SYSTEM CHARACTERISTICS, SATISFACTION AND E-LEARNING USAGE: A STRUCTURAL EQUATION MODEL (SEM) [1]

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ABSTRACT
With the advent of the Internet, more and more public universities in Malaysia are putting in effort to introduce e-learning in their respective universities. Using a structured questionnaire derived from the literature, data was collected from 250 undergraduate students from a public university in Penang, Malaysia. Data was analyzed using AMOS version 16. The results of the structural equation model indicated that service quality ($\beta = 0.20$, $p < 0.01$), information quality ($\beta = 0.37$, $p < 0.01$) and system quality ($\beta = 0.20$, $p < 0.01$) were positively related to user satisfaction explaining a total of 45% variance. The second regression analysis was to examine the impact of user satisfaction on continuance intention. The results showed that satisfaction ($\beta = 0.31$, $p < 0.01$), system quality ($\beta = 0.18$, $p < 0.01$) and service quality ($\beta = 0.30$, $p < 0.01$) were positively related to continuance intention explaining 44% of the variance. Implications from these findings to e-learning system developers and implementers were further elaborated.
Keywords: information quality, system quality, service quality, user satisfaction, continuous usage, e-learning, structural equation model

1.0 INTRODUCTION

Electronic learning (e-learning) is well documented in the IT literature as according to Roca et al. (2006), it has increasingly provided "an entirely new environment and experience of learning that goes well beyond the classrooms, curricula and text-based formats". E-learning generally involves delivery of course content using the electronic media, such as Internet, Intranets, Extranets, satellite broadcast, audio/video tape, interactive TV, and CD-ROM (Urdan & Weggen, 2000). Khan (2001) describes e-learning as synonymous with web-based learning (WBL), Internet-based training (IBT), advanced distributed learning (ADL), web-based instruction (WBI), online learning (OL) and open/flexible learning (OFL). Ramayah et al. (2010) noted that in Malaysian institutions of higher learning, measures of successful e-learning implementation are users' satisfaction and continuance of usage of the facility for research and teaching and learning purposes.

Wang et al. (2007) argued that it is difficult to capture the full dimensions of the e-learning system success in an organization because many combinations of individual, managerial and organizational measures can be adopted. Furthermore, an examination of successful e-learning systems in the IS context is difficult because different players or stakeholders view differently the benefits of the systems (DeLone & McLean, 2003). This study is from the perspective of students using the e-learning system which is basically web-based in nature and since it is also a communication and information system (IS) phenomenon (Wang et al., 2007), the authors contend that it is appropriate to examine its successful implementation by using the extended DeLone and McLean's (2003) IS Success Model. It has been suggested that "despite the multidimensional and contingent nature of IS success, an attempt should be made to reduce significantly the number of measures used to measure IS success, so that research results can be compared and findings validated" (DeLone & McLean, 2003). This study hence, implements a simplified model of DeLone and McLean's (2003) extended model to examine via structural equation modeling (SEM), the role of quality (service quality, information quality and system quality) in influencing user satisfaction and continuing usage of an e-learning system in a Malaysian public university.

2.0 THEORETICAL BACKGROUND AND THE RESEARCH MODEL

The roles of user's satisfaction in influencing e-learning success (Delone & McLean, 1992; Doll & Torkzadeh, 1988) and its impact on e-learning continuance intention (Chiu, Hsu, Sun, Lin, & Sun, 2005; Roca, Chiu, & Martinez, 2006) have been investigated by researchers using several models. A number of studies on e-learning

[1] An initial version of this paper was presented at the International Conference on Business and Management Education (ICBME) 2010 in Bangkok, Thailand, 26-28 January.

continuance decisions have been examined using the technology acceptance model (TAM) (Davis, 1989), an offshoot of the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975). Studies using TAM attempted to establish the impact of perceptions of usefulness and ease of use on attitudes towards technology adoption and usage (Roca, et al., 2006). Recent models to measure IT usage and success have adopted Oliver's (1980) expectancy disconfirmation theory (EDT) as seen in the works of Bhattacherjee (2001), Chiu, et al. (2005), Hayashi, et al. (2004), McKinney, et al.(2002) and Oliver (1980). The EDT proposes that consumer's perceived performance, perceived disconfirmation, and satisfaction influence repurchase intention.

