Assessing Website Usability Attributes Using Partial Least Squares

Nur Sukinah Aziz and Adzhar Kamaludin

***Abstract*—Usability is critical issues especially for website usability because nowadays most of organizations use website as the medium of communication. For a good website, the website must be useful, easy to use, easy to understand and easy to navigate. This paper analyzes the attributes that give some influence to the website usability and the impact of intention to use attributes the website. Usability is attribute that cannot be observed directly. It more on user feel and think about the website in other word it more on user perception to particular web site. 82 respondents are participated in this study. The respondents are given task to explore and find the information in the given website. PLS – SEM is used to analyze the data to see either all attributes are give influence to the website usability.**

***Index Terms*—Website, usability, SEM, PLS.**

I. Introduction

Nowadays, website is used widely all over the world as the medium of communication for information or services. An organization uses website to market their products and services. User will always used the website if the website can achieve their task or goal for searching the information or using it's services more quickly, easily and effectively [1], [2]. There are many factors or characteristic to determine the quality of a web site and usability is one of them [3], [4]. There are many quality models that contain usability characteristic such as McCall's Quality Model, Boehm's Quality Model, ISO 9126 Quality Model, FURPS Quality Model, Dromey's Quality Model and QUIM Quality Model [4]. Many researchers adapted software usability in website usability. The perception of usability is also influenced by user profile such as gender, age, educational level and technology skills. Beside that, the difference of culture or life style of individual also give effect to design layout, use of colour and animation and information content [5]. So to identify the website is usable or not, we can predict by user satisfaction and intention to use information. Based on [6], usability is depends on the interactions among users, products, tasks and environments. There is no thermometer-like instrument that can provide an absolute measurement of the usability of a product.

Nowadays there are many studies in Information System (IS) using Structural Equations Modeling (SEM) to test the theoretical model development [7]. SEM is a second generation statistical analysis techniques to examine or analyze the structure of inter-relationships among multiple variables in a model [8]. The inter-relationships expressed in a series of equations such as in single or multiple regression equations. First-generation techniques, such as regression-based approaches (e.g., multiple regression analysis, discriminant analysis, logistic regression, analysis of variance) and factor or cluster analysis, belong to the core set of statistical instruments which can be used to either identify or confirm theoretical hypothesis based on the analysis of empirical data [9]. The first-generation techniques incapable of either assessing or correcting for measurement errors and only use observed variables.

Meanwhile, SEM can use both observed and unobserved variables. That's why SEM technique is used in this study because many attributes are unobserved variables. This technique also can test complete theories and concepts in one complete model. SEM has two types of variations that are CB-SEM (Covariance-based SEM) and PLS-SEM (Partial Least Squares SEM). CB-SEM is to reproduce the theoretical covariance matrix without focusing on explained variance. For PLS-SEM is to maximize the explained variance of the endogenous latent constructs (dependent variables). There are a few study that used PLS-SEM for analyze the data that focusing issues in website usability [10]. Partial Least Squares (PLS) approach are used to test the research model. PLS is a second generation multivariate techniques that can simultaneously evaluate the measurement model [11]. Measurement model is the relationships between constructs and their corresponding indicators. PLS also can analysis of non-normal data and small sample size. The features in PLS – SEM make it more popular than CB – SEM approaches [12].

II. Review of Usability Model

Usability is a product attributes that give impact or influences the quality of a software system [13]. Usability model is conceptual view and not only states the characteristics but also indicates how those characteristics fit together. There are many definitions or terms about usability.

Human Computer Interaction (HCI) is about designing computer systems that support people so that they can carry out activities productively and safely. In HCI term, usability is more to usable user interface or in other word to make system easy to learn and easy to use [14]. Based on ISO 9241 – 11 in HCI field, usability is defined as the "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" [3], [15]. Refer to the definition

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on ISO 9241 – 11, the criteria of usability are effectiveness, efficiency and satisfaction. It focuses on human interaction perspective for software product standard. This definition has 3 components that can divide such as "specified users", "achieve specified goals" and "specified context to use". This definition is more clearly what usability is mean and many researchers use this definition [14]. There are several usability model such as Eason Model (1984), Shackel Model (1991), Nielsen Model (1993), ISO 9241-11(1998), ISO 9126 (2001) and QUIM model (2006).

Eason Model is proposed by Kenneth Eason (1984) and published his model in an early issue of Behaviour and Information Technology. Eason Model has 3 aspect, task, user and system. For task it has 2 sub attribute that is frequency and openness. User has 3 sub attributes that is knowledge, motivation and discretion. System has ease of learning, ease of use and task match. Eason Model cannot measure usability without considering users and their target task. Eason model is causal type of model because it has input that is independent variable and outcome or result that is dependent variable. A causal model is one that makes prediction about causality. Eason model sees usability as the result of several interacting variables or "multi - variate". [14], [13].

