Journal of Information and Knowledge Management (JIKM)
Volume 5 Number 2 (2015). pp 46-56

Usability Assessment of Web Digital Library: A Survey Among Undergraduate Students

[1*]Mohamad Noorman Masrek, [2]Asad Khan

[1]Faculty of Information Management
Universiti Teknologi MARA
UiTM Selangor
Malaysia

[2]Department of Library and Information Science
University of Peshawar, Pakistan

Abstract

Recognizing the significance of the usage construct as one of the aspect of usability assessment of the digital library (DL), this study further extends past studies by integrating this construct into commonly used criteria, namely, satisfaction, learnability, effectiveness, and efficiency. Building upon these constructs, an interrelationship model was developed and tested empirically using a survey research methodology. The learnability, effectiveness, and efficiency construct were hypothesized as significant predictors of usage and satisfaction. In addition, the usage construct was also hypothesized as a significant predictor of satisfaction. Data were collected from 320 undergraduate students from the Faculty of Information Management (FIM), Universiti Teknologi MARA (UiTM) Puncak Perdana. The results of the Structural Equation Modeling (SEM) analysis showed all postulated hypotheses were fully supported. The contribution of the study can be assessed from the theoretical and practical perspectives. The established model can be further validated in other DL implementation while the validated instrument can be used by practitioner to gauge the usability of the DL.

Keywords: usage**,** usability, digital library, effectiveness

1. INTRODUCTION

One of the impacts of computerization on library services was the creation and establishment of digital libraries (DL). DL are complex information systems consisting of many components depending on each other in their operation in order for the whole system to work flawlessly (Vrana, 2007). According to Jose (2007), since the development of DL requires huge investment in terms of technology, money, and manpower, therefore it is crucial that periodic assessments are executed to ensure that the DLs are meeting the objectives for which they are established. In the DL context, the evaluation can be seen as the process of determining whether the aim for which the DL has been implemented is accomplished or not (Schwartz, 2000; Jose, 2007). In addition, Schwartz (2000) also stated that DL evaluation is to (i) to make a case for increases in equipment, personnel or financing (ii) to test a system component; (iii) to compare several possible solutions to a problem; (iv) and to examine existing problems and assess the success of attempts addressing the problems.

Within the realm of DL evaluation studies, many researchers have stressed the importance of assessing the usability aspects. To this effect, researchers have developed usability models outlining various criteria for assessing DL (e.g. Jeng, 2005; Fuhr et al., 2007). While most of these usability models have provided useful guidelines, it is quite interesting to note that, the aspect of usage was given little attention by the users. In other words, the criteria of usability assessment as proposed by previous models have not included usage as one of the important aspects. Van Welie et al. (1999) emphasized the importance of usage to be integrated in the usability model. According to Xie (2006), the ultimate goal of the development of DL is to serve users and to facilitate their

effective use of information and services. Saracevic (2004) pointed out that, in the context of DL, usage in itself is a criterion involving studies of usage patterns, usage of materials, usage statistics, who utilizes what / when, and the reasons for usages. Recognizing the significance of the usage construct as one of the aspect of usability assessment of the digital library (DL), this study further extends previous studies (Jeng, 2005; Joo & Lee, 2010) by integrating usage into the commonly used criteria of the usability of DL. Against this background, this study is aimed to (i) to examine whether usage fits well into a usability model of DL, (ii) to examine the interrelationship of usage with other usability criteria which are effectiveness, efficiency, learnability and satisfaction.

2. LITERATURE REVIEW

2.1 Overview of Digital Library

There are different definitions in the literature as to what constitutes a DL (Xie, 2006). The definition of DL may vary according to whether they are viewed as new services, as institutions, as collections, as information systems, as new technologies (Fuhr, et al. 2006). Borgman (2002) defined DL as "a set of electronic resources and associated technical capabilities for creating, searching, and using information. In this sense, they are an extension and enhancement of information storage and retrieval systems that manipulate digital data in any medium (text, images, sounds etc.) and exist in distributed networks". Koohang & Onracek (2005) defined DL as the collection of services and the collection of information objects and their organization, structure, and presentation that support users in dealing with information objects available directly or indirectly via electronic / digital means. Fuhr et al. (2007) defined DL as "a special kind of an information system, and consists of several components such as a collection, a computer system (a technical system), persons, and the environment (or usage), for which the system is built."