In addition, extant literature on IT usage also shows that the IS success model of DeLone and McLean (1992) which examines the relationship between system quality and information quality and user satisfaction, and its extended model (DeLone & McLean, 2002, 2003) which incorporates perceived usefulness as a measure of user satisfaction (Delone & McLean, 1992) and perceived ease of use, perceived usefulness and information quality as determinants of user satisfaction have been used to investigate IS usage and success. The recent work of Sharkey et al. (2010) used the DeLone and McLean's (2003) extended model to investigate the influence of quality on E-commerce success. Their study found significant relationships between Information Quality and System Quality and three success dimensions: intention to use, user satisfaction and intention to transact. McKinney et al. (2002) proposed a measurement of Web-customer satisfaction whereby perceived performance was examined in terms of information quality and system quality. Other studies by Parasuraman, et al. (1988) involving the use of quality constructs have included service quality as a measure of user satisfaction while another study by Pitt, et al. (1995) which included service quality in its success model concluded that SERVQUAL is appropriate in measuring IS service quality. In summary, the empirical studies above imply that TAM, EDT and the DeLone and McLean (1992, 2002, 2003) models are appropriate to examining technology usage and continuance.

The DeLone and McLean's (1992) full model proposes six major dimensions of IS success, namely (1) system quality, (2) information quality, (3) use, (4) user satisfaction, (5) individual impacts, and (6) organizational impacts. The extended model (DeLone & McLean, 2002, 2003) incorporates service quality as the third quality dimension and intention to use and net benefits as the other new dimensions. Therefore, as an adaption of the DeLone and McLean's (2002, 2003) extended model, this paper only examines the impact of perceived quality on user satisfaction and usage continuance of the e-learning system among students in a public university in Malaysia. Fig. 1 represents the theoretical model for this paper. The model indicates the relationship between perceived quality as operationalized by the 3 dimensions of system quality, information quality and service quality, and user satisfaction and usage continuance.

2.1 System quality

System quality measures the functionality of a system which comprises usability, availability and response time (DeLone & McLean, 2004). It is also "concerned with whether or not there are "bugs" in the system, the consistency of the user interface, ease of use, response rates in interactive systems" (Chiu, et al., 2005). The importance of these features are confirmed in a study whereby online users were found to be very particular on issues such as easiness to read and navigate (Smith & Merchant, 2001). It was also established that a responsive web site proves to be highly important to end-users (Robbins & Stylianou, 2003).

2.2 Information quality

Information quality has been associated with nine characteristics, namely, accuracy, precision, currency, output timeliness, reliability, completeness, conciseness, format and relevance (Bailey & Pearson, 1983). The literature on technology usage and user satisfaction has also suggested that information quality has a significant impact on user satisfaction (Delone & McLean, 1992; Seddon, 1997).

2.3 Service quality

The closest definition of service quality in online library systems is perhaps associated with LibQUAL+^{TM} which is derived from Parasuraman's study of service effectiveness, SERVQUAL. LibQUAL+^{TM} is a research and development project undertaken to define and measure library service quality across institutions. Library service quality comprises information access (content/scope and timeliness), personal control (ease of navigation and convenience), affect of service (responsiveness and reliability) and library as a place (utilitarian space) (Heath, Boykin, & Webster, 2002).

2.4 User satisfaction

User satisfaction is widely accepted as a desirable outcome of any product or service experience because it is one of the most significant criteria for measuring IS success. In most studies on IT success, it is a factor to monitor

the product or service quality (Oliver, 1993) and also to predict behavioural consequences (Fullerton & Taylor, 2002).

2.5 System Usage

Usage generally refers to "either the amount of effort expended in interacting with an information system or, less frequently, as the number of reports or other information products generated by the information system per unit time" (Trice & Treacy, 1988). In addition, some authors suggest that usage refers to the nature, quality and appropriateness of the actual system use and not just simply a measure of time spent on the system (DeLone & McLean, 2004).

