Hsiao 2013). The potential advantages of adopting cloud computing include reduced costs (Leavitt 2009; Marston et al. 2011; Sultan 2010), expected switching benefits (Park & Ryoo 2013), omnipresent services (Erdogmus 2009; Park & Ryoo 2013), collaborative support (Park & Ryoo 2013), the access to infinite computing resources on demand (Armbrust et al. 2010; Marston et al. 2011), simplified operation, and increased use because of resource virtualization (Armbrust et al. 2010; Marston et al. 2011). Despite these advantages, the barriers to adopting cloud computing include expected switching costs (Hicks 2009; Park & Ryoo 2013), satisfaction with existing IT (Park & Ryoo 2013), and data confidentiality and auditability (Armbrust et al. 2010). In summary, cloud computing yields both opportunities and challenges to users and organizations. Certain challenges are technical and can be currently solved or will be solved in the near future. Human factors cause additional challenges, but understanding these factors may enable users and organizations to achieve their goals. Thus, we identify the critical factors affecting the intentions of college student to use classroom-based cloud computing.

2.2 Prior model comparisons

Numerous studies have empirically evaluated well-known theories, comparing two or more models. For example, Chau and Hu (2002) investigated the acceptance of telemedicine technology among physicians, comparing the TAM, TPB, and an integrated model. Regarding the variance in intention, the results indicated that the TAM, TPB, and integrated model explained 42%, 37%, and 43% of the variance, respectively. Luo et al. (2011) compared the MM, and uses and gratifications (U&G) theory to evaluate web-based information system adoption. They used a partial least squares (PLS) analysis to test each theoretical model in an empirical setting, demonstrating that the MM, U&G theory, and integrated model explained 17.3%, 36.7%, 43% of the variance in behavioral use, respectively. The unified theory of acceptance and use of technology (UTAUT) is another theory widely used to explain behavioral intention and technology acceptance. Venkatesh et al. (2003) developed the UTAUT to compare eight prominent theories, extending previous concepts to form a new research model that addressed facilitating conditions, performance expectancy, effort expectancy, social influence, behavioral intention, and user behaviors. The moderating variables included gender, age, experience, voluntariness, and use. Venkatesh et al. compared eight prominent theories to predict the intention to use technology in a voluntary setting. The models explained the following amount of variance in intention: TRA = 30%, TAM/TAM2 =38%, MM =37%, TPB/DTPB =37%, combined TAM and TPB

(C_TAM_TPB) =39%, model of PC utilization (MPCU) =37%, IDT =38%, social cognitive theory (SCT)=37%, and UTAUT=40% (Venkatesh et al. 2003, pp. 440, 462). Table 1 lists a summary of previous theoretical model comparisons.

Literature	Theory	Participants	Finding
Davis et al. (1989)	TRA and TAM	107 students	The variance in intention explained by TRA was 32% and TAM was 47%.
Mathieson (1991)	TAM and TPB	262 students	The variance in intention explained by TAM was 70% and TPB was 62%.
Taylor and Todd (1995)	TAM and TPB(DTPB)	786 students	The variance in intention explained by TAM was 52%, and DTPB was 60%.
Plouffe et al. (2001)	TAM and IDT	176 merchants	The variance in intention explained by TAM was 33% and IDT was 45%.
Chau and Hu (2001)	TAM, TPB, and DTPB	408 professionals	The variance in intention explained by TAM was 40%, TPB was 32%, and DTPB was 42%.
Chau and Hu (2002)	TAM and TPB	408 professionals	The variance in intention explained by TAM was 42%, TPB was 37%, and integrated model was 43%.
Premkumar and Bhattacherjee (2008)	TAM and EDT	175 students	The variance in intention explained by TAM was 69%, EDT was 50%, and integrated model was 73%.
Shiau and Chau (2012)	TAM and ECT	361 Blog Users	The variance in intention explained by TAM was 11%, ECT-IS was 46%, and integrated model was 47%.
Sun et al. (2013)	TAM,TPB, and PMT	204 customers	The variance in intention explained by TAM was 32.6%, and TPB was 32.77%, and PMT was 38.8%.