DL can potentially support a range of traditional and not-so-traditional library services) but advanced DL research projects normally exploit the possibilities of a digital-only world (Schwartz, 2000). Nonetheless, working DL for the most part support functions that closely resemble the brick-and-mortar library (Schwartz, 2000). Architecturally, a DL typically includes four types of components, namely, repositories,catalogs, identifier systems, and user interfaces (Altman, 2006).Repositories store the raw bits of each digital object contained in the library. Catalogs support the search function by indexing information in the digital objects, and the corresponding metadata describing them. Identifier systems provide a framework for locating and identifying objects. User interfaces bring together the functions of the other components to perform services such as searching, browsing, visualization and delivery.

2.2 Digital Library Evaluation

Schwartz (2000) stated that the purposes of DL evaluation are to (i) to make a case for increases in (or at the least continuation of) financing, personnel, or equipment (ii) to measure achievements against goals (assuming goals have been enumerated); (iii) to test a system component; (iv) to compare several competing solutions to a problem; (v) and to determine whether and where problems exist, or, to assess the success of an attempt to address a problem. According to Fuhr et al. (2007) important issues to be considered when evaluating DL would include the following (i) the underlying system and its components (this involves e.g. classical information retrieval evaluation methods and techniques as well as overall systems performance) (ii) the interface and interaction level of the activities between the user and the system (this involves classical human-computer usability evaluation issues) (iii) Support for different access and usage strategies (e.g. analytical search, browsing, navigation, bibliographic search, collaboration, annotations) (iv) the work tasks should be supported: often, only the task of searching is supported in the design of an access system (v) situational and contextual factors of DLs are important, such as organizational and group issues.

Jose (2007) identified four prominent types of DL evaluation as formative, summative, iterative and comparative. Formative evaluation is usually done at the beginning of the DL development project aimed at providing insights into the needs of the user community and to take corrective measures for any issues or problems that arise. Summative evaluation is conducted at the end of a DL development project and is aimed to understand whether initial objectives with which the system was set up is achieved or not. Iterative evaluations are interim evaluations which are conducted during the DL development and is aimed to verify if the development project is on the right track. Comparative evaluations are full-fledged evaluations conducted using matrices which can be comparable across similar systems and is aimed to find out the value of the DL. Jose (2007) also stressed that in order to design a framework for DL evaluation, it is necessary to identify major components characterizing the dimensions of a DL environment.

2.3 Usability of Digital Library

For different disciplines, usability has a different meaning.The International Organization for Standardization defined usability as the extent to which, a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. Bengts (2004) stated that usability is commonly viewed as a very broad concept that includes completely different aspects and it is usually conceptualized as a collection of separately defined attributes. Blandford & Buchanan (2002) noted that usability is technical, cognitive, social, and design oriented and it is important to bring these different perspectives together, to share views, experiences and insights. According to Chowdhury et al. (2006), librarians perceive the usability of an information service in terms of efficient and effective access to information. Fuhr et al. (2006) defined usability of the DL as the quality of interaction between users and the systems (i.e. the DL) and a usable DL is the one that is easy to learn, flexible and adapts to user preferences and skills. Table 1 presents usability criteria developed by previous researchers in the context of DL.

Table 1 Usability criteria for assessing DL.

Authors	Usability criteria
Evans et al (2002)	Visibility of system status, match between the systems and the real world, user control and freedom, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency of use, aesthetics and minimalist design, help users recognize, diagnose, and recover from errors, Help and documentation.
Saracevic (2004)	Contents, process, format, overall assessment
Jeng (2005)	Effectiveness, efficiency, learnability, satisfaction (ease of use, organization of information, labelling, visual appearance, contents, error corrections)
Snead et al. (2005)	Navigation, content presentation, labels, search process
Xie (2006)	Search and browse, navigation, help feature, view and output, accessibility
Tsakonas & Papatheodorou (2008)	Ease of use, navigation, terminology, learnability
Assim (2009)	Learnability, easiness, time saving, user friendly, comfortable, visibility, memorability, satisfaction, consistency, reliability, error prevention.
Joo & Lee (2011)	Effectiveness, efficiency, learnability, satisfaction
Alasem (2013)	Efficiency, effectiveness, aesthetic appearance, learnability

3. THEORETICAL FRAMEWORK

Figure 1 presents the theoretical framework used in this study. As identified by Jeng (2005) usability of a DL consists of effectiveness, efficiency, learnability and satisfaction. According to Jeng (2005), effectiveness is to evaluate if the DL as a whole can provide information and functionality effectively. Efficiency is to evaluate if the DL as a whole can be used to retrieve information efficiently (Jeng, 2005). Learnability is to measure learning effort for mastering or familiarizing oneself with the use of

the DL functions. Satisfaction will measure users' reaction on the aspect of ease of use of information organization, clear labeling, visual appearance, contents, and error corrections.