Shackel Model was developed by Brian Shackel. In this model, it has 4 attributes that is effectiveness, learnability, flexibility and attitude. Shackel Model does not weight the dimension, recognizing that the importance of each of these may different from project to project. Shackel model emphasizes measurement of a number of human factors, relating to human performance and attitude [13], [14]. [16] modified Shackel model and adapted the model into usefulness, effectiveness, learnability (or ease of use) and attitude (or likeability). [17], [18] said that definition with one or more of four criteria in Booth model are generally accepted by usability community.

Nielson Model was developed by Jakob Nielson. The main model is system acceptability and usability is part of usefulness. Other attribute that contribute to the main model are utility, usefulness, practical acceptability and social acceptability. Under usability it has 5 attributes such as easy to learn (learnability), efficient to use (efficiency), easy to remember (memorability), few error and subjectively pleasing (satisfaction). Nielson Model focus on acceptability that mean if the system is not useful such as did not meet the user requirement, it will not accept it either it usable or not. Same with Shackel Model, Nielson Model also does not weight the dimension, recognizing that the importance of each of these may different from project to project. Nielson model is additive model [13], [14].

ISO 9241 is an international standard for guidance on usability based on process oriented. Nielson and Shneiderman are among the committee members in the development of ISO guidelines. For ISO 9241 – 11 has 3 attributes that are effectiveness, efficiency and satisfaction. ISO 9241 – 11 are put together from a different usability viewpoint. Effectiveness describes the interaction from the process viewpoint, efficiency which focus on results and resources involved and satisfaction which is a user viewpoint [12], [19], [20]. ISO 9241-11 has objective measures of usability [21]. The disadvantage of this model is that it is to abstract [22], [23].

ISO 9126 is an international standard for the evolution of software quality model from the product perspective. The approach was quality model of the product and initially published in 1991 and refined over the next ten years by ISO's group of software engineering experts. ISO 9126 is an extension of previous work done by McCall (1977), Boehm (1978), FURPS and others in defining a set of software quality characteristics [24]. ISO 9126 divided into 4 parts which address respectively to the quality model, external metrics, internal metrics and quality in use metric. The internal and external metrics are functionalities, reliability, usability, effectiveness, maintainability and portability [19]. Under usability it has 5 attributes such as understandability, learnability, operability, attractiveness and usability compliance [19], [20], [13]. The advantage of ISO 9126 model is it provide a framework for making trade-offs between software product capabilities and the attribute are applicable to any kind of software including computer programs and provide consistent terminology for software product quality. The disadvantage of ISO 9126 was unclear architecture at the detail level of the measures, overlapping concepts, lack of a quality requirement standard, lack of guidance in assessing the results of measurement and ambiguous choice of measures [21].

QUIM or Quality in Use Integrated Measurement developed by Ahmed Seffah et al in 2006. QUIM is a consolidated model for usability measurement and metrics. It combines various standard and model such as ISO 9241 and ISO 9126 and unified into a single consolidated, hierarchical model. It outlines methods for establishing quality requirements as well as identifying, implementing, analyzing, and validating both process and product quality metrics. This model appropriate for novice user that have little knowledge of usability and can be applied by usability experts and non-experts. QUIM model consists of 10 factors and subdivided into 26 criteria or measurable criteria, and finally into specific metrics consists 127 specific metrics. The 10 factors consists Efficiency, Effectiveness, Satisfaction, Learnability, Productivity, Safety, Trustfulness Accessibility, Usefulness and Universality. The model is used to measure the actual use of working software and identifying the problem. In QUIM model associates factors with criteria and metrics in a clear and consistent way. It also usable generally and can adapt in specific context of use. The limitation of this model,it is not optimal yet and needs to be validated [22], [23], [25].

III. Proposed Model

Some of the usability models have been discussed in this paper. Refer to Table I for their main attributes in usability model and other researchers that have been made in previous study. There are many attributes in each model but there has similarity between the models. The high frequency of attributes that used in usability are effectiveness, efficiency, learnability and satisfaction.

TABLE I: SIMILARITY BETWEEN THE USABILITY MODEL

	Effectiveness	Efficiency	Learnability	Satisfaction	Accessibility
Eason Model (1984)		√	√		
Shackel Model (1986)	√		√		
Nielson Model (1993)		√	√	√	
ISO 9241 – 11 (1998)	√	√		√	
ISO 9126 (2001)				√	
QUIM (2006)	√	√	√	√	√

4 attributes are selected based on frequency in each model and other study made by researchers to see the similarity and represent it in Table I. The attribute that have been selected are effectiveness, efficiency, learnability and satisfaction. As a results in Table I, the 4 usability attributes that have been use frequently in the previous model are selected since they are suitable and important to evaluate usability on web site.

