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The Web-based Learning System Adoption by Computer and Information Technology Instructors in Thai Universities

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Abstract

The objectives of this research were to develop and to examine an integrated model for Web-based Learning system (WBLS) adoption by Computer and Information Technology (CIT) instructors in Thai universities. To achieve these objectives, the integrated model of this research was developed by incorporating four existing models and theories (i.e. Technology Acceptance Model, Delone & McLean IS success model, Diffusion of Innovations theory, and theory of planned behavior). The survey data were collected from 295 CIT instructors in Thai universities, and, then, were analyzed by using the structural equation modeling in order to verify the proposed model. The results showed that the proposed model was consistent with the empirical data, and accounted for 81.10% of variance in WBLS adoption. The results, moreover, showed that factors affecting the WBLS adoption of CIT instructors in Thai universities, sorted in descending order by their total effect sizes, were intention to use, system quality, information quality, perceived usefulness, perceived ease of use, compatibility, service quality, and computer self-efficacy.

Keywords: Integrated Model; WBLS Adoption; Web-based Learning System; SEM

1. Introduction

During the past few decades, Web-based Learning Systems (WBLSs) have been widely used in several institutions. They were used not only to support the teaching-learning processes, but also to increase flexibility and to create good image of performing that processes. However, according to the preliminary survey, the rate of WBLS continuous use was slowly increased [1]. The problem of WBLS use that the institutions are currently facing is the instructors have dropped out of the use. The main causes of this failure are the difficulty of system accessibility; especially outside the campus, the insufficient internet bandwidth, and the shortage of related hardware and software [2 – 4]. Additionally, although the users of WBLS are categorized into 2 groups (i.e. instructors and students), the users who play the most important role in the WBLS adoption are instructors. If the instructors decide to use the WBLS for supporting or conducting their class activities, the students have to accept and use it [5 – 7]. Therefore, identifying and understanding the factors affecting the WBLS adoption by CIT instructors, who extensively used the WBLS, are useful for the institutions which plan to use the WBLS or to increase the continuous use rate of the WBLS.

2. Materials and Methods

Literature Review

While the WBLSs have been widely used in many educational institutions, several researches used Technology Acceptance Model (TAM) as the foundation to examine factors affecting the adoption of them. Since TAM provided a trace of impact of external variables on internal beliefs, attitude, and intention to use technology by the users [8], there are several researches extended TAM by incorporating various external variables depend on target group of users, technology, and context. These TAM's extensions increase capability and effectiveness of multidimensional examination of factors affecting the WBLS adoption.

The study of Chen and Tseng [9] examined factors influencing the WBLS adoption by the junior high school teachers in Taiwan. This study used TAM as the foundation of the research framework and, then, combined psychological factors (i.e., motivation to use, computer anxiety, an internet self-efficacy) as the external variables which affect the internal beliefs (i.e., perceived usefulness, and perceived ease of use) of the users. The research findings indicated that motivation to use and internet self-efficacy had positive indirect effects to the users' intention to use the WBLS, while, the computer anxiety had negative indirect effect to the intention of WBLS use.

To investigate the adoption of WBLS from IS perspectives, the study of Motaghian, Hassanzadeh, and Moghadam [10] integrated TAM with IS-oriented factors (i.e., information quality, system quality, and technical service quality). Moreover, in order to make a clearer understanding in the psychological dimension with TAM, the psychological factors (i.e., subjective norm, and computer self-efficacy) were incorporated with the proposed research model. The results of this study revealed that the IS-oriented factors and the psychological factors significantly influenced the perception of usefulness and ease of use of the Iranian technical instructors. Finally, these perceptions send the effect to WBLS use.

While the study of Chen and Tseng [9] and the study of Motaghian, Hassanzadeh, and Moghadam [10] focused on investigating factors affecting the WBLS adoption by instructors, the study of Sanchez and Hueros [11] examined factors influencing student satisfaction of WBLS. The technical support and computer self-efficacy were used as the external variables of TAM. The research findings showed that technical support had the significant direct effect on perceived ease of use and perceived usefulness of the students.