Delone & Mclean (2003) conceptualized the Information Systems Success Model (ISSM) which has six inter-related dimensions which are information quality, systems quality, service quality, usage, satisfaction and impact. Information quality assesses the aspect of information produced by the information systems. Systems quality assesses the characteristics of the information systems such as user friendliness, availability. Service quality is concerned with the quality of services provided by the information systems itself. Usage is about the extent to which users utilize the information systems. It is also defined by Preece et al. (2002) as the extent to which the system provides the right kind of functionality so that users can do what they need or want to do. Satisfaction is related to the extent users are pleased with the information systems. Impact is the three quality dimensions of ISSM and also termed as usability by Roca et al (2006). The term was also adopted by Ramayah et al. (2012) for assessing the quality of e-learning systems.

Comparing the dimensions of usability of DL as identified by Jeng (2005) and the dimensions of ISSM, some similarities could be observed. The three usability dimensions of a DL, namely effectiveness, efficiency and learnability are normally embedded as items or indicators for measuring the three quality dimensions of ISSM. In ISSM, the three quality dimensions are posited to have a positive relationship with usage and satisfaction. In addition, usage is also posited to have a positive relationship with satisfaction. Drawing upon this justification, we also argue that in the context of DL, the effectiveness, efficiency and learnability dimensions will have a positive relationship with usage and satisfaction. Based on ISSM also, usage of DL is posited to have a relationship with satisfaction. To this effect, the following hypotheses are established (i) H1: Usage has positive relationship with satisfaction, (ii) H2: Effectiveness has positive relationship with satisfaction, (iii) H3: Effectiveness has positive relationship with usage, (iv) H4: Efficiency has positive relationship with satisfaction, (v) H5: Efficiency has positive relationship with usage, (vi) H6: Learnability has positive relationship with usage (vii) H7: Learnability has positive relationship with satisfaction.

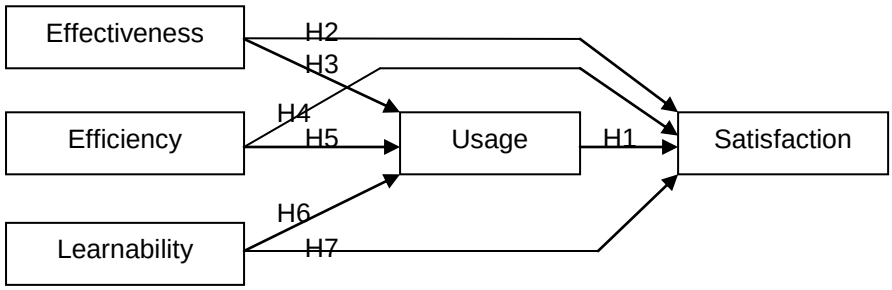

Figure 1 Theoretical Framework.

4. RESEARCH METHODOLOGY

To achieve the stated objectives, this study used survey research methodology. A self administered paper-based questionnaire with an added option of completing the questionnaire via the Internet was used to collect the data. The population of the study was 1722 undergraduate students from the Faculty of Information Management, Universiti Teknologi MARA, Puncak Perdana Campus, Shah Alam Malaysia. The population was chosen because besides being the users of the DL of the university, they also had a good deal of knowledge on DL exposed to them through a course known as "Foundation of Information Management". The course was made compulsory for all of them. Drawing upon the instrument developed by Joo & Lee (2011) and Samadi, Masrek & Yatin (2014), a questionnaire was developed to measure all the constructs in the framework. For each construct, a perceptual measure in the form of statements or items with a corresponding five point Likert Scale

was developed. The respondents were required to indicate the degree of their agreement or disagreement with the listed statements on a Likert scale from 1 (strongly disagree) to 5 (strongly agree).