Learnability is the most attribute or characteristic that used among the models. The satisfaction attribute selectable because to determine whether the web site is usable or not. If the user feels more satisfied, they are willing to reuse and revisit he web portal based on the study Arbaugh and Duray (2002). In addition, more satisfying experiences sometimes lead to better learning performance in the future based on the study conducted by Shih, Muroz, & Sanchez, 2006 [26]. Based on Table I, it can be concluded that among the usability model, QUIM model is more complete than other models and suitable to be used in the web site usability because it consolidated model based on previous works and model. QUIM model brings together usability factors, criteria, metrics and data mentioned in various standards or model for software quality and defines them and their relations with one another in a consistent way [22].

Based on the discussions above, QUIM model as a based in this study and modified it focusing on web site. In table 1, QUIM model used 4 attribute that are Effectiveness, Efficiency, Learnability, Satisfaction and also include Accessibility. This model also based on ISO standards and previous research in the area usability and quality in use. The context of use is considered when selecting the aspects of the web site that should be measured. In this way, the consideration of context in usability measurement will ideally make such measurement more realistic and meaningful [22].

IV. PROPOSED ATTRIBUTES IN WEBSITE USABILITY

A. Effectiveness

Effectiveness is among attributes that always include in standard usability model or previous work [13], [27]. Effectiveness is more about the accuracy and completeness with which users can achieve certain goal. The main focus users when visit the website are wanted to complete the main reason visit the website. It also include It can be measure by measuring the outcome of the user's interaction with system and error rates while attempting to complete the task or how many answers are correct. Some study focus on interface effectiveness point of view human-computer interaction [28].

B. Efficiency

According to International Organization for Standardization (ISO) efficiency refers to the resources used in completing a task (ISO, 1998). Based on [29], efficiency defined as a representation of resources expended in relation to achieving goals while visiting a website. The user can achieve goals a quick visit without putting much cognitive effort and do what is of interest to them in an effective. They feel that the website responds at a reasonable speed. Disorientation, or the tendency to lose one's sense of location in a website, can cause users to become frustrated, lose interest, and experience a measurable decline in efficiency [29]. Efficiency also can measure as task completion time and learning time.

C. Accessibility

As discuss above, usability is about web site that usable and can be access by everyone. So element of accessibility is should be consider being a part of usability. Accessibility refers to the ease with which a visitor can reach a website. Poor download speeds due to access logs, transmission logs or server logs can be source of irritation to users. Adding graphic and media sometimes can make long waiting time to load a web page or inability to access a website temporarily (due to server breakdown or server capacity constraints). It can cause users frustration and negative publicity. There are a few issues that consider in accessibility such as cultural issues including language, colour and symbols, social issues involving matters such as disability, gender and age, skills, economic factors and legal matters and technological issues that relate to computer, internet connections, telecommunications network and infrastructure [30]. Good website also must consider about user with has some type of disability (e.g., visual, hearing, psychomotor). Some of the web site are did not consider about user that has disability. The World Wide Web Consortium (W3C) suggested various design guidelines for making Web sites more accessible to persons with disabilities [22]. Cascading Style Sheets (CSS) was developed by W3C that enabled web designers and publishers to establish a coherent style for a web site without burdening every page with formatting code. Web pages that use CSS a more compatible with any web browser and will load faster.

D. Learnability

In order to achieve the efficiency and effectiveness while using a website, users must first learn how to interact with the device. The ease, in time or effort with which users can learn website and achieving a sufficient level of competence with the website and be able to complete goals in efficient and effective manner. Based on Nielson's usability model (1993), learnability refers to how easy it is for casual users to learn a system. In the websites with high learnability users feel they are able to start using the site with the minimum of introductions and everything is easy to understand from the

start. In the websites with low learnability users feel that the site may be using concepts or terminologies which are unfamiliar and need more explanations [31].

E. Satisfaction

Satisfaction is a multi-dimensional construct [28]. Satisfaction means that when users feel comfort and positive attitudes towards the use of the website. Users believe that the website can fulfill their needs has an impact on user satisfaction. The International Standard ISO 9241-11 (1998) defined this as the extent in which the users are free from discomfort while using the product and the general attitude of users during the use of the product [32]. It also measure the level of comfort that user feels when using the website and how acceptable the website to user in achieving their goals. This attribute is more subjective and researchers tends to indicate that is more difficult to measure.

Identified effectiveness, efficiency, learnability, satisfaction and accessibility as the main attributes of website usability. All the attributes will re-examined based on relevant literatures related to website usability. Below in Table II are the attributes or characteristics that are choose as the element in the model.

