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Research paper



User Engagement and Satisfaction: The Case of Web Digital Library

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Abstract

In the era of Internet, user engagement has become more significant and relevant due to the intensification of interaction between the user and web applications. Today, most of the computer-based information systems that are in use to support our day-to-day activities are deployed on the web-based platform. The quality and intensity of interaction between the user and these web-based applications are referred as user engagement. While studies on user engagement have been quite extensively reported in the literature, very few have attempted to examine its relationship with user satisfaction. To this effect, this study was conducted with the aim of filling this research gap. The study used survey as the research methodology and the web, digital library as the object of assessment. 299 respondents provided the research data that were analyzed using Partial Least Square Structural Equation Modeling (PLS-SEM) approach. The results of the study showed that user engagement is a strong predictor of user satisfaction. The findings provide additional empirical evidence on the topic of user engagement.

Keywords: *Information Systems; User Engagement; User Satisfaction; Web Digital Library.*

1. Introduction

The term user engagement has its root in human computer interaction research. In [1] described user engagement as a restricted explanation of user experience that concentrates on judgment of product quality during interaction. In [2] defined user engagement as "the emotional, cognitive and behavioral connection that exists, at any point in time and possibly over time, between a user and a resource". On the other hand, in [3] describe user engagement as "a quality of user experience with technology that is characterized by challenge, aesthetic and sensory appeal, feedback, novelty, interactivity, perceived control and time, awareness, motivation, interest and affect". In [4] explain user engagement by highlighting the term 'web application'. This is because, in this era, most computer based information systems are deployed on the web-based platform. In a web based environment, the concept of user engagement has become more significant and relevant because studies have shown that user engagement has a strong effect on continuous use which is one of the success indicators of any computer-based information systems.

In an attempt to better understand user engagement, researchers have developed models and frameworks dimensionalising user engagement. Along with these models and frameworks, researchers have also examined the corresponding antecedents and outcome of user engagement. Further scrutiny on these studies unveiled that very few have examined the effect of user engagement on user satisfaction. Driven by the aim to fill this gap, a study was conducted in the context of web digital library (DL). Universities and higher learning institutions nowadays depend very much on web digital library. The students and faculty members depend heavily on web digital libraries for getting their learning and teaching resources. It is also because of the digital libraries that the students and the faculty members can be actively involved in research activities. Given the importance and contribution of digital libraries, it is therefore necessary to further explore the user experience of interacting with these digital libraries.

2. Literature Review and Research Model

The literature showed that various factors are associated as the antecedents and outcome of user engagement. In [5] identified 20 design elements that have an effect on user engagement: 1) organization; 2) content utility; 3) navigation; 4) graphical representation; 5) purpose; 6) memorable elements; 7) valid links; 8) simplicity; 9) impartiality; 10) credibility; 11) consistency/reliability; 12) accuracy; 14) security/privacy; 15) interactive; 16) strong user control capabilities; 17) readability; 18) efficiency; 19) scannability; and 20) learnability. However, out of the 20 design elements, seven were most often discussed in relation to user engagement, which is navigation, graphical representation, organization, content utility, purpose, simplicity, and readability.

The outcome of user engagement varies depending on the object or technology that the user interacts. In [6] discovered that user engagement was a significant predictor of brand loyalty, in the context of social networking sites. In [7] also reported that user engagement was found to have a significant outcome on frequency of social media usage. In [8] examine the effect of user engagement on systems usage and system performance in the context of business intelligence systems. The results showed that the former was a significant predictor of the later.

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User satisfaction is a construct that is widely adopted when assessing the effectiveness of an information system (IS) or information technology (IT). User satisfaction can be defined as the extent to which users believe the IS meets their needs [9]. In [10] defined user satisfaction is "the affective attitude towards a specific computer application of someone who interacts with the application directly". In [11] defined user satisfaction as "the affective and cognitive evaluation the user develops from a pleasant experience using an IS". In [12] defined user satisfaction as "a subjective evaluation of the various consequences (individual, organizational, social consequences of IS use) evaluated on a pleasant-unpleasant continuum".