To ensure that the questionnaire meets the reliability and validity requirements, rigorous steps involving pre-testing and pilot testing were carried out. The pre-testing was done with several experts and prospective respondents. These experts were two academic and two senior librarians working in the university library. Four prospective respondents who were undergraduate students from the faculty were consulted. Drawing upon the feedbacks from the pre-testing exercise, the questionnaire was revised accordingly. Subsequently, a pilot test was carried out. A total of 30 undergraduate students was engaged to respond to the questionnaire. Using the IBM SPSS, the responses of the 30 students were analyzed so as to determine the reliability of the measurement. The item by item reliability test or simply known as Cronbach Alpha, ranges between 0.767-0.884 which falls within an acceptable standard (Hair et al. 2010), hence, implying that the questionnaire was acceptably reliable. Using a convenient sampling technique, a total of 400 questionnaires was administered to samples within the population. However, at the end of the data collection period, 345 were received, giving a response rate of 86.25%. However, upon further scrutiny, 25 were found unusable because more than 30% of the questions were not answered, leaving only 320 for further analysis. The IBM SPSS version 22.0 was used for descriptive analysis while the IBM AMOS was used for Structural Equation Modeling (SEM).

5. FINDINGS

The background information of the respondents is shown in Table 2. Out of 320 respondents, the majority were females (75.0%). The bulk of the respondents indicated to be in Year One (42.8%) while the minority is in Year Three (24.7%). With regards to program being pursued, 32.2% stated that there were enrolled in the BSc Information Management Systems, 24.1 % enrolled in the BSc Records Management, 21.1% registered in BSc Library Science and the remaining were enrolled in BSc Resource Centre Management.

Table 2 Background Information.

		Frequency	%
Gender	Male	80	25.0
	Female	240	75.0
Year	1	137	42.8
	2	104	32.5
	3	79	24.7
Program	Bachelor of Science Information Management Systems	103	32.2
	Bachelor of Science Library Science	77	24.1
	Bachelor of Science Records Management	77	24.1
	Bachelor of Science Resource Center Management	63	19.7

Realizing that the data for both independent and dependent variables were collected from the same source, i.e. same respondent, the threat of common method bias was quite possible. According to Podsakoff et al. (2003) common method biases can potentially cause serious effects on research results, hence, to ascertain whether its effect is severe or negligible, the Harman single factor test was executed. The results showed that, the total variance accounted for a single factor was 31.8%, less than the cutoff value of 50% (Hair et al. 2010), which means common method bias was not a serious threat.

A normally distributed data is one of the key requirements for SEM analysis. In light of this, the assessment of normality was assessed based on the skewness and kurtosis scores. Kline (2005) recommended that the skewness score should not be greater than 3 while the kurtosis should not exceed 10. As shown in Table 3, these two requirements are fully adhered in this study. In terms of

multivariate normality, the assessment was done based on the Mardia's coefficient. According to Raykov & Marcoulides (2008), multivariate normality can be assumed when the value of OV x (OV + 2) is less than the Mardia's coefficient (Note: OV is the number of items or observed variables). In this study, there are 24 observed variables. Therefore, applying the formula, 24 x (24 + 2) is equivalent to 624. The Mardia's coefficient as calculated by AMOS is 15.052, which is smaller than 624. To this effect, the multivariate normality of the data can be assumed.

Table 3 Univariate and Multivariate Normality Assessment.

Construct	Items	Minimum	Maximum	Skewness	c.r.	Kurtosis	c.r.
Learnability	LE1	1.000	5.000	-.031	-.228	.363	1.325
	LE2	1.000	5.000	.136	.994	.544	1.988
	LE3	1.000	5.000	-.023	-.171	.348	1.269
	LE4	1.000	5.000	-.002	-.011	-.023	-.084
	LE5	1.000	5.000	.131	.958	.193	.705
Satisfaction	SA1	2.000	5.000	.152	1.113	-.567	-2.069
	SA2	2.000	5.000	.329	2.404	-.952	-3.474
	SA3	2.000	5.000	-.126	-.917	-.508	-1.856
	SA4	2.000	5.000	-.003	-.024	-.779	-2.843
Usage	UT5	1.000	5.000	-.147	-1.071	.458	1.671
	UT4	1.000	5.000	.106	.772	.296	1.081
	UT3	1.000	5.000	.241	1.760	-.316	-1.155
	UT2	1.000	5.000	.333	2.429	.109	.396
	UT1	1.000	5.000	.225	1.644	-.398	-1.452
Efficiency	EF1	2.000	5.000	.252	1.841	-.473	-1.728
	EF2	2.000	5.000	.248	1.809	-.262	-.958
	EF3	2.000	5.000	.234	1.705	-.395	-1.443
	EF4	2.000	5.000	.108	.791	-.451	-1.648
	EF5	2.000	5.000	.070	.512	-.414	-1.514
Effectiveness	EC1	1.000	5.000	-.191	-1.392	.077	.281
	EC2	1.000	5.000	-.028	-.204	-.102	-.373
	EC3	1.000	5.000	.079	.576	-.213	-.777
	EC4	1.000	5.000	-.123	-.897	.041	.149
	EC5	1.000	5.000	.120	.879	.132	.484
Multivariate						59.292	15.012