TABLE II : DESCRIPTION FOR PROPOSED USABILITY

Attributes	Description
Efficiency	– the way a website supports user in carrying out their tasks and capability of the website to enable users to expend appropriate amounts of resources in relation to the effectiveness achieved in a specified context of use.
Effectiveness	– refer to how good a website is at doing what it is supposed to do and the capability of the website to enable users to achieve specified tasks with accuracy and completeness
Learnability	– refer to how easy a website is to learn to use. It is the capability of the website to enable users to feel that they can productively use the website right away and then quickly learn other new (for them) functionalities.
Accessibility	- refer to how easy the user to access the website and the capability of website to be used in terms of response time to each task that perform by user and by users with some type of disability (e.g., visual, hearing, psychomotor).
Satisfaction	– refer to subjective response how users comfort to use the website and their positive attitude after use the web site.

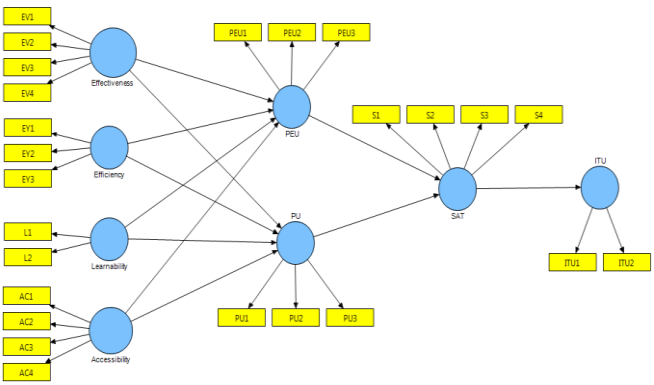

Fig. 1. Research model.

V. METHODOLOGY

The usability in quality model and usability model are identified to see the pro and cons each model. The instrument for the research, the constructs were adapted from previous validated instruments such as QUIM model. To see either the website is usable or not, it reflective on intention to use that has indirect effect with user satisfaction. Higher education institution web sites are chosen to evaluate the proposed usability model. Evaluating website usability is of significant importance to the success of higher education websites [33]. Higher education web sites often contain important information about academic resources, campus events, and administrative policies. These sites also provide information on college services such as the college library, campus bookstore, and course registration system. As college websites take on significant and increasingly important roles, it is imperative that these sites be user-friendly. For the instrument for this study, questionnaire from Computer System Usability Questionnaire (CSUQ) were adapted and also include a few question that refer to the item constructs that used [34]-[36].

The first part of the research contains demographic profile of respondents including gender, age, internet usage duration and internet experience. The questionnaire assesses web site usability by asking participants to compare their expectations againts their finding on the web site. The items of the constructs such as Effectiveness, Efficiency, Learnability, Accesibility, Satisfaction (SAT), Perceived Usefulness (PU), Perceived Ease of Use (PEU), and Intention to Use (ITU) are used. A five-point Likert-type scale ranging from (1) ‘‘strongly disagree” to (5) ‘‘strongly agree” was used to answer the questions in the 28 item of the questionnaire. A pilot test was required to test the research model and questionnaire. Since some items in the questionnaire were developed which are adapted from CSUQ and a few are additional, a pretest was required.

The research model is shown in Fig. 1.
hypotheses were developed to be tested:

H1. Efficiency will positively affect the Perceived Usefulness of website.

H2. Efficiency will positively affect the Perceived Ease of Use of website.

H3. Effectiveness will positively affect Perceived Usefulness of website.

H4. Effectiveness will positively affect Perceived Ease of Use of website.

H5. Learnability will positively affect Perceived Usefulness of website.

H6. Learnability will positively affect Perceived Ease of Use of website.

H7. Accessibility will positively affect Perceived Usefulness of website.

H8. Accessibility will positively affect Perceived Ease of Use of website.

H9. Perceived Usefulness will positively affect the Satisfaction of user

H10. Perceived Ease of Use will positively affect the Satisfaction of user

H11. Satisfaction will positively affect the Intention to Use of UMP website

VI. DATA ANALYSIS AND RESULT DISCUSSION

A pilot study was conducted to identify consistency of the questions and an understanding of the respondents to the

questionnaire. 82 respondents were involved in this pilot study.In this section, the descriptive statistics and SEM-PLS results to test the research hypothesis are presented. Data analyses is conduct using SPSS 18.0 and SmartPLS 2.0.

About 82 respondents were involved. Before respondents answer the questionnaire, all the respondents need to use the web site that have been told and explore the website based on the questions that have been given. They need search and find the information based on question. About 42 respondents are male and 40 respondents are female. Most of respondents about 93.9 % are between ages 18 – 24 years old and the rest are 25 – 45 years old. 92.7 % are students and it reflective on age that between 18-24 years old. 7.3% are government employees and private sector employees. More than 50% of respondents have internet experience more than 4 years. About 70% of respondents use internet 5 hours per day and it show that most of us are always use internet does not matter for searching information, learning, social network or other activities. About 52.4% never visit or use the website that given to them before this. That's why in this pilot study the respondents are given question to search the information and explore the website to give their experience to use the website.