The literature on the web DL studies, the characteristics of the DL itself were found to be significant predictors of user satisfaction. In a study involving library portal found that information quality, systems quality and service quality were significantly correlated with user satisfaction [13]. In another study found that information quality, systems quality, service quality, cognitive absorption, perceived ease of use and perceived usefulness jointly predict user satisfaction [14]. Cognitive absorption, being one of the most significant predictor of user satisfaction is closely related to user engagement [14]. By definition, cognitive absorption is a state of deep involvement with the software, represents a situation specific state [15]. According to [16], cognitive absorption is based on three closely related pillars, namely, the state of the flow, the trait of absorption, and notion of cognitive engagement. In [17] extended this concept of user engagement by developing a multi-dimensional construct comprises of focused attention, perceived usability, aesthetics, endurability, felt involvement and novelty.

Figure 1 depicts the research model used in the study. The independent variable (i.e. exogenous construct) is the user engagement which is a multi-dimensional construct comprises of focused attention, perceived usability, aesthetics, endurability, felt involvement and novelty. As discussed in the previous section, user engagement is hypothesized to be a significant predictor of user satisfaction (i.e. endogenous construct) in a web digital library context.

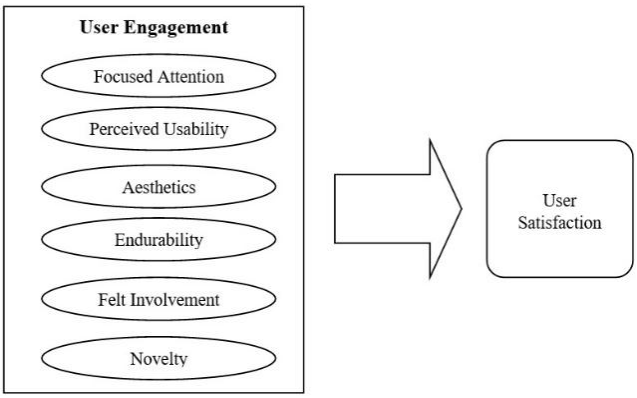


Fig. 1: Research Model.

Focused attention is the concentration of mental activity contained some elements of flow, specifically focused concentration, absorption, and temporal dissociation. Perceived usability is the users' affective (e.g. frustration) and cognitive (e.g. effort) responses to the DL. Aesthetics is the assessment of user's perception regarding the interface such as the screen layout and graphics/images. Endurability is the assessment of users' perception of success with a task, and their willingness to use an application in the future or recommend it to others. It also measures users' overall aesthetic impressions of the DL attractiveness and sensory appeal. Felt involvement is the users' feelings of being drawn in, interested, and having fun during the interaction with the DL. Novelty is defined as the assessment of the user's perception of the extent that the DL stimulates curiosity. It also gauges experience in the form of surprises, unexpected, or new information at various points in time. User satisfaction is the affective attitude in which users believe that the DL meet their needs and expectations.

3. Methodology

3.1. Instruments

Approaches to measure user engagement can be categorized into three main groups: self-reported engagement, cognitive engagement, and online behavior metrics [4]. The self-reported engagement approach uses questionnaires and interviews to elicit user engagement attributes or to create user reports and to evaluate engagement. In this study, the self-reported approach was used. However, instead of using both questionnaires and interviews, the study only employed the former for collecting the research data. The reason for not using the interview approach was because it requires a great deal of time for collecting the research data. The questionnaire of the study was adapted from the user engagement model, which was originally developed by [17]. The model comprised of 31 items to assess six constructs, namely focused attention (7 items), perceived usability (8 items), aesthetics (5 items), endurability (5 items), felt involvement (3 items) and novelty (3 items). However, the instrument by [17] was developed based on e-commerce context. Given that the context of e-commerce websites and DL are dissimilar, the researcher felt that it was therefore necessary to make some adjustments and revisions of the instrument. Past studies focusing on the assessment of DL were referred [13-14, 18-19] and then adapted for the current study. The first draft of the questionnaire comprised a total of 35 items. Each of the construct used five items. For each item, a Likert scale of five anchoring was used. The respondents were required to indicate the extent which they agree or disagree with the items by ticking the Likert scale labelled as 1= "strongly disagree", 2= "disagree", 3 = "undecided", 4 = "agree" and 5 = "strongly agree".