Anderson & Gerbing (1988) stated that convergent validity is the extent to which different methods used to gauge the same construct produce similar results. As for this study, the convergent validity was assessed in terms of factor loadings, composite reliability (CR) and the average variance extracted (AVE). As shown in Table 4, all the factor loadings met the requirement of 0.7 (Hair et al. 2010), while for the composite reliability, all the scores surpassed the recommended value of 0.7 (Hair et al. 2010). Following Fornell & Larcker (1981), the AVE for all constructs exceed the benchmark value of 0.5. Given these results, convergent validity of the model can be assumed.

In addition to assessing the convergent validity, the discriminant validity also needs to be assessed. According to Hair et al. (2010), discriminant validity is the degree to which a construct is truly distinct from other constructs. The discriminant validity of the construct is assessed by comparing the square root of the average variance extracted (AVE) of the constructs with the correlation between the constructs and all other constructs. As displayed in Table 5, the square root of the AVE values surpassed the correlation values, hence implying a good discriminant validity.

Table 4 Convergent Validity Assessment of the Model.

Model constructs	Measurement Item	Loading	Composite Reliability (CR)	Average Variance Extracted (AVE)
Effectiveness	EFT1	0.772	0.861	0.553
	EFT2	0.746		
	EFT3	0.765		
	EFT4	0.707		
	EFT5	0.726		
Efficiency	EFC1	0.714	0.880	0.595
	EFC2	0.818		
	EFC3	0.773		
	EFC4	0.828		
	EFC5	0.716		
Learnability	LRN1	0.701	0.856	0.505
	LRN2	0.716		
	LRN3	0.727		
	LRN4	0.766		
	LRN5	0.776		
Usage	UTI1	0.725	0.836	0.602
	UTI2	0.712		
	UTI3	0.703		
	UTI4	0.703		
	UIT5	0.709		
Satisfaction	SAT1	0.698	0.803	0.505
	SAT2	0.714		
	SAT3	0.726		
	SAT4	0.704		

Table 5 Discriminant Validity Assessment of the Model.

	[1]	[2]	[3]	[4]	[5]
[1] Effectiveness	*0.743*				
[2] Efficiency	0.194	*0.771*			
[3] Learnability	0.288	0.167	*0.711*		
[4] Usage	0.239	0.235	0.289	*0.776*	
[5] Satisfaction	0.434	0.362	0.522	0.570	*0.711*

Note: Diagonals (italicized) represent the square root of the Average Variance Extracted (AVE) while the other entries represent correlation values.

According to Hair et al. (2010), when doing SEM analysis, the measurement model must meet several fit criteria, namely, Goodness-of-Fit Index (GFI), Root Mean Square Error of Approximation (RMSEA) and Root Mean Square Residual (RMR), Normed Fit Index (NFI), Comparative Fit Index (CFI), Adjusted Goodness-of-Fit Index (AGFI) and the Parsimony Normed Fit Index (PNFI). Apparently, as shown in Table 6, the majority of the recorded indices surpassed the fit criteria indicating that the SEM model fits the data very well. The corresponding AMOS output is shown in Figure 2 and Figure 3 for both measurement and structural models.

Table 6 Fit Indices of the Measurement Model

Fit Index	Fit Criteria	Measurement Model
Chi Square ($\chi^{2)}$		397.185
Degrees of freedom		242
P-value (probability)	≥ 0.5	0.00
CMIN (χ^2)/DF	3	1.600
Goodness of Fit Index – GFI	≥ 0.9	0.909
Root Mean Square Error of Approximation – RMSEA	≤ 0.05	0.043

Root Mean Square Residual - RMR	≤ 0.05	0.033
Adjusted Goodness of Fit Index – AGFI	≥ 0.8	0.887
Parsimonious Normed Fit Index – PNFI	≥ 0.5	0.783
Normed Fit Index – NFI	≥ 0.9	0.893
Comparative Fit Inex - CFI	≥ 0.9	0.956