In addition, in 2009, Intharaksa [12] used the qualitative study to examine the use and adoption of WBLS by Thai faculty members through the diffusion of innovation theory. The results revealed that the 4 attributes of innovation, which are relative advantage, compatibility, trialability, and observability, accelerated the WBLS adoption. However, complexity decelerated the system adoption by faculty members.

Based on the reviews above, several studies used TAM as a theoretical foundation of the research and integrated it with IS-oriented factors and psychological factors in order to make a clearer understanding in WBLS adoption from IS and psychological perspectives. However, these studies did not investigate the WBLS adoption from the perspective of innovation characteristics. Therefore, to enrich the investigation of factors affecting the WBLS adoption by CIT instructors in Thai universities, the previously studied variables were selected and integrated to TAM, a foundation of research framework, in order to develop the research model.

Research Model

In order to develop the research model, 4 existing models and theories were integrated. The brief details are as follows:

Technology Acceptance Model (TAM)

The aim of TAM is to explain the computer (or information system) acceptance of the broad range of users [8]. TAM proposed 2 major beliefs (i.e. "Perceived Usefulness (PU)" and "Perceived Ease of

Use (PEOU)") which influence the "Attitude toward Using" and "Behavioral Intention to Use" of users to a specific computing system. These 2 beliefs, as the first-level internal beliefs, are impacted by the external variables consecutively. Based on the reviewed literatures, several researches proved that PEOU had the direct effect on PU [9 – 11]. While, both PEOU [9 – 11] and PU [9 – 11, 13] had the direct effects on "Intention to Use (IU)", which finally affected toward the System Use (SU) of the users. These findings lead to the relationships among perceived ease of use (PEOU), perceived usefulness (PU), intention to use (IU), and system use (SU) shown in research model through *H15 – H18* (Fig. 1).

Delone & McLean IS Success Model

Delone and McLean information system success model, a model used for measuring the success or failure of the information system [14], was integrated to the research model. This integration enables TAM to explain the relationship between an information system and internal beliefs of the users, which finally affects the system adoption. The previous researches proved that the quality of technical support, the quality of information provided by the system, and the quality of system were the important factors affecting the system adoption of the users [10, 13]. These factors played an important role in the system adoption by sending the effects through PU, PEOU, and IU. Therefore, the characteristics of information system, (i.e. information quality (IQ), system quality (SQ), and service quality (SeQ)) were integrated, *H1 – H7*, to serve as the external variables of the research model (Fig. 1).

Diffusion of Innovations (DOI) Theory

The DOI theory defined diffusion as *"the process by which an innovation is communicated through the certain channels over time among the members of social system"* [15]. By focusing on the innovation itself, there are 5 individual-perceived characteristics of innovations related to the adoption rate. These characteristics are relative advantage, compatibility, complexity, trialability, and observability. By considering the definition of innovation characteristics, relative advantage and complexity similarly reflect the individual perception in usefulness and ease of use of technology stated in TAM [16 – 17]. Therefore, only 3 characteristics of innovation defined by DOI (i.e. observability (OBS), trialbility (TRI), and compatibility (COM)) were integrated to the research model (Fig. 1). The relationships among these innovation characteristics and intention to use (IU) were examined through *H8 – H10*.

The Theory of Planned Behavior (TPB)

TPB, a well known psychological theory, stated that the human's intention to perform a specific behavior can be predicted by "attitude toward the behavior", "subjective norms", and "self-efficacy" in performing a specific task. This theory was supported by a number of research studies which showed that the "computer self-efficacy (CSE)" affected the intention to use [10, 13] and the perceived ease of use of the users [9, 10, 13, 18]. Moreover, the "subjective norm (SN)" influenced the intention to use [10, 13, 19, 20] and the perceived usefulness of system use [10, 13, 19]. Therefore, to determine the relationships among social factors and the human's behavioral intention, subjective norm (SN) and computer self-efficacy (CSE) were integrated to the research model, *H11 –H14* (Fig. 1).