3.2. Sample and Data Collection Procedure

The population of the study was students of the Faculty of Information Management, Universiti Teknologi MARA, Malaysia. At the time of data collection, the total population was 1800. The student number was used to arrange the sample in ascending order. Using a random number generator from this website: http://stattrek.com/statistics/random-number-generator.aspx), a total 400 random numbers between were generated as the targeted samples. Several students and faculty members were engaged to assist in reaching the targeted samples. The study sets the data collection period to be seven weeks. At the end of the data collection, a total of 352 questionnaires were successfully collected. However, during the data cleaning, 53 responses had to be removed because of more than 20% of the questions were not answered. This is in line with [20] who stated that "deletion methods such as listwise and pairwise deletion, have traditionally been used to deal with missing data".

3.3. Data Analysis Technique

This study used Partial Least Square Structural Equation Modeling (PLS-SEM) for analyzing the research data. The reason for choosing this approach was because of (1) the exploratory nature the study and (ii) as discussed in subsequent section, the model used formative measurement as part of the assessment. The use of PLS-SEM analysis involves two steps, which are the assessment of measurement model followed by the assessment of the structural model. The measurement model in SEM is of two types, namely reflective model and formative model. In [21] stated that "prior to designing a measurement instrument, the researcher may have a choice as to which type of the measurement model to use". According to [22], model misspecification occurs when a reflective (formative) construct is wrongly modelled as formative (reflective). In a reflective model the construct is viewed as the cause

and the measures or indicators its manifestations while informative model, the indicators determine or cause the construct. A construct can be either unidimensional or multidimensional and applicable to both reflective and formative models. Hence, it is possible to have a multidimensional construct that is formative but each construct is using reflective indicators. In this study, a formative measurement model was adopted for the user engagement. Following [17], the researcher argued that each of the construct, namely, focused attention, perceived usability, aesthetics, endurability, felt involvement and novelty carries different weight in the formation of user engagement.

In PLS-SEM analysis, the measurement model is assessed in terms of the convergent validity and discriminant validity. The convergent validity is assessed in terms of Cronbach's Alpha, composite reliability (CR) and the average variance extracted (AVE). Both Cronbach's Alpha and composite reliability (CR) measure the internal consistency of a scale (i.e. the questionnaire), while the average variance extracted (AVE) measures the total amount of variance in the indicators accounted for by the latent variable. The assessment of the structural model is done by evaluating the R2 and Q2 respectively. Both R2 and Q2 assess the predictive power of the model. R2 is the measure of the model's predictive accuracy and can be viewed as the combined effect of exogenous variables on endogenous variables, while Q2 can be considered a type of model fit indicator.

4. Results and Analysis

4.1 Common Method Bias

The likelihood of experiencing common method bias is quite possible for a study that uses single data. Common method bias refers to the variance attributable exclusively to the measurement procedure as opposed to the actual variables the measures represents. To examine the possibility of this threat, the Harman single factor test was executed and the result indicated that, when all items, constrained to a single factor, the total variance explained was 29.97.1 %, less that the cutoff value of 50%. Given the result, it can be concluded that the data obtained from the study was free from common method bias.

4.2 Demographic Profiles of Respondents

The demographic profiles of respondents are shown in Table 1. Between male and female, the former was 24.4%, while the later was 75.6%. In terms of semester of study, the majority indicated to be in semester two (30.8%), followed by semester three (21.1%) and semester five (15.4%). With regard to program of study, the undergraduate students were 76.6%, while the postgraduate was 23.4%.

Table 1: Demographic Details of Respondents

		Frequency	Percent (%)
Gender	Male	73	24.4
	Female	226	75.6
Semester	1	38	12.7
	2	92	30.8
	3	63	21.1
	4	33	11.0
	5	46	15.4
	6	27	9.0
Program	Postgraduate	70	23.4
	Undergraduate	229	76.6

4.3. Measurement Model

Table 2 presents the results of the convergent validity assessment. As shown in Figure 2, the loadings for all items are well above 0.7 [23]. The Cronbach's Alpha for all constructs surpassed the benchmarked value of 0.7, while the composite reliability (CR) and average variance extracted (AVE) also surpassed the recommended values of 0.7 and 0.5 respectively [23].