Table 1. Theoretical model comparisons

3 RESEARCH MODEL AND HYPOTHESES

A cloud computing system was recently established at a university in Northern Taiwan comprising more than 18,000 students. During the initial stage of establishing cloud computing classrooms, the university moved certain functions of computer laboratories to the university cloud to offer a ubiquitous learning environment. Students can use the cloud in school or outside the university wherever they have access to an Internet connection. The university plans to offer this technology to most students. The TRA/TPB and TAM are suitable theories to explain student behavior. To attract students to use cloud-based resources, student motivations should be considered. MM theory can be used to represent students' motives. Cloud computing enables providing students with access to software and product services; thus, students must be able use these resources and computer and cloud SE play critical roles in their behavior. SQ and cloud services are also critical factors in the use of cloud computing classrooms. Thus, SE and SQ are suitable theories for explaining student behaviors. Cloud computing is an innovative technology that can be used to construct online classrooms and facilitate student learning. The IDT is an appropriate theory for investigating student behaviors in the context of an innovative cloud computing classroom; thus, we focused on well-known theories regarding the factors that influence behavioral intentions (i.e., the TRA/TPB, TAM, MM, SE, SQ, and IDT models; Figure 1).

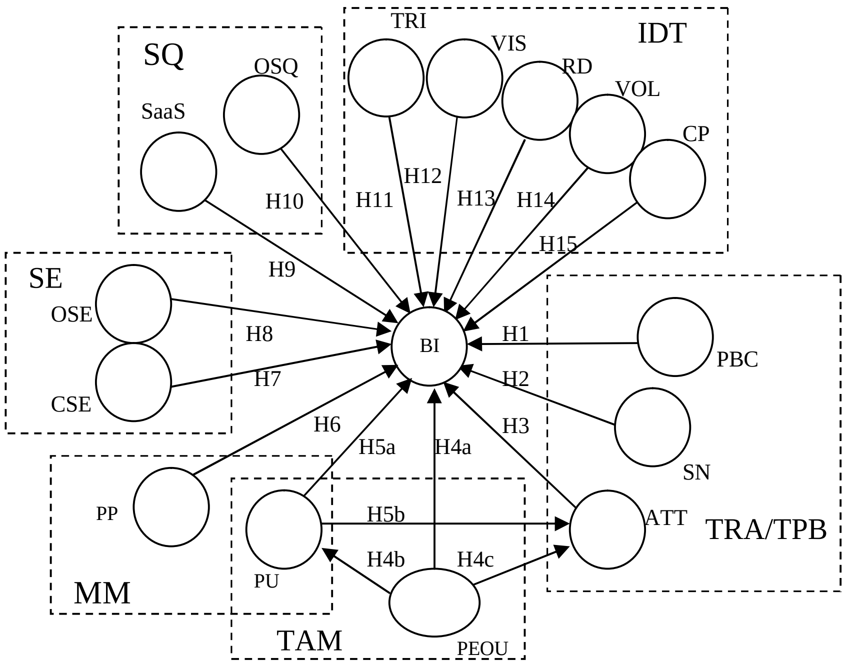
Perceived behavioral control was added to the TRA (Fishbein & Ajzen 1975) to develop the TPB (Ajzen 1988).Studies have validated and supported the relations among the TRA and TPB constructs. For example, attitudes and subjective norms (i.e., the TRA) significantly influence intentions (Ajzen

1991; Armitage & Conner 2001; Sheeran & Taylor 1997) and perceived behavioral control is a critical factor determining behavioral intention (Ajzen 1991; Armitage & Conner 2001; Conner & Armitage 1998; Jackson et al. 2013; Leng et al. 2011; Sheeran & Taylor 1997). Based on the TPB and cloud computing classroom, we hypothesize the following:

H1: Perceived behavioral control is positively associated with the behavioral intention to study in a cloud computing classroom.

H2: Subjective norms are positively associated with the intention to study in a cloud computing classroom.

H3: Attitude is positively associated with the intention to study in a cloud computing classroom.