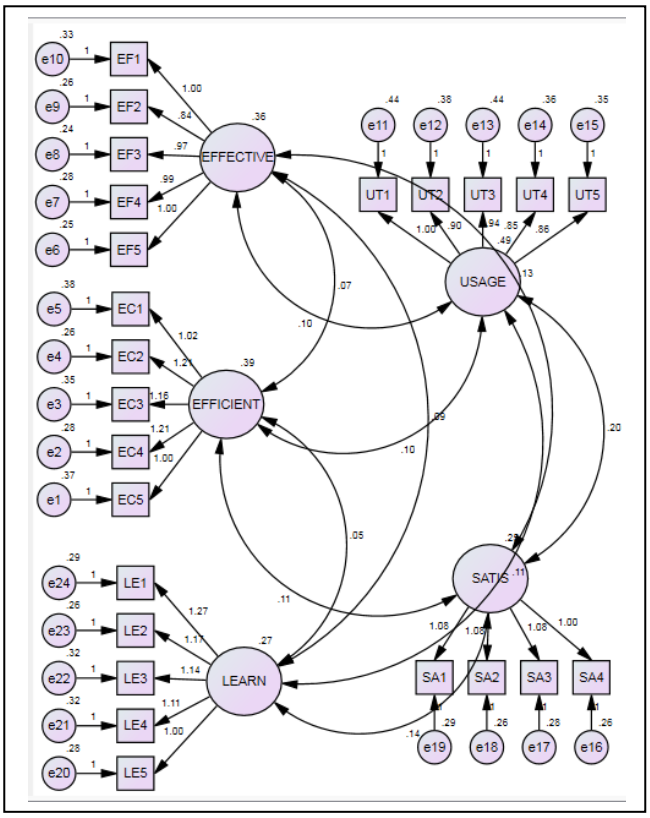

Figure 2 AMOS Output of Measurement Model.

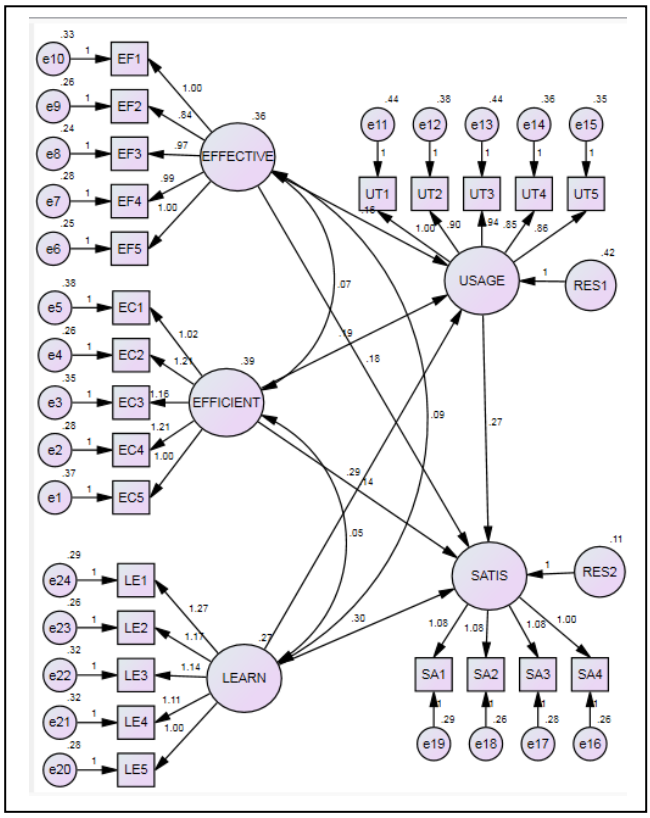

Figure 3 AMOS Output of Structural Model.

The Squared Multiple Correlation (R^2) value for the relationship between the four variables and users' satisfaction with digital library was 0.543 signifying that 54.3 per cent of the variance in users' satisfaction with digital library can be explained by the combination or usage (β = 0.385, p < 0.01), effectiveness (β = 0.216, p < 0.01), efficiency (β = 0.177, p < 0.01) and learnability (β = 0.319, p < 0.01). The Squared Multiple Correlation (R^2) value for the relationship between the three variables and usage 0.138 suggesting that 13.8 per cent of the variance in usage can be explained by the combination or effectiveness (β = 0.142, p < 0.01), efficiency (β = 0.171, p < 0.01) and learnability (β = 0.220, p < 0.01). The overall results as summarized in Table 7 indicate that all hypotheses were fully supported.

Table 7 Regression Weights of Paths.