VII. Reliability and Validity of the Measures

A. Measurement Model

Reliability of attribute in the questionnaire using Cronbach's Alpha is .939 using 28 item. Cronbach's Alpha was used to check reliability of each attribute. For the whole questionnaire for the survey is reliable because the results is above .5. All attributes in the questionnaire is above .5. Fig. 2 shows the research model that run in SmartPLS to analyze the measurement model. Table III shows the Cronbach's Alpha for each attribute. The measurement model is the model that show the relationship between response items and their underlying latent construct [8]. Convergent validity is the degree to which multiple items to measure the same concept are in agreement. To assess convergence validity there are three items that are factor loadings, average variance extracted (AVE) and composite reliability (CR). The recommended values for loading are set at > 0.5, the AVE should be > 0.5 and CR should be > 0.7 [34]. From Table III it can be seen that the results of the measurement model exceeded the recommended values for indicating sufficient convergence validity.

After confirming the convergent validity, discriminant validity are tested. Discriminant validity is the degree to which items differentiate among constructs or measure distinct concepts. The diagonal values in bold is the square root of AVE while other values are the correlation between the respective constructs. The discriminant validity is achieved when a diagonal value in bold is higher than the values on its row and column.

The result in Table IV shows that all values in diagonal are greater than the values in the row and columns on the particular constructs. It shown that the measures discriminant are distinct. Table V result for loadings and cross loadings. The value that are bold must higher than the values in row and column on particular items.

TABLE III : Measurement Model

Construct (attribute)	Item	Loadings Weight	Cronbach's Alpha	AVE	CR
Accessibility	AC1	0.818	0.783	0.605	0.859
	AC2	0.825			
	AC3	0.697			
	AC4	0.764			
Effectiveness	EV1	0.861	0.821	0.651	0.882
	EV2	0.816			
	EV3	0.797			
	EV4	0.750			
Efficiency	EY1	0.743	0.749	0.664	0.855
	EY2	0.850			
	EY3	0.847			
ITU	ITU1	0.901	0.775	0.816	0.899
	ITU2	0.906			
Learnability	L1	0.873	0.640	0.735	0.847
	L2	0.840			
PEU	PEU1	0.798	0.683	0.614	0.826
	PEU2	0.849			
	PEU3	0.696			
PU	PU1	0.886	0.874	0.799	0.923
	PU2	0.884			
	PU3	0.911			
SAT	S1	0.875	0.777	0.693	0.871
	S3	0.872			
	S4	0.743			

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 AVE = (summation of squared factor loadings)/(summation of squared factor loadings) (summation of error variances)

TABLE IV: Discriminant Validity

	Accessibility	Effectiveness	Efficiency	ITU	Learnability	PEU	PU	SAT
Accessibility	**0.778**							
Effectiveness	0.704	**0.807**						
Efficiency	0.632	0.783	**0.815**					
ITU	0.527	0.498	0.463	**0.904**				
Learnability	0.700	0.753	0.582	0.485	**0.857**			
PEU	0.617	0.669	0.647	0.475	0.619	**0.783**		
PU	0.549	0.636	0.644	0.371	0.597	0.709	**0.894**	
SAT	0.771	0.776	0.598	0.578	0.775	0.688	0.610	**0.833**

Note : Diagonal represent the square root of the AVE and the off-diagonals represent the correlations.

B. Structural Model

The structural model is the model that demonstrates the correlation or causal dependencies among the measurement model in the study. The latent constructs are assembled into the structural model based on the hypothesized inter relationships among them [8]. To evaluate the structural model, bootstrapping is used with re-sampling of 500. The path estimates and t-statistics were calculated for the hypothesized relationships.

Table VI shows the structural model analysis. From the analysis all the value in *t*-value are $p<0.01$. This shown that all hypothesis H1, H5, H6, H7, H8, H9 and H10 that include attributes such accessibility, efficiency, satisfaction and learnability are significant and positively affect the web site usability. All the paths are significant at the 0.05 level and 0.1 level. Meanwhile hypothesis H2, H3 and H4 are not supported after run the analysis. The H2 is hypothesis about accessibility will has influence to perceive of usefulness, H3 is hypothesis about effectiveness will has influence to

perceive of ease of use and H4 about hypothesis effectiveness will has influence to perceive of usefulness. Fig. 3 shown the research model after run the analysis.