ATT: Attitude; CP: Compatibility; CSE: Computer self-efficacy; BI: Behavioral Intention; OSE: Cloud self-efficacy; OSQ: Cloud Service quality; PBC: Perceived behavior control; PEOU: Perceived ease of use; PP: Perceived playfulness; PU: Perceived usefulness; RD: Result demonstration; SN: Subjective norm; SaaS: Software as a Service; TRI: Triability; VIS: Visibility; VOL: Voluntariness.

Figure 1. A united model of behavioral intention

Based on the TRA, Davis (1986) proposed using the TAM to study computer acceptance behaviors. The TAM yields strong predictions and explanations for diverse IS, including computer applications, enterprise resource planning, digital libraries, and e-shopping systems (Davis 1989; Ha & Stoel 2009; Mathieson 1991; Park et al. 2009; Shiau & Chau 2012; Sun et al. 2013; Uzoka et al. 2008). The TAM consists of perceived ease of use (PEOU), perceived usefulness (PU), attitude (ATT), behavioral intention to use (BI), and AU. According to the TAM, we hypothesize the following:

H4a: PEOU is positively associated with the behavioral intention to study in a cloud computing classroom.

H4b: PEOU is positively associated with the PU of studying in a cloud computing classroom.

H4c: PEOU is positively associated with the attitude toward studying in a cloud computing classroom.

H5a: PU is positively associated with the behavioral intention to study in a cloud computing classroom.

H5b: PU is positively associated with the attitude toward studying in a cloud computing classroom.

The MM involves using intrinsic or extrinsic motives to explain human behaviors. Numerous researchers have posited that behavioral intention can be both extrinsically and intrinsically motivated (Lee et al. 2005; Moon & Kim 2001; Venkatesh et al. 2002). From an extrinsic motivational perspective, behavioral intention is driven by perceived values and benefits. PU explains the utility value of using a system and is a key driver of use behavior and intention (e.g., H5a: PU is positively associated with the intention to study in a cloud computing classroom). From an intrinsic motivational perspective, behaviors are performed based on feelings of fun, happiness, and pleasure. We hypothesize the following:

H6: Enjoyment is positively associated with the behavioral intention to use a cloud computing classroom.

According to the SCT (Bandura 1986), SE is a person's belief in his or her ability to attain certain levels of performance. Because of the rapid development of IT, SE was extended to computer self-efficacy (CSE), which is a person's judgment of their ability to use a computer (Compeau & Higgins 1995). In the context of cloud computing classrooms, CSE is used to assess student confidence when using software skills to complete a task. Moreover, specific application SE (i.e., cloud efficacy) refers to the ability to use cloud-based applications. In general, people who consider themselves competent computer users are likely to use computers applications (Oliver and Shapiro 1993). Thus, we hypothesize the following:

H7: High levels of general CSE positively affect the behavioral intention to use a cloud computing classroom.

H8: High levels of cloud efficacy positively affect the behavioral intention to use a cloud computing classroom.

Customers form service expectations based on their past experiences, word of mouth, and advertisements; SQ is used to assess and compare the perceived service and expected service. The importance of SQ has been stressed in the IS field because of the increasing number and type of services delivered using websites, (Cenfetelli et al. 2008; Kettinger et al. 2009; Xu et al. 2013). In the context of a cloud computing classroom, SQ is assessed based on the overall evaluations and judgments of students regarding both the excellence of the cloud service quality (OSQ) and the on-demand SaaS.Thus, we hypothesize the following:

H9: High levels of SaaS positively affect the behavioral intention to use a cloud computing classroom.

H10: High levels of OSQ positively affect the behavioral intention to use a cloud computing classroom.

Rogers (1995; 2003) defined the IDT as the process by which an innovation is communicated through certain channels over time among the members of a social system. In the framework of Rogers (2003), IDT involves five characteristics of innovation: relative advantage, compatibility, complexity, triability, and observability. The relative advantage and complexity constructs in the IDT have been considered similar to the PU and PEOU constructs in the TAM, respectively (Chen et al. 2002). Observability is measured using visible innovations; however, visibility was directly measured in this study. According to Moore and Benbasat (1991), result demonstrability and voluntariness affect perceptions regarding the adoption of an IT innovation. Furthermore, Venkatesh et al. (2003) regarded triability, visibility, result demonstrability, voluntariness, and compatibility as vital factors affecting behavioral intention. Cloud computing is a new technology and cloud computing classrooms are new learning environments; therefore, these IDT innovation characteristics are suitable for evaluating the behavioral intentions of students toward using innovations in a cloud-computing classroom. Thus, we hypothesize the following:

H11: Triability positively affects the behavioral intention to use a cloud computing classroom.