Hypothesis	Coefficients	t-value	p-values	Supported
H1: Usage→ satisfaction	0.275	5.717	< 0.01	Yes
H2: Effectiveness→ satisfaction	0.178	3.661	< 0.01	Yes
H3: Effectiveness→usage	0.164	2.086	< 0.01	Yes
H4: Efficiency→satisfaction	0.142	3.125	< 0.01	Yes
H5: Efficiency →usage	0.192	2.628	< 0.01	Yes
H6: Learnability→usage	0.292	3.161	< 0.01	Yes
H7: Learnability →satisfaction	0.302	4.965	< 0.01	Yes

6. DISCUSSION

The main purpose of this is to examine whether usage construct fits well into a usability model of a DL and to examine the interrelationship of usage construct with other usability criteria which are effectiveness, efficiency, learnability and satisfaction. The result of the Confirmatory Factor Analysis (CFA) indicates that usage fits well into the DL usability model. The finding corroborates on the suitability of usage as an important aspect or construct for measuring DL usability. In order to examine the interrelationship of the usability constructs, seven hypotheses were developed. The results of the Structural Equalition Modelling (SEM) reveal that all the formulated hypotheses are fully supported. The effectiveness, efficiency, learnability and usage constructs are found to have a positive and significant relationship with usage and satisfaction. In other words, effectiveness, efficiency, learnability were significant predictors of DL usage. In addition, effectiveness, efficiency, learnability and usage constructs were also found to have a positive and significant relationship with satisfaction.

The findings further strengthen the usability model developed by Jeng (2005) and its corresponding instrument developed by Joo & Lee (2011). Besides that, it also strengthens the ISSM developed by Delone & McLean (2003) and comparable to that of Masrek et al. (2010) and Samadi et al. (2014) because as stated in the preceding section, the three usability dimensions of a DL, namely effectiveness, efficiency and learnability are normally embedded as items or indicators for measuring the three quality dimensions of ISSM i.e. information quality, systems quality and service quality. The implication of the findings is that, in order to increase the intensity of DL usage, DL designers need to address the efficiency, effectiveness and learnability requirements. The users should be engaged or consulted during the development stage and continuous maintenance of the DL. Failing to address these aspects, i.e. efficiency, effectiveness and learnability, will result in the DL being underutilized. As shown in the results of the study, it is the combination of efficiency, effectiveness, learnability and usage that will make users of the DL happy and satisfied with the DL services.

7. CONCLUSION

The value of the study can be described in terms of empirical, theoretical and practical contribution. From the empirical dimension, this study further adds to the body of literature. From the theoretical dimension, it has further extended the DL usability model with the inclusion of usage construct. The theoretical framework developed in this study can be further tested in DL implementation or other information system settings. From the practical dimensions, the validated instrument can be used to periodically assess the DL installed in their libraries.

Just like any other studies, this study has several limitations. Firstly, the sample size involved in the study was drawn from one faculty of one university, hence limiting the possibility of generalizing the findings. Secondly, due to the difficulty in accessing the sample frame, probability sampling could not be adopted. Thirdly, the scope of variables or construct is limited to five only.

Future studies should consider expanding the sample size and instead of focusing on one university, several universities should be engaged. Larger sample size taken from several universities would make generalizations of the findings possible. In addition, besides using perceptual measures, future researchers should consider using objective measures, especially when measuring the extent of usage. Unlike perceptual measures, objective measures will provide a more accurate result. Finally, future researchers intending to expand this study, should also consider integrating other individual related variables such as self efficacy, experience in using DL or other demographic related variables.

REFERENCES

Aasim, M.M.U.A (2009). *Usability Evaluation of Digital Library Blekinge Tekniska Högskolan a case study*. Unpublished masters thesis. School of Computing Blekinge Institute of Technology, Sweden.

Alasem, A.N. (2013).Evaluating the Usability of Saudi Digital Library's Interface (SDL). *Proceedings of the World Congress on Engineering and Computer Science 2013 Vol I WCECS 2013, 23-25 October, 2013, San Francisco, USA.*

Anderson, J.C. and Gerbing, D.W. (1988). Structural equation modelling in practice: a review and recommended two-step approach, *Psychological Bulletin* , 103(3), 411-423.

Bengts, M. (2004). *Usability as A Constituent of End User Computing Satisfaction*. Unpublished Masters Thesis, Department of Computer Science and Information Systems, University of Jyväskylä.