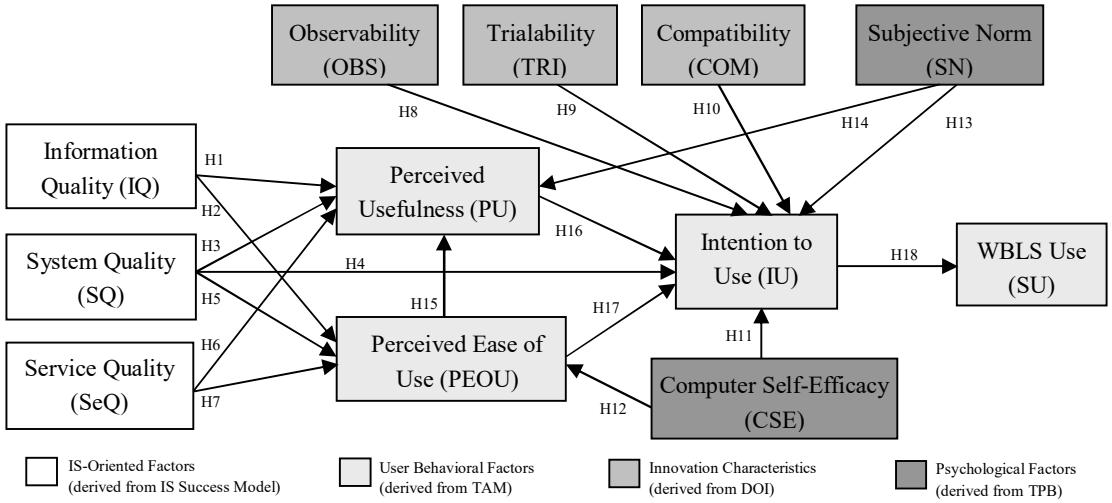

Fig. 1 The research model

The variables shown in the research model (Fig. 1) are categorized into 4 groups:

IS-oriented Factors: Information Quality (IQ), System Quality (SQ), and Service Quality (SeQ) were derived from Delone & McLean IS success model. These variables acted as the external variables to explain the relationship between WBLS and internal beliefs of the users (i.e., Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and Intention to Use (IU)). They enable the investigation of WBLS adoption by CIT instructors from IS perspectives.

User Behavioral Factors: Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Intention to Use (IU), and WBLS Use (SU) were derived from TAM, a foundation of the research framework. These variables would be impacted by the external variables, and, then, finally affect the system adoption.

Innovation Characteristics: Observability (OBS), Trialbility (TRI), and Compatibility (COM) were derived from DOI theory. These external variables were used to explain the relationship between innovation characteristics and behavioural intention to use WBLS of the CIT instructors.

Psychological Factors: Subjective Norm (SN) and Computer Self-Efficacy are the external variables were derived from TPB. These external variables were used to explain the relationships among social factors, internal beliefs, and behavioural intention to use WBLS of the CIT instructors.

Research instruments

The developed questionnaire, a research instrument, consists of 62 items relevant to 12 factors shown in the research model. The items were rated on a 7-point Likert scale, ranging from strongly disagree (1) to strongly agree (7). The questionnaire was validated by 5 domain experts from the fields of computer and education. Later on, the validated questionnaire was pilot-tested by 50 CIT instructors, who are not the target respondents of the research. The gathered questionnaires were analyzed by using the Cronbach's alpha coefficient analysis. The results reported that the Cronbach's alpha coefficient of every factor is above 0.7 while the overall Cronbach's alpha coefficient is 0.991. Therefore, it can be inferred that all items are highly reliable [21].