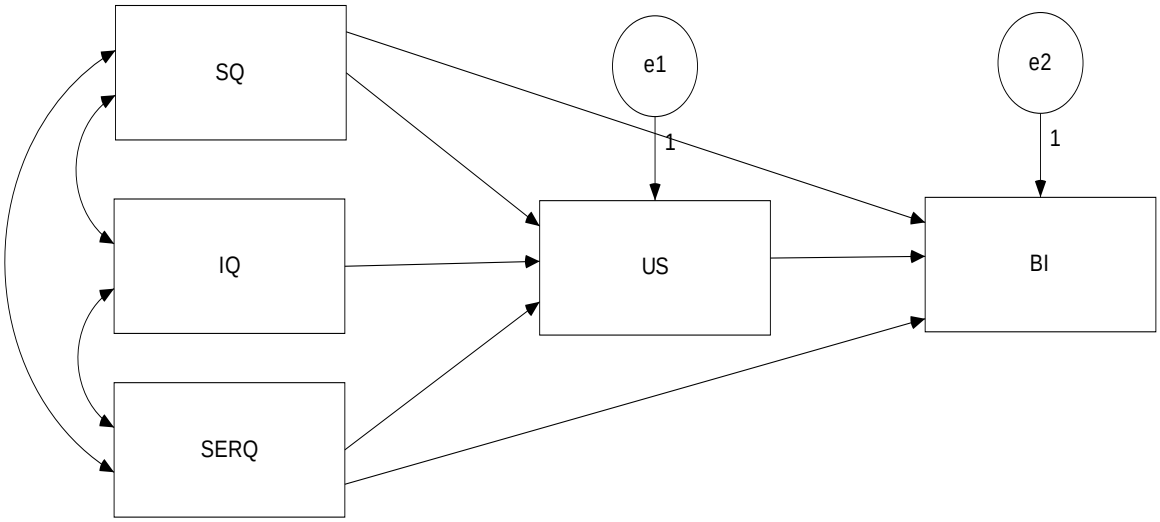

Fig. 1. The research model

The related literature on technology usage has established that users' continued usage intention of IT is determined by usage satisfaction, which in turn is jointly influenced by perceived usability, perceived quality and usability disconfirmation (Roca, et al., 2006). Hsu et al. (2003) and Khalifa and Liu (2002) noted that information quality, system quality and service quality are conceptualized as three different constructs for operationalizing perceived performance. DeLone and McLean (1992) noted that system quality and information quality are directly related to user satisfaction and IS use. Their findings were supported by Bharatia and Chaudhury (2004) and McGill et al. (2003) who found that information quality and system quality as separate constructs, are related to satisfaction. Negash et al. (2003) concluded that information and system quality impact on satisfaction while service quality has no significant relationship with satisfaction and in contrast, service quality was found to be a significant predictor of satisfaction (Lai, 2004) while Rai et al. (2002) have established that information quality influences satisfaction. A recent study by Ozkan and Koseler (2009) used the hexagonal e-learning assessment model (HELAM) which consists of six dimensions, namely, (1) system quality, (2) service quality, (3) content quality, (4) learner perspective, (5) instructor attitudes, and (6) supportive issues to evaluate a web-based learning system. Results show that each of the six dimensions of the model had a significant effect on the learners' perceived satisfaction. The literature suggests that various models using perceived quality either as a composite or separate constructs generally has an impact on user satisfaction. Hence, based on the above literature review, this paper proposes the following hypotheses:

H1: System quality has a positive relationship with user satisfaction.

H2: Information quality has a positive relationship with user satisfaction.

H3: Service quality has a positive relationship with user satisfaction.