H12: Visibility positively affects the behavioral intention to use a cloud computing classroom.

H13: Result demonstrability positively affects the behavioral intention to use a c loud computing classroom.

H14: Voluntariness positively affects the behavioral intention to use a cloud computing classroom.

H15: Compatibility positively affects the behavioral intention to use a cloud computing classroom.

4 RESEARCH METHODOLOGY

Structural equation modeling (SEM) comprises covariance-based SEM (CB-SEM) and component-based SEM (i.e., PLS-SEM). Numerous studies, including Chin and Newsted (1999), Gefen et al. (2011), and Hair et al. (2011, 2012), have compared using both approaches. PLS-SEM is suitable for use with the complex model in this study (uniting six theories and 16 constructs). CB -SEM is suitable for evaluating individual theoretical models and comparing the six theoretical models. Thus, both CB-SEM and PLS-SEM were used to support the research objective, clarifying behavioral intention by comparing and unifying six well-known theories. SPSS software, version 19.0 was used to measure the descriptive statistics. SmartPLS version 2.0 M3 (PLS -SEM) was used to estimate an overall model unifying the six theories. LISREL version 8.8 (CB -SEM) was used to estimate each theoretical model and to compare and rank the six theories.

4.1 Participants

The research models were tested using data collected from the users of a cloud computing classroom. To compare and unify 6 theoretical models, a field study was conducted, evaluating a medium-size university, which established the first cloud computing classrooms in Taiwan. A two-part online survey was used to test the proposed theoretical models. The first part consisted of questions measuring 16 constructs in the research models and the second part captured demographic data regarding the participants, who were assured that their personal information would remain confidential. Of the 488 completed web survey questionnaires, 10 exhibited incomplete data, yielding478 valid responses for use in the data analysis.

Because certain students did not respond to the survey, non response bias might be a concern. Armstrong and Overton (1977) suggested that late respondents are more likely to resemble non respondents compared with early respondents. After comparing the genders and ages of early and late respondents, the *t* test indicated no significant differences ($p > .05$) in gender or age. Thus, we excluded the possibility of non response bias. In addition, because all data were collected from a single source at the same time, common method variance might be a concern (Podsakoff et al. 2003). We assessed the data set using Harman's one-factor test to identify any potential common method bias (Podsakoff & Organ1986). No general factor accounted for more than 50% of variance, suggesting that common method bias was not a concern.

4.2 Measurement Development

Six theories were measured and 16 constructs were adapted from previous studies. Each construct is operationalized as a reflective model. Attitude represents how willing or unwilling a person is to use a cloud computing classroom (Fishbein & Ajzen 1975). Subjective norms are operationalized as a person's perception that most of the people who are valuable to him or her think that he or she should or should not use the cloud computing classroom (Fishbein & Ajzen 1975). A behavioral intention refers to the subjective probability that a person will use a cloud computing classroom (Fishbein & Ajzen 1975). Perceived behavioral control refers to perceived ease or difficulty of using a cloud computing classroom (Ajzen 1991). PU is defined as the subjective perception of a user that using the cloud computing classroom will yield enhanced academic achievement (Davis et al. 1989). PEOU refers to the degree to which the user expects using the cloud computing classroom to be free of effort (Davis et al. 1989). Compatibility is defined as the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of users regarding cloud computing classrooms (Moore & Benbasat 1991). Voluntariness refers to the degree to which using the cloud computing classroom is perceived as voluntary (Moore & Benbasat 1991). Result demonstrability is defined as the tangibility of the results of using the cloud computing classroom (Moore & Benbasat 1991). Visibility refers to the degree to which a person observes others using the cloud computing classroom (Moore & Benbasat 1991). Triability refers to the degree to which users can try or practice using the cloud computing classroom (Moore & Benbasat 1991). Perceived playfulness is the strength of the belief that interacting with the cloud computing classroom will fulfill various intrinsic motives (Moon & Kim 2001). Cloud SQ (OSQ) refers to an overall service evaluation of cloud computing classroom (Bitner & Hubbert 1994; Zeithaml 2000). SaaS refers to the degree to which the key functionalities of the software used in the cloud computing classroom meet the requirements of college students (Benlian et al. 2011- 2012). Cloud SE (OSE) refers to personal self-confidence in the ability to use a cloud computing classroom (Taylor & Todd 1995). CSE refers to the personal judgment regarding the ability use multiple computer application domains (Compeau & Higgins 1995; Marakas et al. 2007). The measurement items were adapted from related studies and slightly modified to suit the context of a cloud computing classroom. The scale items were scored on a 5-point Likert scale that ranged from 1 (*strongly disagree*) to 5 (*strongly agree*). The primary survey was conducted after determining the content validity of the questionnaire. Appendix A shows a su mmary of the measurement items.