Data collection

The total population consisted of 1,169 CIT instructors from 43 Thai universities, which provide the computer and IT programs to students. According to the Cochran's sample size formula [22], the calculated sample size was 289. During the early stage of multistage sampling technique, 43 universities were classified into 3 categories (i.e. autonomous university, public university, and

private university). And, then, the simple random sampling was used to select the universities from each category. Lastly, self-administered survey questionnaires were randomly sent to 628 CIT instructors through air-mail. After gathering the questionnaires, 295 CIT instructors from 24 universities (47%) responded.

3. Results

The gathered questionnaires were analyzed by SPSS 17.0 and LISREL 8.8. The results are as follows:

Demographics and descriptive statistics

Table 1 presents that the majority of the respondents were male (57.05%) and were between 31 to 40 years old (54.90%). Most of the respondents had the master degree (60.48%). Furthermore, 35.56% of the respondents had teaching experience from 11 to 20 years. The 69.12% of the respondents had used the WBLS to support their teaching activities for 5 years or less. Only 26.67% of the respondents had 6 to 10 years of teaching experience with WBLSs. In addition, the average score on capability of computer use was 8.21, indicating that the respondents strongly believed in their capability of using and controlling computers.

Table 1 Demographic statistics of the respondents.

		Frequency	Percentage
Gender			
Male		166	57.05
Female		125	42.96
	Total	291	100.00
Age (by years)			
30 and below		25	8.74
31 - 40		157	54.90
41 - 50		81	28.32
Above 50		23	8.04
	Total	286	100.00
Degree of Education			
Bachelor		9	3.09
Master		176	60.48
Ph.D.		106	36.43
	Total	291	100.00
Teaching Experience (by years)			
5 and below		76	28.15
6 - 10		80	29.63
11 - 20		96	35.56
Above 20		18	6.67
	Total	270	100.00
Teaching Experience with WBLSs (by years)			
5 and below		197	69.12
6 - 10		76	26.67
above 10		12	4.21
	Total	285	100.00
Average Score on Capability of Computer Use (self evaluation, Total = 10): ***8.21***			

In Table 2, the results illustrated that the respondents had positive perceptions on WBLS use. All means, except the mean of intention to use (IU), were in range of 4.46 to 5.30, which means "somewhat agree". The highest mean belongs to intention to use (IU). This can be concluded that CIT instructors intended to use the WBLS to support their teaching activities.

Table 2 The degree of agreement of factors in research model.

Factor	Mean	S.D.	Degree of Agreement
IS-Oriented Factors			
IQ	5.127	1.046	Somewhat agree
SQ	5.197	0.949	Somewhat agree
SeQ	4.778	1.215	Somewhat agree
Psychological Factors			
CSE	5.299	0.947	Somewhat agree
SN	5.268	1.210	Somewhat agree
Innovation Characteristics			
OBS	5.266	1.020	Somewhat agree
TRI	4.876	1.182	Somewhat agree
COM	5.145	1.188	Somewhat agree
User Behavioral Factors			
PEOU	5.081	1.055	Somewhat agree
PU	5.213	1.106	Somewhat agree
IU	*5.459*	1.207	*Agree*
SU	5.231	1.259	Somewhat agree

Correlation coefficient and multicollinearity analysis

The sampling adequacy, correlations, and multicollinearity among factors in the research model were examined. In Table 3, the 66 correlations, which indicated the strength of association among 12 factors in research model, ranged from 0.423 to 0.824 and had a statistical significance level at 0.01. The significant degree of correlation among all factors existed (Bartlett's Test of Sphericity: $\chi^2 = 2994.944$, df = 66, p-value = 0.000). In addition, the KMO index (0.949) showed that the survey samples were adequately selected.

By considering the tolerance and VIF values of each factor, tolerance values were higher than 0.19 and VIF values were lower than 5.30. Therefore, the degree of multicollinearity among 12 factors was not too high to decrease the predictive ability of the research model [23].

Table 3 Correlation matrix and multicollinearity analysis.