User satisfaction is often regarded as an individual's feelings of pleasure or disappointment resulting from comparing a product's performance (or outcome) in relation to his or her expectations (Chiu, et al., 2005). Previous research has suggested strongly that satisfaction has a positive impact on future intentions to repurchase (Oliver, 1980). A study on usage of online banking services established the significance of satisfaction as a predictor of IS continuance (Bhattacherjee, 2001) while Van Riel et al. (2001) found that satisfaction has a strong impact on intention to continue using a portal site, and users' continuance intention is determined by satisfaction (Roca et al., 2006). Hence, based on the above findings, the following hypothesis is proposed:

H4: User satisfaction is positively related to usage continuance.

A recent study by Sharkey, Scott, and Acton, (2010) using DeLone and McLean's IS Success Model (DeLone & McLean, 2002, 2003) in an e-commerce environment found that information quality and system quality are significantly related to user satisfaction, intention to use and intention to transact. In another study by Ramayah et al. (2010) in an e-learning environment in Malaysia, the impact of information quality on intention to use was found to be fully mediated by user satisfaction. Roca et al. (2006), based on the expectancy disconfirmation theory, used a decomposed technology acceptance model in the context of an e-learning service to examine the determinants of user satisfaction and users' continuance intention. The perceived performance component was decomposed into perceived quality and perceived usability. Results from a sample of 172 respondents suggest that users' continuance intention is determined by satisfaction which in turn is jointly influenced by perceived usefulness, information quality, confirmation, service quality, system quality, perceived ease of use and cognitive absorption.

A revised conceptual model which was derived from the technology acceptance model, expectation-confirmation theory and IS success theory was tested and validated using data gathered from 166 online consumers in South Africa (Brown & Jayakody, 2008). The study found that 7 interrelated dimensions of B2C e-commerce success, namely service quality, system quality, information quality, trust, perceived usefulness, user satisfaction and continuance intentions were confirmed. Findings indicate that user intentions to continue using an online retail site are directly influenced by perceived usefulness, user satisfaction and system quality. User satisfaction is directly influenced by service quality and perceived usefulness, whilst perceived usefulness is directly influenced by trust and information quality. Trust in the online retailer is directly influenced by service quality and system quality. The literature suggests that perceived quality are positively related to users' intention to use an e-learning system. Hence, based on the findings described above, the following hypotheses are proposed:

H5: System quality is positively related to intention to use.

H6: Service quality is positively related to intention to use.

3.0 RESEARCH METHOD

3.1 Data Collection

Data was collected from 250 students from a public university in Penang, Malaysia using a structured questionnaire which was derived from the literature. The questionnaire consisted of 4 sections. The first section collected the demographic data, the second section elicited information about information quality, service quality and system quality, section three measured user satisfaction and the last section measured continuance intention. Since there was no list available, non-probability convenient purposive sampling method was used. The sample selected were students who have used the e-learning system as the measures required them to rate the system, information and service quality as well as the satisfaction and continuance intention.

3.2 Measures

The measures were all adapted from published literature. The measures for service quality, information quality and system quality were from Lee and Lee (2008). Satisfaction measures were adapted from Spreng et al. (1996) whereas intention to use was adapted from Venkatesh et al. (2003).

3.3 Sample Profile

The demographics of the respondents tabulated in Table 1 were derived from descriptive analysis. Females (69.6%) outnumber males (30.4) in this study which somewhat reflects the gender ratio of undergraduates for public universities in Malaysia. About 70% of the students were from the Arts stream while 30% were from Science. More than 66% of students stayed in the campus and the rest outside the campus. About 50% of students used the e-learning system for between 1-5 hours per day while about a quarter used the system for less than an hour per day. Twenty-eight percent of students claimed they belonged to the slightly frequent to extremely frequent user group of the system.