5 RESULTS

5.1 Demographic Profiles

Descriptive statistics indicated that of the participants, 51% were men (N=244), 49% were women (N=234), 68% were 18–22 years old, 30.4% were 21–23 years old, and 1% were 24–26 years old. The participants demonstrated the following amount of experience using cloud computing classrooms: 1–2 months (45%), 2–5 months (21.8%), 5–6 months (6.3%), 6–7 months (3.7%), or greater than 7 months (23.2%). The amount of time spent using cloud computing classrooms was less than 30 minutes (38.3%), 30 minutes to 1 hour (33.9%) 1–2 hours (18.4%), 2–3 hours (6.1%), or more than 3 hours (3.3%).

5.2 Measurement Model

A measurement model was used to assess the reliability and validity of the study. Fornell and Larcker (1981) suggested evaluating measurement scales as follows: (a) all indicator factor loadings should be significant and exceed 0.5; (b) construct reliabilities should exceed 0.8; and (c) the average variance extracted (AVE) by each construct should exceed the amount of variance caused by measurement error (AVE >0.5). The results indicated that all indicator loadings exceeded 0.5 (range: 0.61–0.94); all construct reliabilities exceeded 0.8 (range: 0.88–0.95); and all AVEs exceeded 0.50 (range: 0.7–0.86), indicating satisfactory convergent validity. The discriminate validity was calculated based on the square root of the AVE for each construct exceeding the correlation between others (Chin 1998). The results listed in Table 2 show that all criteria were met, indicating that the proposed models demonstrate satisfactory reliability and validity.

	ATT	CP	CSE	BI	OSE	OSQ	PBC	PEOU	PP	PU	RD	SN	SaaS	TRI	VIS	VOL
ATT	0.93															

CP	0.50	0.91														
CSE	0.37	0.39	0.90													
BI	0.58	0.60	0.30	0.87												
OSE	0.59	0.55	0.47	0.60	0.88											
OSQ	0.47	0.58	0.42	0.54	0.51	0.93										
PBC	0.47	0.54	0.42	0.60	0.57	0.40	0.89									
PEOU	0.60	0.62	0.43	0.64	0.63	0.53	0.69	0.93								
PP	0.41	0.59	0.41	0.50	0.49	0.69	0.41	0.47	0.91							
PU	0.60	0.66	0.40	0.67	0.62	0.55	0.59	0.75	0.50	0.88						
RD	0.50	0.63	0.41	0.64	0.66	0.53	0.60	0.62	0.56	0.65	0.91					
SN	0.53	0.59	0.36	0.54	0.43	0.47	0.48	0.49	0.50	0.50	0.45	0.84				
SaaS	0.52	0.57	0.55	0.52	0.59	0.62	0.53	0.55	0.60	0.59	0.61	0.47	0.87			
TRI	0.47	0.62	0.45	0.55	0.59	0.64	0.51	0.56	0.67	0.60	0.58	0.53	0.66	0.87		
VIS	0.32	0.51	0.37	0.51	0.49	0.44	0.49	0.48	0.56	0.44	0.56	0.53	0.50	0.55	0.91	
VOL	0.52	0.59	0.42	0.57	0.65	0.48	0.56	0.63	0.47	0.63	0.64	0.46	0.55	0.56	0.48	0.84