Factors	IQ	SQ	SeQ	CSE	SN	OBS	TRI	COM	PEOU	PU	IU	SU
IQ	1.000											
SQ	0.723**	1.000										
SeQ	0.548**	0.532**	1.000									
CSE	0.608**	0.559**	0.438**	1.000								
SN	0.631**	0.631**	0.628**	0.544**	1.000							
OBS	0.641**	0.631**	0.467**	0.695**	0.680**	1.000						
TRI	0.507**	0.509**	0.486**	0.520**	0.540**	0.607**	1.000					
COM	0.677**	0.682**	0.502**	0.605**	0.722**	0.727**	0.640**	1.000				
PEOU	0.626**	0.687**	0.537**	0.691**	0.675**	0.751**	0.613**	0.772**	1.000			
PU	0.670**	0.675**	0.449**	0.624**	0.701**	0.746**	0.599**	0.824**	0.780**	1.000		
IU	0.654**	0.636**	0.483**	0.561**	0.716**	0.677**	0.552**	0.785**	0.713**	0.810**	1.000	
SU	0.524**	0.591**	0.423**	0.508**	0.622**	0.645**	0.529**	0.642**	0.710**	0.726**	0.737**	1.000
Bartlett's Test of Sphericity: $\chi^2 = 2994.944$, df = 66, p-value = 0.000, Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) = 0.949												
Tolerance	0.356	0.367	0.514	0.427	0.325	0.301	0.514	0.224	0.254	0.208	0.275	-
VIF	2.813	2.723	1.947	2.340	3.081	3.328	1.947	4.463	3.935	4.810	3.632	-

** $p < 0.01$

Results of model examination

The results of the full model examination showed that 7 relationships (i.e., SQ → IU, OBS → IU, TRI → IU, CSE → IU, SN → IU, SN → PU, and PEOU→PU) were statistically insignificant. Therefore, H4, H8, H9, H11, H13, H14, and H15 were rejected from the full research model. The research model, then, was minimized into the form of parsimonious model (Fig. 2) and, re-examined by the LISREL. The results of path analysis were shown in Table 4 and Fig. 2.

Table 4 The results of path analysis (parsimonious model).

Cause Variables	Effect Variables											
	PEOU			PU			IU			SU		
	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE
IQ	0.472 *** (0.058)	-	0.472 *** (0.058)	0.732 *** (0.059)	-	0.732 *** (0.059)	-	0.419 *** (0.063)	0.419 *** (0.063)	-	0.377 *** (0.060)	0.377 *** (0.060)
SQ	0.582 *** (0.057)	-	0.582 *** (0.057)	0.734 *** (0.066)	-	0.734 *** (0.066)	-	0.454 *** (0.072)	0.454 *** (0.072)	-	0.409 *** (0.068)	0.409 *** (0.068)
SeQ	-0.103 (0.054)	-	-0.103 (0.054)	-0.339 *** (0.068)	-	-0.339 *** (0.068)	-	-0.157 *** (0.046)	-0.157 *** (0.046)	-	-0.142 *** (0.044)	-0.142 *** (0.044)
CSE	0.184 *** (0.054)	-	0.184 *** (0.054)	-	-	-	-	0.058 ** (0.025)	0.058 ** (0.025)	-	0.053 ** (0.023)	0.053 ** (0.023)
COM	-	-	-	-	-	-	0.236 *** (0.067)	-	0.236 *** (0.067)	-	0.212 *** (0.065)	0.212 *** (0.065)
PEOU	-	-	-	-	-	-	0.317 *** (0.082)	-	0.317 *** (0.082)	-	0.286 *** (0.074)	0.286 *** (0.074)
PU	-	-	-	-	-	-	0.367 *** (0.066)	-	0.367 *** (0.066)	-	0.331 *** (0.064)	0.331 *** (0.064)
IU	-	-	-	-	-	-	-	-	-	0.901 *** (0.051)	-	0.901 *** (0.051)