Table 1: Demographics of respondents

Gender	Frequency	Percent
Male	76	30.4
Female	174	69.6
Ethnicity		

Malay	72	28.8
Indian	24	9.6
Chinese	148	59.2
Others	6	2.4
Stream		
Arts	174	69.6
Science	76	30.4
Residence		
In campus	166	66.4
Outside campus	84	33.6
Hours	Frequency	Percent
Almost never	6	2.4
< 1 hour	62	24.8
1-5 hours	124	49.6
6-10 hours	38	15.2
11-15 hours	14	5.6
More than 20 hours	6	2.4
Frequency of use		
Extremely infrequent	16	6.4
Quite infrequent	50	20.0
Slightly infrequent	64	25.6
Neither infrequent nor frequent	50	20.0
Slightly frequent	46	18.4
Quite frequent	14	5.6
Extremely frequent	10	4.0

4.0 DATA ANALYSIS

AMOS version 16.0 was used to analyze the hypotheses generated. AMOS and LISREL are the most widely used Structural Equation Modeling (SEM) software available in the market. Since we considered AMOS 16.0 to be more user friendly this software was adopted. We followed the 2-step analytical procedure suggested by Hair et al.(2010) whereby the measurement model was evaluated first and then the structural model was assessed next.

4.1 Measurement Model

Convergent validity measures the extent to which the items of a scale that are theoretically related are correlated. According to Hair et al. (2010) a composite reliability of 0.70 or above and an average variance extracted of more than 0.50 are deemed acceptable. As can be seen from Table 2, all the composite reliability values are above 0.70 except for intention which is acceptable as there are only 2 measurement items. The average variance extracted is all above 0.50. Therefore, we can conclude that convergent validity has been established.

Next, we assessed the discriminant validity which is the extent to which a measure is not a reflection of some other variable. This can be established by low correlations between the all the measure of interest and the measure of other constructs. Also according to Fornell and Larcker (1981) when the square root of the average variance extracted is greater than its correlations with all other constructs then discriminant validity has been established. (see Table 3)

Table 2: Result of CFA for measurement model

			Convergent validity		
Construct	Item	Internal reliability Cronbach alpha	Factor loading	Composite reliability[a]	Average variance extracted[b]
Information Quality	IQ1	0.896	0.66	0.78	0.54
	IQ2		0.80		
	IQ3		0.74		
System Quality	SQ1	0.901	0.73	0.75	0.51
	SQ2		0.64		
	SQ3		0.76		
Service Quality	SERQ1		0.68	0.77	0.53
	SERQ2		0.74		
	SERQ3		0.77		
User Satisfaction	US1	0.911	0.67	0.76	0.76
	US2		0.79		
	US3		0.71		
Intention to Use	BI1	0.837	0.71	0.68	0.52
	BI2		0.73		

Note:
[a] Composite reliability = (square of the summation of the factor loadings)/{(square of the summation of the factor loadings) + (square of the summation of the error variances)}
[b] Composite reliability = (summation of the square of the factor loadings)/{(summation of the square of the factor loadings) + (summation of the error variances)}

Table 3: Discriminant validity of constructs

Constructs	(1)	(2)	(3)	(4)	(5)
(1) Information Quality	**0.734**				
(2) System Quality	0.250	**0.714**			
(3) Service Quality	0.146	0.166	**0.728**		
(4) User Satisfaction	0.130	0.232	0.090	**0.872**	
(5) Intention	0.082	0.104	0.063	0.229	**0.721**

Note: Diagonals represent the square root of the average variance extracted while the other entries represent the squared correlations

4.2 Structural Model

The structural model was estimated using the maximum likelihood method (MLE). Fig. 2 presents the results. The fit statistics are presented in Table 3. All the fit measures from this study are above the recommended values suggesting a good model fit. The model accounts for 45% of the variance explained in user satisfaction and 44% of the variance in user intention. All the paths are significant at the 0.01 level. Information quality has the strongest effect on user satisfaction whereas user satisfaction has the strongest effect on user intention. Thus the results of the structural model have established support for H1, H2, H3, H4, H5 and H6 (See Table 4).