ATT: Attitude; CP: Compatibility; CSE: Computer self-efficacy; BI: Behavioral Intention; OSE: Cloud self-efficacy; OSQ: Cloud Service quality; PBC: Perceived behavior control; PEOU: Perceived ease of use; PP: Perceived playfulness; PU: Perceived usefulness; RD: Result demonstration; SN: Subjective norm; SaaS: Software as a Service; TRI: Triability; VIS: Visibility; VOL: Voluntariness.

Table 2. Discriminate validity of research model

5.3 Results of the Structural Model

Regarding the results of the six individual theories, each theory explained the following percentage of the variance in behavioral intention: TPB = 62% (R^2=0.62; degrees of freedom [df] =59), TAM =66% (R^2=0.66;df =24),MM =69% (R^2= 0.69; df =24),SE =48% (R^2= 0.48; df =32),SQ =48% (R^2= 0.48; df =32), and IDT =66% (R^2= 0.66; df =155).The unified model of six theories (Table 3)explained 61.8% (R^2= 61.8) of the variance in behavioral intention.

	Dependent variable: behavioral intention			Dependent variables: Attitude	
Independent variables	R2	Beta	Independent variables	R2	(Beta)
PBC	0.618	0.150**	PEOU	0.416	0.352***
SN		0.089	PU		0.338***
ATT		0.142**		Dependent variable: Perceived Usefulness	
PEOU		0.035	Independent variables	R2	(Beta)
PV		0.206***	PEOU	0.560	0.748***
PP		-0.011			
CSE		-0.144***			
OSE		0.084			
SaaS		0.132**			
OSQ		-0.002			
TRI		-0.002			
VIS		0.105*			

RD		0.141**	
VOL		0.027	
CP		0.032	

ATT: Attitude; CP: Compatibility; CSE: Computer self-efficacy; BI: Behavioral Intention; OSE: Cloud self-efficacy; OSQ: Cloud Service quality; PBC: Perceived behavior control; PEOU: Perceived ease of use; PP: Perceived playfulness; PU: Perceived usefulness; RD: Result demonstration; SN: Subjective norm; SaaS: Software as a Service; TRI: Triability; VIS: Visibility; VOL: Voluntariness.

Table 3. Results of the unified model

6 DISCUSSION, IMPLICATIONS, AND LIMITATIONS

6.1 Discussion

In this study, six theories related to behavioral intention were adapted to develop a unified model that explains behavioral intentions toward using cloud computing classrooms. The study yielded three primary findings. First, all six theoretical models (MM, TAM, IDT, TPB, SE, and SQ) demonstrated strong explanatory power regarding the behavioral intention to use cloud computing classrooms (R^2 = 0.48–0.69), indicating that these theories are suitable for elucidating behaviors in cloud computing classrooms. Second, comparing the explained variance (R^2) values indicated the following: MM (R^2= 0.69)>TAM (R^2=0.66) >IDT (R^2= 0.66)>TPB (R^2=0.62) >SE=SQ(R^2= 0.48). Comparing the F value with the R^2 and df values yielded similar results: MM=TAM>IDT>TPB> SE=SQ. Specifically, MM and TAM, which focus on motivation, yielded the strongest explanatory power, indicating that the motives are most determining factors of behavioral intention to use cloud computing classrooms. Consequently, innovative characteristics of IDT have good explanation powers. The TPB, which focuses on self-control and opinion-based concerns, also effectively explains behavior in a cloud computing classroom. SE and SQ, which focus on individual ability and service concerns, demonstrated less explanatory power than did the other models. Third, the unified model effectively explained behavior in the cloud computing classroom (R^2= 0.618) with more comprehensive viewpoints than individual models. Based on the unified six-theory model, the following factors significantly and positively affected behavioral intention: PU>ATT>OSQ>PBC>RD>VIS>OSE. The following factors do not significantly affect behavioral intention: PEOU, PP, SaaS, TRI, VOL, CP, and SN. From a comprehensive point of view, the PEOU, PP, SaaS, VOL, CP, and SN factors were less valuable compared with the significant factors. Furthermore, CSE significantly and negatively affected behavioral intention. This may be because in a cloud computing classroom, the functional software typically used on a personal computer is moved to the cloud; thus, students who were highly skilled using computers could already complete their tasks, and because of their high CSE levels, the cloud was not an attractive alternative. Thus, college students with high CSE levels are reluctant to use the software and services associated with a cloud computing classroom.