χ^2 = 5.921, **df** = 9, **p-value** = 0.748, **RMSEA** = 0.000, **RMR** = 0.011, **SRMR** = 0.009, **GFI** = 0.996, **AGFI** = 0.978, **CFI** = 1.000

R^2	PEOU	PU	IU	SU
	0.766	0.836	0.730	0.811

** p < 0.01, *** p < 0.001, Value in ( ) is "Standard Error", DE = Direct Effect, IE = Indirect Effect, TE = Total Effect

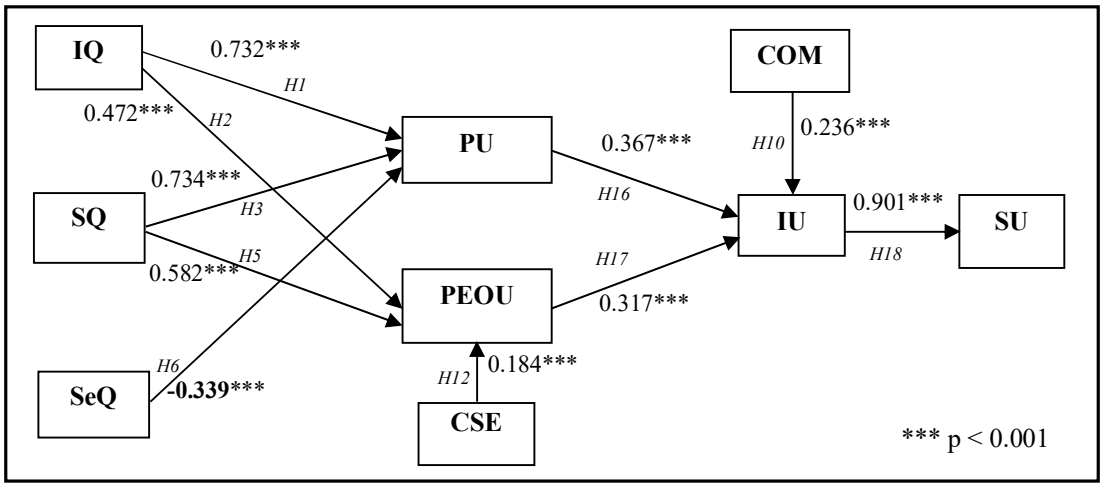

Fig. 2 The parsimonious model of WBLS adoption by CIT instructors in Thai Universities.

As shown in Table 4, the parsimonious model was consistent with the empirical data (χ^2 = 5.921, df = 9, p-value = 0.748). The goodness of fit indices (i.e., RMSEA, RMR, SRMR, GFI, AGFI, CFI) indicated that the model was an appropriate structural model and had a good fit with the empirical data. All goodness of fit indices fell into the acceptable range [24]. The R^2 value of PEOU, PU, IU

and SU were 76%, 83.6%, 73%, and 81.10% consecutively. These values indicated that the model had strong predictive ability in the WBLS adoption by CIT instructors. In general, all variables influenced the system use accounted for 81.10% of variance in WBLS adoption.

By considering the causal relationships among 9 factors shown in Table 4 and Fig. 2, 10 direct-effect relationships had the statistical significance level at 0.001. The hypotheses H1, H2, H3, H5, H6, H10, H12, H16, H117, and H18 were supported while H7 (SeQ → PEOU), H4 (SQ → IU), and H11 (CSE → IU) were not. However, the system quality (SQ) had indirect effect on intention to use (IU) through perceived usefulness (PU) and perceived ease of use (PEOU). At the same time, the computer self-efficacy (CSE) had indirect effect on intention to use (IU) through perceived ease of use (PEOU).

According to the effect directions, the service quality (SeQ) was the only one factor which had the negative direct effect on the perceived usefulness (PU). Finally, perceived usefulness (PU) and intention to use (IU) acted as the mediators between service quality (SeQ) and WBLS use (SU). The total effect sizes of all factors, which influenced the WBLS adoption of CIT instructors in Thai universities, were presented in Table 5.