Table 3: Fit indices

Fit Measures	Study	Recommended values
df	1	
χ^2	2.595	
χ^2/df	2.595	≤ 3.00
GFI	0.996	≥ 0.90
AGFI	0.978	≥ 0.80
CFI	0.997	≥ 0.90
RMSEA	0.080	≤ 0.08
NNFI (TLI)	0.972	≥ 0.90

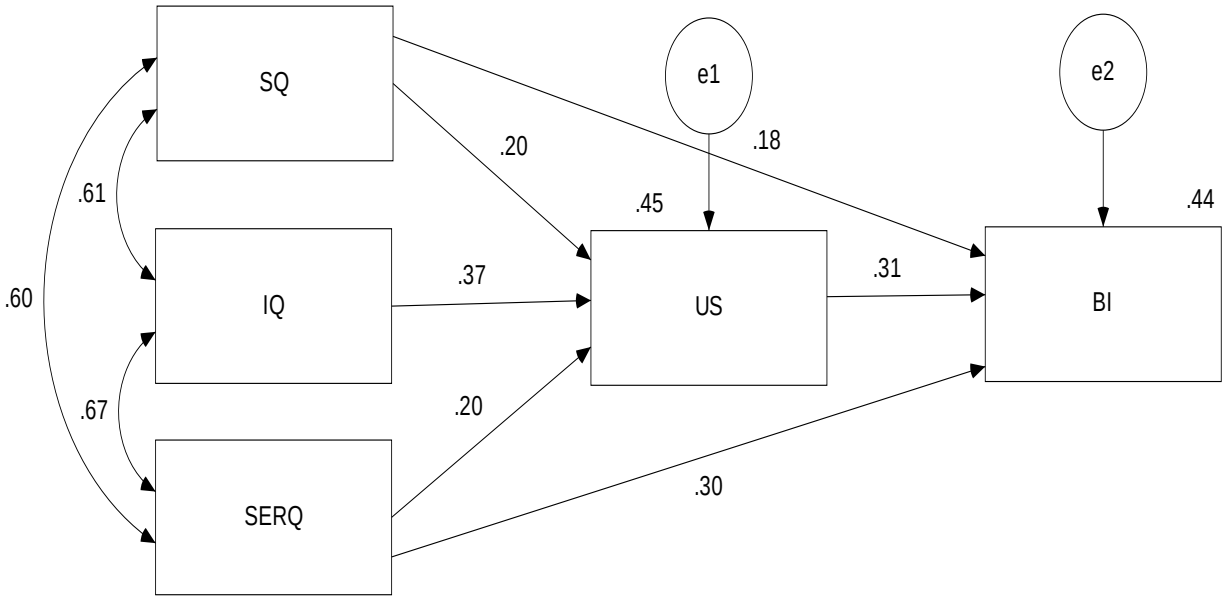

Fig. 2. Structural model

Table 4 summarizes the results of hypotheses testing in this study.

Table 4: Hypotheses testing

Hypothesis	Critical ratios (CR)	p-value	Decision
H1: System quality has a positive relationship with user satisfaction.	3.256	0.001	Supported
H2: Information quality has a positive relationship with user satisfaction.	5.399	0.000	Supported
H3: Service quality has a positive relationship with user satisfaction.	2.948	0.003	Supported
H4: User satisfaction is positively related to usage continuance.	5.069	0.000	Supported
H5: System quality is positively related to intention to use.	2.837	0.005	Supported
H6: Service quality is positively related to intention to use.	4.697	0.000	Supported

5.0 DISCUSSION AND IMPLICATIONS

The purpose of this study was to test DeLone and McLean's (2003) IS success model in a public university in Malaysia. The study also examined the relationships between perceived quality (in terms of system quality, information quality and service quality) and user satisfaction, and the impact of user satisfaction on usage continuance.

The results of the multiple regression analysis corroborate with those found in a similar study by Roca et al.,(2006) where all the 3 dimensions of perceived quality were positively related to user satisfaction. In addition, the findings of this study are consistent with Chiu et al.'s (2005) findings which used a composite construct of perceived quality comprising the dimensions of service quality, information quality and system quality. Results of this study are also consistent with earlier findings where Rai et al. (2002) and Seddon (1997) have established that system quality positively affected user satisfaction while Zhu et al. (2002) found that service quality had a significant impact on customer satisfaction. Roca et al.'s (2006) study also found that user satisfaction has a direct impact on system continuance intention which is consistent with the findings of this study. Another study has also established the strong positive effect of satisfaction on the intention to continue using a portal site (Van Riel, et al., 2001) which further support the findings in this study.