Discriminant validity refers to the degree to which items differentiate across constructs. The Fornell & Larker criterion [24] was used to assess the discriminant validity and the results as shown in Table 3 indicate that the AVE of a latent variable are higher than the squared correlation between the latent variable and all other variable.

Apart from the Fornell & Larker criterion [24], the Heterotrait-Monotrait criterion was also used to assess discriminant validity. HTMT refers to the ratio of correlations within the constructs to correlations between the constructs. As shown in Table 4, none of the values surpassed either 0.85 [25] or 0.90 [26], suggesting that there is no issue in terms of discriminant validity of the model.

As this study uses the formative measurement model for the engagement construct, it is imperative to assess the convergent validity through redundancy analysis. In [23] suggest that the part coefficient between the second order construct and the endogenous construct is above 0.7. In this study, the path coefficient is 0.679 (Table 5). Given that this study is exploratory, the value is considered acceptable. To further determine whether collinearity issues exist in the formative measurement model, the variance inflation factor (VIF) was assessed. Collinearity issues are normally present in cases where VIF of the construct is 3.3 or higher [27]. As shown in Table 5, the scores of VIF for all constructs were less than 3.3, suggesting that there is no issue of multicollinearity.

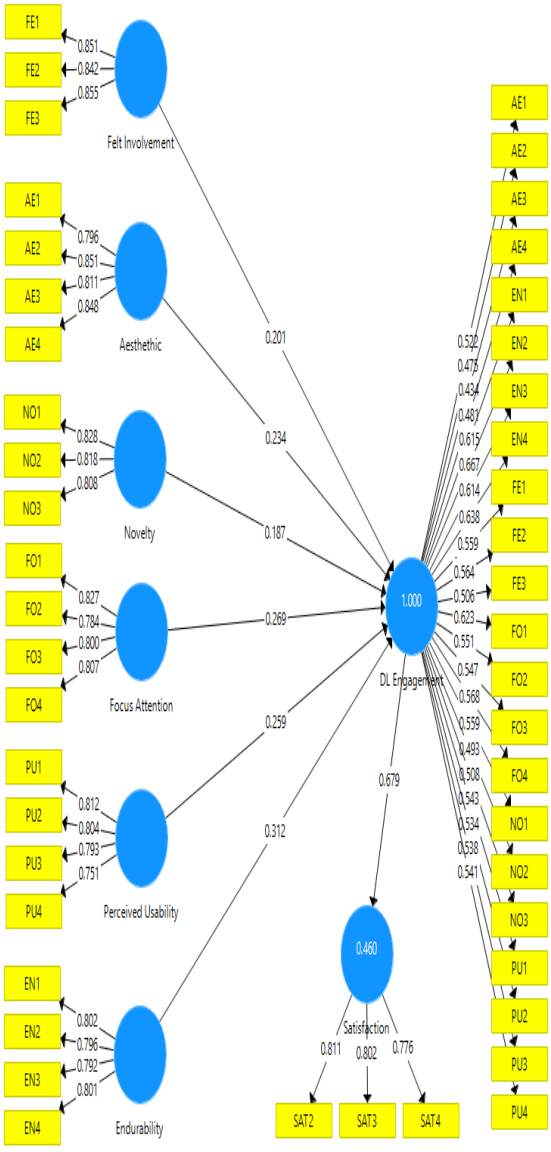


Fig. 2: Measurement Model

Table 2: Heterotrait-Monotrait Criterion for Discriminant Validity

	AE	EN	FE	FO	NO	PU
AE						
EN	0.448					
FE	0.300	0.508				
FO	0.349	0.534	0.420			
NO	0.255	0.516	0.540	0.495		
PU	0.286	0.571	0.390	0.458	0.421	
SA	0.487	0.782	0.518	0.589	0.548	0.653

AE = Aesthetic, EN = Endurability, FE = Felt Involvement, FO = Focus Attention, NO = Novelty, PU = Perceived Usability, SA = Satisfaction