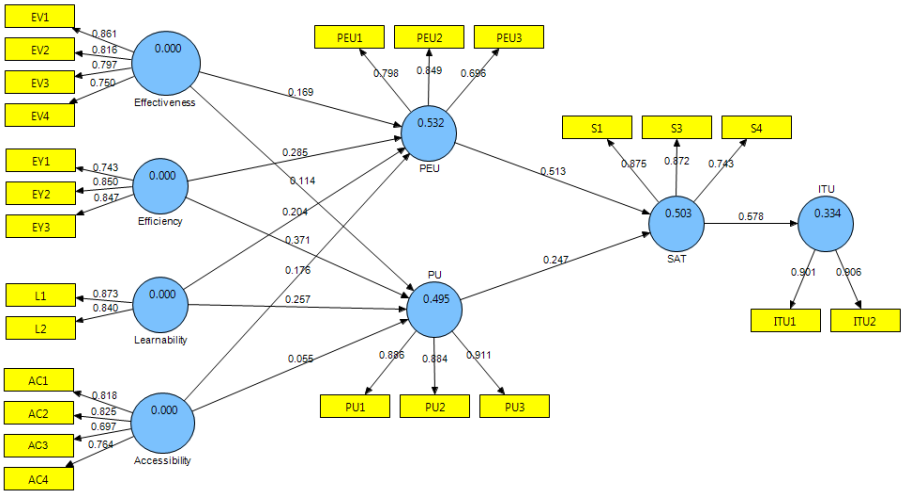

Fig. 2. Research model run in SmartPLS for measurement model.

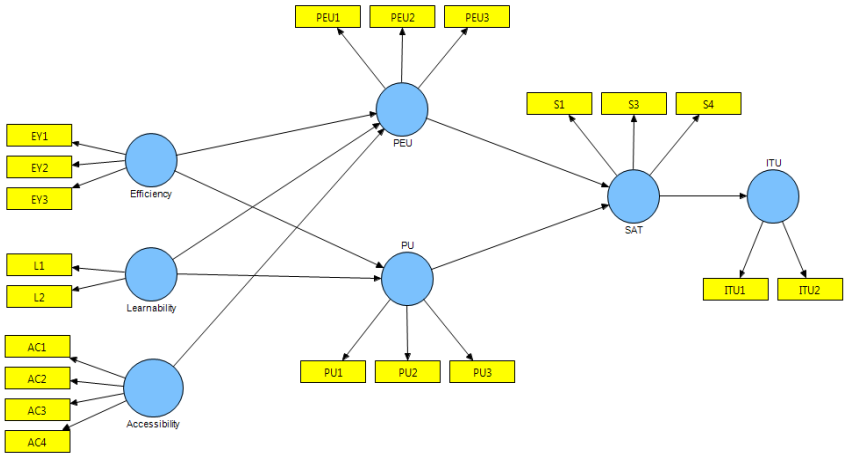

Fig. 3. Research model result after analysis using PLS.

TABLE V: LOADINGS AND CROSS LOADINGS

	Accessibility	Effectiveness	Efficiency	ITU	Learnability	PEU	PU	SAT
AC1	**0.818**	0.560	0.476	0.471	0.669	0.503	0.481	0.670
AC2	**0.825**	0.604	0.546	0.407	0.516	0.552	0.502	0.585
AC3	**0.697**	0.430	0.440	0.417	0.365	0.464	0.298	0.518
AC4	**0.764**	0.587	0.503	0.340	0.618	0.383	0.398	0.627
EV1	0.608	**0.861**	0.696	0.516	0.766	0.611	0.561	0.696
EV2	0.579	**0.816**	0.589	0.324	0.580	0.534	0.554	0.621
EV3	0.552	**0.797**	0.577	0.423	0.571	0.543	0.442	0.632
EV4	0.531	**0.750**	0.666	0.332	0.490	0.461	0.489	0.548
EY1	0.515	0.621	**0.743**	0.309	0.400	0.434	0.398	0.403
EY2	0.471	0.644	**0.850**	0.352	0.418	0.518	0.543	0.406
EY3	0.563	0.655	**0.847**	0.452	0.581	0.607	0.606	0.624
ITU1	0.430	0.437	0.422	**0.901**	0.422	0.415	0.317	0.516
ITU2	0.520	0.462	0.415	**0.906**	0.454	0.444	0.354	0.529
L1	0.608	0.695	0.554	0.474	**0.873**	0.562	0.533	0.687
L2	0.592	0.591	0.437	0.351	**0.840**	0.497	0.488	0.641
PEU1	0.493	0.531	0.455	0.307	0.558	**0.798**	0.635	0.603
PEU2	0.521	0.540	0.586	0.367	0.439	**0.849**	0.528	0.577
PEU3	0.432	0.503	0.479	0.464	0.461	**0.696**	0.499	0.420
PU1	0.455	0.577	0.582	0.325	0.554	0.576	**0.886**	0.509
PU2	0.471	0.545	0.547	0.394	0.532	0.699	**0.884**	0.549
PU3	0.545	0.583	0.598	0.280	0.516	0.625	**0.911**	0.577
S1	0.689	0.593	0.450	0.458	0.649	0.637	0.525	**0.875**
S3	0.671	0.731	0.548	0.497	0.752	0.657	0.547	**0.872**
S4	0.557	0.611	0.499	0.496	0.516	0.397	0.446	**0.743**