Blandford, Ann, and George Buchanan. 2002a. Usability for digital libraries. *Proceedings of the Second ACM/IEEE-CS Joint Conference on Digital Libraries, 424. New York: ACM Press*.

Bollen, K.A. (1989). *Structural equations with latent variables*. New York: Wiley.

Chowdhury, S., Landoni, M., & Gibb, F. (2006). Usability and impact of digital libraries: a review*. Online Information Review*, 656-680.

Delone, W.H. & McLean, E.R. (2003). The Debone and McLean model of information systems success: a ten-year update. *Journal of Management Information Systems*, 19(4), 9-30.

Evans, J., O'Dwyer, A., & Schneider, S. (2002). Usability evaluation in the context of digital video archives. *Proceedings of the 4th DELOS Workshop on Evaluation of Digital Libraries: Testbeds, Measurements, and Metrics. Budapest, Hungary, 6 June 2002.*

Fornell, C. and Larcker, D.F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, 19, 39- 50.

Fuhr. N. et al. (2007). Evaluation of digital libraries. International Journal of Digital Library, 8, 21-38.

Hair, J. F., Black, B., Babin, B., Anderson, R.E. and Tatham, R. L. (2010). *Multivariate data analysis: a global perspective.* New Jersey, Pearson Education Inc..

Jeng, J. (2005). What is usability in the context of the digital library and how can it be measured? *Information Technology and Libraries,* 24(2), 3-12.

Joo, S. & Lee, J.Y. (2011). Measuring the usability of academic digital libraries Instrument development and validation. *The Electronic Library*, 29(4), 523-537.

Jose, A. (2007). Evaluation of Digital Libraries: A Case Study. In A.R.D. Prasad & Devika P. Madalli (Eds.): ICSD-2007, pp. 229-238.

Kline, R.B. (2005), *Principles and practice of structural equation modeling*, 2nd ed., Guilford Press, New York, NY.

Koohang, A., Ondracek, J., (2005). Users' views about the usability of digital libraries. *British Journal of Educational Technology*, 36, 407–442.

Masrek, M.N., Jamaludin, A. & Mukhtar, S.A. (2010). Evaluating academic library portal effectiveness: a Malaysian case. *Journal of Library Review*, 59(3), 198-212.

Podsakoff, P.M. , MacKenzie, S.B. , Lee, C.A. and Podsakoff, N.P. (2003). Common method biases in behavioural research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88, 879-903

Preece, J., Rogers, Y. & Sharp, H., (2002). *Interaction design.* John Wiley & Sons.

Ramayah, T. (2006a). Doing e-research with e-library: determinants of perceived ease of use of e-library. *International Journal of Technology, Knowledge and Society*, 1 (4), 71–82.

Raykov, T. & Marcoulides, G.A. (2008), *An Introduction to Applied Multivariate Analysis* , Taylor and Francis, New York, NY.

Roca, J.C., Chiu, C.M.& Martinez, F.J. (2006). Understanding e-learning continuance intention: an extension of the technology acceptance model, *International Journal of Human Computer Studies*, 64(8), 683-696.

Samadi, I. Masrek, M.N. & Yatin, S.F.M (2014) The Effect of Individual Characteristics and Digital Library Characteristics on Digital Library Effectiveness: A Survey at University of Tehran. *World Applied Sciences Journal*, 30, 214-220.

Schwartz, C. (2000). Digital Library: An overview. *The Journal of Academic Librarianship*, 26(6), 385–393.

Snead J.T., Bertot, J.C., Jaeger P.T. & McClure C.R. (2005) Developing multi-method, iterative, and user-centered evaluation strategies for digital libraries: functionality, usability, and accessibility. In: *Proceedings of the American Society for Information Science and Technology*, 42(1).

Tsakonas, G. & Papatheodorou, C. (2008). Exploring usefulness and usability in the evaluation of open access digital libraries. *Information Processing and Management*, 44(3), 1234–1250.

van Welie M., van der Veer G. C., Eliëns A., 1999. Breaking down usability. In: Sasse A., Johnson C. (Eds.), 1999. *Proceedings of Interact '99, Edinburgh, August 8 - September 3. Edinburgh: IOS Press, 613-620*.

Vrana, R. (2007). The Importance of Usability in Development of Digital Libraries. *Proceedings of The INFuture2007 Conference - Digital Information and Heritage.*

Xie, H.I. (2008). Users' evaluation of digital libraries (DLs): Their uses, their criteria, and their assessment. *Information Processing and Management*, 44, 1346–1373.