Table 3: Assessment of Convergent Validity

Constructs	Item Code	Item	Loading	α	CR	AVE
Endurability	EN1	Resource finding in the DL websites is very rewarding	0.802	0.81	0.875	0.637
	EN2	Resource finding in the DL websites has always been successful	0.796			
	EN3	I will always use the DL websites to find academic resources	0.792			
	EN4	I will always recommend to my colleague to use the DL websites	0.801			
Perceived Usability	PU1	The DL websites is well designed to find what I want	0.812	0.799	0.869	0.625
	PU2	I can complete a resource-finding task quickly using the DL websites	0.804			
	PU3	The DL websites is easy to use to perform my search tasks	0.793			
	PU4	Using the DL website has never been frustrating for me	0.751			
Felt Involvement	FE1	When using the DL websites, I was really drawn to my resource finding task	0.851	0.807	0.886	0.722
	FE2	I felt fully involved in resource finding when using the DL websites	0.842			
	FE3	Resource finding task using the DL websites was fun	0.855			
Focused attention	FO1	I forgot about my immediate surroundings while using the DL websites	0.827	0.819	0.88	0.647
	FO2	I lost track of time while using the DL websites	0.784			
	FO3	I was so involved in using the DL website that I ignored everything around me	0.800			
	FO4	The time I spent on the DL website just slipped away	0.807			
Aesthetic	AE1	The DL websites was attractive	0.796	0.846	0.896	0.683
	AE2	The DL websites was visually appealing	0.851			
	AE3	I liked the graphics and images used in the DL websites	0.811			
	AE4	This DL website appealed to my visual senses	0.848			
Novelty	NO1	I continued using the DL websites out of curiosity	0.828	0.754	0.859	0.67
	NO2	The content of the DL websites incites my curiosity	0.818			
	NO3	I felt more interested with my resource finding when using the DL websites	0.808			
Satisfaction	SAT2	The DL is effective	0.811	0.712	0.839	0.635
	SAT3	The DL website is efficient	0.802			
	SAT4	My interaction with the DL website is very satisfying	0.776			

α = Cronbach Alpha, CR = Composite Reliability, AVE = Average Variance Extracted

Table 4: Fornell & Larker Criterion [24] for Discriminant Validity

	AE	EN	FE	FO	NO	PU	SA
AE	0.827						
EN	0.374	0.798					
FE	0.251	0.412	0.850				
FO	0.295	0.436	0.345	0.805			
NO	0.209	0.407	0.425	0.389	0.818		
PU	0.238	0.460	0.313	0.372	0.326	0.79	
SA	0.379	0.593	0.395	0.451	0.404	0.493	0.797

AE = Aesthetic, EN = Endurability, FE = Felt Involvement, FO = Focus Attention, NO = Novelty, PU = Perceived Usability, SA = Satisfaction

Table 5: Validity Parameter Estimate of the second order (formative)

Second Order Construct	First Order Dimension	Convergent Validity	Weight	Variance Inflation Factor (VIF)	t-Value	p-Value
Engagement	Aesthetic	0.679	0.234	1.203	8.108	0.000
	Endurability		0.312	1.640	15.048	0.000
	Felt Involvement		0.201	1.374	13.204	0.000
	Focus Attention		0.269	1.408	15.298	0.000
	Novelty		0.187	1.399	12.691	0.000
	Perceived Usability		0.259	1.362	12.837	0.000

4.4. Structural Model

Table 6 presents the results of the structural model assessment (Figure 3). Following [23], the t and the p value to meet the recommended values, i.e. $t > 2.58$ and $p < 0.01$. According to [28], R2 should be high enough for the model to achieve a minimum level of explanatory power. The results on the assessment showed that the results of the path analysis were substantial because the R2 of the outcome variable is 0.46, exceeding the recommended value of 0.30 [29]. In this study, the predictive relevance (Q2) is assessed using the blindfolding procedure which is a "resampling technique that systematically deletes and predicts every data point of the indicators in the reflecting measurement model of endogenous construct" [30]. In PLS-SEM, the blindfolding procedure is applied to endogenous construct that have a reflective measurement model specification as well as to endogenous single item construct [30]. A model is said to have predictive relevance when $Q2 > 0$ but if $Q2 \leq 0$, the model is said to be lacking of predictive relevance. As shown in Table 6, user engagement was also found to have predictive relevance because the Q2 value is more than 0.