TABLE VI: HYPOTHESIS TESTING

Hypothesis	Relationship	Beta	SE	t-value	Decision
H1	Accessibility -> PEU	0.176	0.118	1.489*	Supported
H2	Accessibility -> PU	0.055	0.131	0.417	Not Supported
H3	Effectiveness -> PEU	0.169	0.150	1.125	Not Supported
H4	Effectiveness -> PU	0.114	0.140	0.814	Not Supported
H5	Efficiency -> PEU	0.285	0.131	2.179**	Supported
H6	Efficiency -> PU	0.371	0.134	2.762**	Supported
H7	Learnability -> PEU	0.204	0.128	1.590*	Supported
H8	Learnability -> PU	0.257	0.124	2.076**	Supported
H9	PEU -> SAT	0.513	0.128	4.011**	Supported
H10	PU -> SAT	0.247	0.126	1.961**	Supported
H11	SAT -> ITU	0.578	0.095	6.096**	Supported

**p<0.05, *p<0.1

The result expected as shown because most of the respondents are first time using the web site and they maybe think that it did not important for usefulness. For H3 and H4 that involve elements of effectiveness to perceived

usefulness and perceived ease of use. The respondents might be feeling that the web site was not effective in context of them. For next pilot test, the respondents must be the specific focus group and select the right instrument or questionnaire and case study. But satisfaction has proved that it will reflect to intention to use the website based on the study by [37] and [38] which is consistent with the findings of this study.

VIII. Conclusion

In conclusion, this paper has investigated the connection among the attributes for website usability. Most of the hypotheses are supported in this study. However, the attribute of effectiveness and the path between accessibility and perceived usefulness were not significant. Future research is needed to further explore these findings. This may be explained by assuming that the users feel that there are not relevant to them to use the website based on the answer in questionnaire. For the future study, there are a few considerations must take that are about focus group, the new and existing users, task that given for experimental and questionnaire. User satisfaction is also found to be significant in affecting user's intention to use. If the users feel more satisfied, they are willing to reuse and revisit the website again. The findings provided by the study may enable the creators of website to think seriously on these factors that will affect user satisfaction and behavioral intention to use in order to maximize the use to actual website.

References

[1] R. Ramli and A. Jaafar, "Design and Development of e-RUE as a Web-based Evaluation Tool," in *Proc. 2010 IEEE International Symposium in Information Technology (ITSim)*, vol. 3, pp. 1268-1273, 2010.

[2] Y. Lee and K. A. Kozar, "Understanding of website usability: Specifying and measuring constructs and their relationships," *Decis. Support Syst.*, vol. 52, no. 2, pp. 450–463, Jan. 2012.

[3] A. Fernandez, E. Insfran, and S. Abrahão, "Usability evaluation methods for the web: A systematic mapping study," *Inf. Softw. Technol.*, vol. 53, no. 8, pp. 789–817, Aug. 2011.

[4] S. K. Dubey, A. Rana, and Mridu, "Analytical comparison of usability measurement methods," vol. 39, no. 15, pp. 11–18, 2012.

[5] S. A. Becker and F. E. Mottay, "A global perspective on web site usability," *IEEE Software*, vol. 18, no. 1, pp. 54-61, 2001.

[6] J. R. Lewis and B. Raton, "Usability testing," 2006.

[7] N. Roberts and V. Grover, "Theory development in information systems research using structural equation modeling: Evaluation and recommendations," 2009.

[8] Z. Awang, *Structural Equation Modeling Using AMOS Graphic*，Uitm Press, 2012.

[9] M. Haenlein and A. M. Kaplan, "A beginner's guide to partial least squares analysis," *Underst. Stat.*, vol. 3, no. 4, pp. 283–297, Nov. 2004.

[10] L. V. Casaló and J. Cisneros, "An empirical test of the multiplicative effect of usability on consumer trust and satisfaction," in *Proc. 2008 19th Int. Conf. Database Expert Syst. Appl.*, Sep. 2008, pp. 439–443.

[11] D. X. Peng and F. Lai, "Using partial least squares in operations management research: A practical guideline and summary of past research," *J. Oper. Manag.*, vol. 30, no. 6, pp. 467–480, Sep. 2012.

[12] J. F. Hair, M. Sarstedt, C. M. Ringle, and J. A. Mena, "An assessment of the use of partial least squares structural equation modeling in marketing research," *J. Acad. Mark. Sci.*, vol. 40, no. 3, pp. 414–433, Jun. 2011.

[13] A. Madan and S. K. Dubey, "Usability evaluation methods: a literature review," vol. 4, no. 02, pp. 590–599, 2012.