6.2 Implications

The current findings yield various implications valuable to academic research in the user behavior domain. Theoretically, these results confirm that the six theories (MM, TAM, IDT, TPB, SE, and SQ) used to explore behavioral intentions toward cloud computing classrooms demonstrate adequate individual explanatory power. Based on these results, future research on user behavior in cloud computing classrooms can focus on developing context-specific antecedents to the established constructs in this unified model. In practice, cloud computing generates both opportunities for and challenges to people and organizations. Using a unified model may enable practitioners to concomitantly elucidate the factors affecting the behavioral intentions of users. Our results indicate that when establishing cloud computing classrooms, managers should focus on the factors that significantly affect (PU, ATT, OSQ, PBC, RD, VIS, and OSE) the behavioral intentions of users toward such classrooms; if the classroom is not used, it cannot benefit the organization. Understanding and leveraging the advantages of cloud computing classrooms may yield superior elaborating levels to practitioners.

6.3 Limitations and future research

Although the six individual theoretical models and unified model adequately explainedthe behavioral intention to use cloud computing classrooms, our findings should be interpreted based on various limitations. Fist the empirical data were collected at a university. Additional data, such as commercial or industrial data, may require further verification. Second, each of the six individual theoretical models adequately explained cloud computing. Future studies should investigate the antecedents and consequences of these models based on the characteristics of cloud computing. Third, unifying six well-known theories (TPB, TAM, MM, SE, SQ, and IDT) may not sufficiently elucidate the cloud computing classroom, and future studies should consider additional theories associated with behavior in cloud-based classrooms. Researchers should also focus on parsimonious and comprehensive points of view based on specific contexts and/or distinct research objectives.

7 CONCLUSION

The advancement of Internet and computational evolution has driven the emergence of cloud computing services. In higher education, colleges and universities provide cloud computing systems as a novel service to attract students. Thus, understanding the behavioral intentions of students toward cloud computing classrooms is vital. Data were collected from a medium size university. Both covariance-based SEM (LISREL) and component-based SEM (PLS) were used to test the empirical data. The six individual theoretical models and unified model demonstrated adequate explanatory power regarding the behavioral intention to use a cloud computing classroom. However, each theoretical model exhibits distinct features that could make it superior based on the context and research objective. The unified model provides a comprehensive view of the factors affecting the behavioral intention to use cloud computing classrooms. We clarified this behavioral intention by comparing and unifying six well-known theories (TRA/TPB, TAM, MM, SE, SQ, and IDT) in the context of a cloud computing classroom. The results of this study elucidate the critical factors affecting behavioral intentions toward cloud computing classrooms and serve as a valuable reference to mangers when planning, evaluating, and executing systems to provide classroom-based cloud computing.

Appendix

Construct	Measurement items	Adapted from
Perceived Behavioral Control	PBC1. I would be able to handle the cloud computing classroom.	Taylor and Todd (1995)
	PBC2. Using the cloud computing classroom is entirely within my control.	
	PBC3. I have resources, knowledge, and the ability to make use of the cloud computing classroom.	
Subjective Norms	SN1. People who influence my behavior would think that I should use the cloud computing classroom.	Taylor and Todd (1995)
	SN2. People who are important to me would think that I should use the cloud computing classroom.	
	SN3. My classmates would think that I should use the cloud computing classroom.	
	SN4. My professors would think that I should use the cloud computing classroom.	