5. Discussion

The aim of this study has been to examine the effect of user engagement on user satisfaction in a DL context. Defining user engagement as the multi-dimensional constructs, this study has shown that user engagement has a strong and positive relationship with using satisfaction. Instead of using the reflective model, this study used formative model in the measurement. As shown in the results all the constructs namely focused attention, perceived usa-

bility, aesthetics, endurability, felt involvement and novelty carries significant weight in the formation of user engagement. The results simply suggest that, the higher is the rating of the user engagement, the higher is the satisfaction of the user. The findings of the study are almost comparable to [13, 18, 19]. Similar to the findings of these studies, the present study further highlights the importance and significance of the DL characteristics in determining user satisfaction.

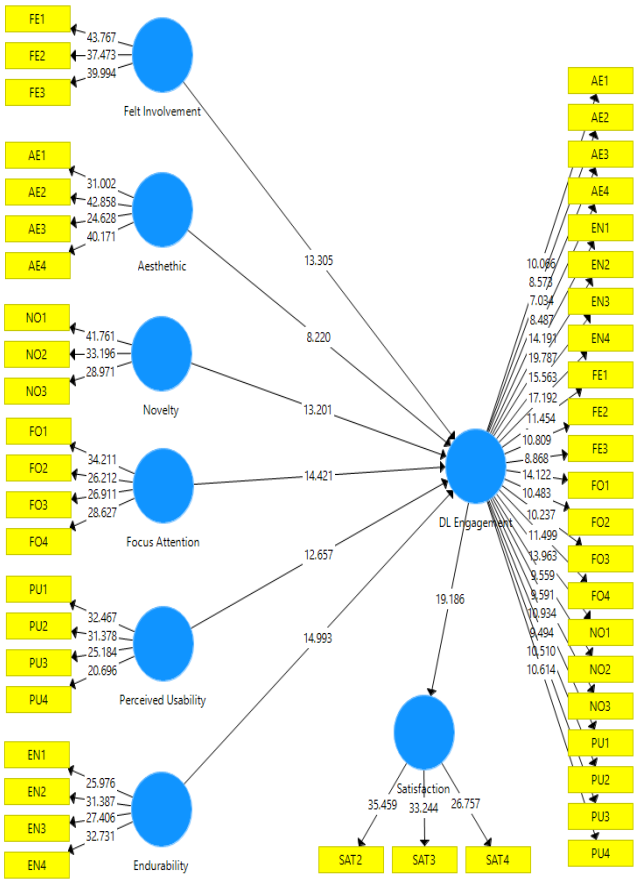


Fig. 3: Structural Model

Table 6: Validity Parameter Estimate of the second order (formative)

	β	T Value	P Values	R^2	Q^2
DL Engagement → Satisfaction	0.679	19.186	0	0.46	0.277

A web DL, just like any other form of computer-based information systems is considered effective or successful when the users are highly satisfied with the experience of using them [31, 32]. In line with the advancement and sophistication of the Internet and web technologies, the users of web DL tend to increase their expectations and demands for better functionality and service delivered by the DL [33]. A well-developed DL interface that is highly usable, aesthetically attractive and stimulates curiosity of users will result in a more satisfied users. This is because the experience of engagement with such DL interface is pleasurable and that the users are deeply involved in the usage. According to [34], "flow and the feeling of losing track of time is considered to be a key indicator of a person's successful use when deeply engaged in the process of searching". To this effect, any task performed on the DL which is normally concentrating in information searching that does not end up with any failure or a breakdown will also translate into a more satisfied user.

6. Conclusion

As claimed earlier, the study attempts to fill the research gap on the relationship between user engagement and user satisfaction. From the theoretical viewpoint, it has contributed significantly to the body of knowledge through the creation of empirically-based research model. This model could be further tested in other web based information systems. Future research can also consider integrating other antecedents of user engagement along with satisfaction as the outcome. From the practical viewpoint, DL developers should consider the design elements delineated in this study, when developing user engagement strategies. In addition, the instrument developed in the study can be used as a diagnostic tool for assessing the effectiveness of the DL.

Just like in other empirical research, several limitations are worth to be mentioned. Firstly, the study used self-reported measurements which are bound to several biases. Secondly, the respondents involved in this study were only students. The results would be more interesting if faculty members were also engaged as respondents. Thirdly, the object of assessment was only one DL of one university. Engaging more DLs in a study would probably provide better findings as comparison analysis can be further done.

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