The model adopted in this study shows that system quality, information quality and service quality can account for 45% of the variance in user satisfaction while user satisfaction, system quality and service quality can explain about 44% of the variance in usage continuance. These results suggest that the simplified model of DeLone and McLean's IS success model has relatively good predictive power on user satisfaction and usage.

The implications of the findings in this study is that e-learning system developers and implementers need to ensure the availability of quality, relevant and complete information to meet the needs of students to ensure user satisfaction without sidelining the importance of a reliable and accessible system. If systems usage continuance intention is low because of low user satisfaction, e-learning system implementation is deemed unsuccessful in public universities in view of the high investment costs involved in developing and maintaining the e-learning systems. Completeness of information provided by the e-learning system seems to bring a greater sense of satisfaction among the users. If sources of information are not complete and hence not available to the students, this may affect their perceived quality of the system which in turn affects user satisfaction and hence affects successful implementation of the system. The demographic data in Table 1 indicate that less than 30% of the students belong to the slightly frequent to extremely frequent group of users of the e-learning system in the university. This suggests that about 70% of the students are infrequent users of the system, implying that the existing e-learning system may not have met the expected level of satisfaction among the users.

Perhaps future research on critical success factors of e-learning systems should examine the prospects and roles of institutional funding as well as integration and sharing of multiple e-learning systems nationwide for public universities. In addition, it should be interesting to make a comparison of e-learning usage continuance intention between public and private universities considering the fact that tuition fees in public universities are heavily subsidized by the government and hence are much lower than those in the private universities where students fork out much higher fees. In this respect, it can be assumed that private university students should expect more out of the e-learning system in terms of perceived quality and user satisfaction than those in the public universities.

6.0 LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

This study developed a theoretical rationale for, and empirically tested the effect of system quality, information quality, service quality, on satisfaction and intention to use. Despite the useful findings of this study there are several limitations that need to be acknowledged. Firstly, when generalizing the results of the study, the researcher should take into account the sample size that has been used in this study, although this study found significant relationships between the independent variables and dependent variable. Secondly, due to time and resource constraints the study is limited as it consists of a small sample size of 250 respondents. Thirdly, the findings cannot be generalized extensively in Malaysia, as the scope of the study is confined to individuals who study in USM, Penang; there might be potential moderators such as gender and demographic factors. Therefore, caution may be needed before generalizing the findings to the whole country. Fourthly, the data were collected from the user's side only. Since relationships involve two participants groups, the creators who create the online learning system and the users, collecting data from both would allow a deeper insight between creator and user relationships. Such a study would require a sampling from both sides in order to make the obtained data match the particular relationship. Lastly, our study only focused on testing the effect of system quality, information quality, service quality, satisfaction and intention to use. Thus, the finding might be limited in its potential when generalizing the results toward other systems.

Future research can expand this study by (1) including the effect of different users' experience on the adoption of e-learning in Malaysia, (2) improving the model by incorporating other relevant independent variables and dependant variables based on new findings from latest literature at the time and, (3) further research is needed to determine whether this study can be replicated in other systems.

7.0 CONCLUSION

In this study, we found that system quality, information quality and service quality are significant factors influencing user satisfaction in using an e-learning system. User satisfaction is also found to be significant in affecting user's intention to use. The findings provided by the study may enable the creators of e-learning systems to think seriously on these factors that will affect user satisfaction. In addition, this study may provide a direction as to how satisfaction can be cultivated among users in order to encourage them to use the e-learning system. The findings provided by the study may give empirically justified foundation for the creators to develop strategies to enhance their e-learning system's quality by focusing on the user satisfaction. By understanding the determinants of user satisfaction, appropriate actions can be taken to increase the users' perceptions of their experience on adoption of the e-learning system. In short, continued research is needed to improve this study and to address its limitations. It is hoped that this study will give a preliminary insight and understanding on user satisfaction and behavioral intention in order to maximize the actual use of the e-learning system.

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