Attitude	ATT1.Using the cloud computing classroom is a good idea. ATT2. Using the cloud computing classroom is a wise idea. ATT3. I like the idea of using the cloud computing classroom.	Taylor and Todd (1995)
Perceived Ease of Use	PEOU1. Instructions for using applications in the cloud computing classroom will not be hard to follow. PEOU2. It will be difficult to learn how to use the cloud computing classroom. PEOU3. It will be easy to operate the applications in the cloud computing classroom.	Taylor and Todd (1995)
Perceived Usefulness	PU1. Using the cloud computing classroom will improve my grades. PU2. The advantages of the cloud computing classroom will outwe igh the disadvantages. PU3. Overall, using the cloud computing classroom will be advantageous.	Taylor and Todd (1995)
Perceived Playfulness	PP1. When interacting with cloud computing classroom, I do not realize the time elapsed PP2. When interacting with cloud computing classroom, I am not aware of any noise. PP3. Using cloud computing classroom gives enjoyment to me for my task.	Moon and Kim (2001)
Computer Self-Efficacy	CSE1. I believe I have the ability to install new software applications on a computer. CSE2. I believe I have the ability to identify and correct common operational problems with a computer. CSE3. I believe I have the ability to unpack and set up a new computer.	Marakas et al. (2007)
Cloud Self-Efficacy	OSE1. I believe I have the ability to do tasks in cloud computing classroom if there was no one around to tell me what to do. OSE2. I believe I have the ability to finish tasks in cloud computing classroom if I had only the software manuals for reference OSE 3. I believe I have the ability to finish tasks in cloud computing classroom if I had seen someone else using it before trying it myself. OSE4. I believe I have the ability to finish tasks in cloud computing classroom if I could not call someone for help as I got stuck.	Compeau and Higgins (1995)
SaaS	SaaS1 There is data reporting and extracting features in cloud computing classroom. SaaS2. There is application's configuration (e.g., user administration, etc.) features in cloud computing classroom. SaaS3. There are application's help funct ionalities in cloud computing classroom. SaaS4. There are application's core features to support process steps/activities in cloud computing classroom.	Benlian et al. (2011-12)
Cloud Service Quality	OSQ1. The quality of services of cloud computing classroom is excellent OSQ2. The quality of services of cloud computing classroom is superior OSQ3. The quality of services of cloud computing classroom is high standards	Oh (2000)
Triability	TRI1. I've had a great deal of opportunity to try various cloud computing classroom applications. TRI2. I know where I can go to satisfactorily try out various uses of the cloud computing classroom. TRI3. The cloud computing classroom was available to me to adequately test run various applications. TRI4. Before deciding whether to use any cloud computing classroom applications, I was able to properly try them out.	Moore and Benbasat (1991)

Visibility	VIS1. I have seen what others do using their cl oud computing classroom.	Moore and Benbasat (1991)
	VIS2. In my school, one sees cloud computing classroom on many desks.	
	VIS3. I have seen a cloud computing classroom in use outside my school.	
	VIS4. It is easy for me to observe others using cloud c omputing classroom in my school.	
Result Demonstrability	RD1. I would have no difficulty telling others about the results of using a cloud computing classroom	Moore and Benbasat (1991)
	RD2. I believe I could communicate to others the consequences of usi ng the cloud computing classroom.	
	RD3. The results of using the cloud computing classroom are apparent to me.	
Voluntariness	VOL1. My professors do not expect me to use a cloud computing classroom.	Moore and Benbasat (1991)
	VOL2.My use of a cloud computing classroom is voluntary.	
	VOL3.My professors do not require me to use a cloud computing classroom.	
Compatibility	CP1. Using a cloud computing classroom is completely compatible with my current situation	Moore and Benbasat (1991)
	CP2. I think that using a cloud computing classroom fits well with the way like to study.	
	CP3. Using a cloud computing classroom fits into my study.	
Behavioral Intention	BI1. I intend to use the cloud computing classroom to print projects, papers or assignments this term.	Taylor and Todd (1995)
	BI2. I intend to use the cloud computing classroom frequently this term.	
	BI3. I will recommend cloud computing classroom to others.	Lu et al. (2009)

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