Table 5 Factors affecting the WBLS adoption of CIT instructors in Thai universities.

Factors Affecting WBLS Adoption	Total Effect Size	Types of Effect		Directions of Effect		Mediators
		Direct	Indirect	Positive	Negative	
IU	0.901	✓		✓		-
SQ	0.409		✓	✓		PEOU, PU, IU
IQ	0.377		✓	✓		PEOU, PU, IU
PU	0.331		✓	✓		IU
PEOU	0.286		✓	✓		IU
COM	0.212		✓	✓		IU
SeQ	0.142		✓		✓	PU, IU
CSE	0.053		✓	✓		PEOU, IU

4. Discussion

The research findings indicated that perceived usefulness (PU) and perceived ease of use (PEOU) influenced the WBLS adoption by CIT instructors through intention to use (IU). These findings were consistent with previous studies [9, 10, 12]. However, perceived usefulness (PU) was not affected by perceived ease of use (PEOU). The relationship between these two factors was different from the findings of Chen and Tseng [9], and the findings of Fathema, Shannon, and Ross [25], which concluded that perceived ease of use (PEOU) influenced perceived usefulness (PU) of WBLS by the instructors. The different fields of instructors may potentially cause this difference. While this research focused only on gathering data from the CIT instructors, as the technical users, the previous researches studied and gathered data from the instructors of various fields. According to the average score on capability of computer use shown in Table 1, the CIT instructors, as the technical and skilful users, strongly believed in their capabilities of using and controlling computers. This group of users believed that the difficulty of system use cannot disrupt them from system use. Moreover, the subject norm (SN) has no effect on their system uses.

By focusing on the effect directions of the service quality (SeQ), the service quality had the negative indirect effect on the WBLS use (SU). The explanation for this situation is that CIT instructors were the skilful users, who have high confidence in using and controlling computer, and use high criteria in measuring the quality of technical supports. According to the results, they believed

that the quality of technical support was important to the system adoption of the users. However, at the present, the technical services and supports offered by the office in charge failed to satisfy the CIT instructors. This finding urges the technical supporters to develop their technical skills and improve the service quality in order to retain the WBLS use and to increase the continuous use rate. According to a previous study [26], the system quality and the service quality of the LMS played a significant role in the e-learning environment.

5. Conclusions

By integrating four existing models and theories (i.e. TAM, D&M IS success model, DOI theory, and TPB), the results of research model examination showed that the factors affecting WBLS adoption by CIT instructors in Thai universities, sorted in descending order by their total effect sizes, were intention to use (IU), system quality (SQ), information quality (IQ), perceived usefulness (PU), perceived ease of use (PEOU), compatibility (COM), service quality (SeQ), and computer self-efficacy (CSE). An interesting issue found in this research is that "service quality (SeQ)" is the only one factor which had a negative effect on system use (SU). The given result indicated that the technical supports offered by the office in charge (e.g. computer centre) did not currently satisfy the CIT instructors. The research findings can be used as the guideline on managing the ways in which the WBLS is used to support teaching-learning activities as well as establishing strategies for promoting the WBLS adoption by CIT instructors, as the skilful and experienced users, in Thai universities. The established strategies may increase not only the WBLS use, but also the system continuous use rate.

6. Suggestions

Since the focus of this research is the WBLS adoption by CIT instructors in Thai universities, the proposed research model should be used to apply with the instructors of the other fields. The different groups of user may lead to the different factors influencing the WBLS adoption. These findings may provide the precise guidelines to the policy makers in order to establish strategies for promoting the WBLS use or increasing the WBLS continuous use. Furthermore, the research framework may be adjusted by combining the level of adoption (e.g. organizational adoption, individual adoption) to the research model. This combination may draw the clearer relationships among the IS-oriented factors, the user behavioural factors, the innovation characteristics, and the psychological factors which lead to the WBLS use and continuous use.

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