[14] L. Leventhal and J. Barnes, *Usability Engineering Process, Products, and Examples*, Pearson Prentice Hall, 2008.

[15] M. De Marsico and S. Levialdi, "Evaluating web sites: exploiting user's expectations," *Int. J. Hum. Comput. Stud.*, vol. 60, no. 3, pp. 381–416, Mar. 2004.

[16] P. Booth, *An Introduction To Human-Computer Interaction*, Taylor & Francis, Inc, 1989.

[17] J. Rubin, *Handbook of Usability Testing: How to Plan, Design, and Conduct Effective Tests*, Wiley Technical Communications Library, 1994.

[18] J. Rubin and D. Chisnell, *Handbook of Usability Testing: Howto Plan, Design, and Conduct Effective Tests*, 2nd Edition, 2008, pp. 384.

[19] A. Abran, A. Khelifi, W. Suryn, and A. Seffah, "Usability Meanings and Interpretations in ISO Standards," *Softw. Qual. J.*, vol. 11, no. 4, pp. 325–338, 2003.

[20] S. U. Services, H. Court, and L. Wcv, "International Standards for HCI," no. May, pp. 1–15, 2006.

[21] P.-Y. Yen, "Health information technology usability evaluation: methods , models , and measures," Columbia University, 2010.

[22] A. Seffah, M. Donyaee, R. B. Kline, and H. K. Padda, "Usability measurement and metrics: A consolidated model," *Softw. Qual. J.*, vol. 14, no. 2, pp. 159–178, Jun. 2006.

[23] A. Hussain and E. Ferneley, "Usability Metric for Mobile Application: A Goal Question Metric (GQM) Approach," pp. 567–570, 2008.

[24] R. E. Al-qutaish, "Quality Models in Software Engineering Literature: An Analytical and Comparative Study," vol. 6, no. 3, pp. 166–175, 2010.

[25] A. Khalili, "User Interfaces for Semantic Content Authoring: A Systematic Literature Review," no. May, 2012.

[26] I.-F. Liu, M. C. Chen, Y. S. Sun, D. Wible, and C.-H. Kuo, "Extending the TAM model to explore the factors that affect Intention to Use an Online Learning Community," *Comput. Educ.*, vol. 54, no. 2, pp. 600–610, Feb. 2010.

[27] S. K. Dubey and A. Rana, "Analytical Roadmap to Usability Definitions and Decompositions," vol. 2, no. 9, pp. 4723–4729, 2010.

[28] J. Jeng, "Usability Assessment of Academic Digital Libraries□ : Effectiveness , Efficiency , Satisfaction , and Learnability," vol. 55, pp. 96–121, 2005.

[29] D. R. Tojib, L.-F. Sugianto, and S. Sendjaya, "User satisfaction with business-to-employee portals: conceptualization and scale development," *Eur. J. Inf. Syst.*, vol. 17, no. 6, pp. 649–667, Dec. 2008.

[30] M. Elsley, "Minor Thesis The Issue of Accessibility□ : Considerations when Designing for a Worldwide Audience," RMIT University, 2007.

[31] A. M. Nam and A. H. T. Nam, "Assessing The Usability Of University Websites: An Empirical," vol. 11, no. 3, pp. 61–69, 2012.

[32] J. Moore, "A case study of usability testing on an asynchronous e-Learning platform," *2009 Jt. Conf. Pervasive Comput.*, pp. 693–698, Dec. 2009.

[33] L. L. Broberg, "A Grounded Theory Approach To Examining Design And Usability Guidelines For Four-Year Tribal College Web Sites," Faculty Mentor and Chair Valerie Coxon , PhD , Committee Member Gerald Giraud , PhD , Committee Memb," Capella University, 2011.

[34] S. Poelmans, P. Wessa, K. Milis, E. Bloemen, and C. Doom, "Usability and acceptance of e-learning in statistics education, based on the compendium platform," in *Proc. International Conference of Education, Research and Innovation*, 2008, pp. 1-10.

[35] Y.-L. Theng and J. Sin, "Evaluating usability and efficaciousness of an e-learning system: A quantitative, model-driven approach," in *Proc. 2012 IEEE 12th Int. Conf. Adv. Learn. Technol.*, Jul. 2012, pp. 303–307.

[36] K. Milis, P. Wessa, S. Poelmans, C. Doom, and E. Bloemen, "The impact of gender on the acceptance of virtual learning environments," in *Proceedings of the international conference of education, research and innovation*, 2008.

[37] C.-M. Chiu, M.-H. Hsu, S.-Y. Sun, T.-C. Lin, and P.-C. Sun, "Usability, quality, value and e-learning continuance decisions," *Comput. Educ.*, vol. 45, no. 4, pp. 399–416, Dec. 2005.

[38] T. Ramayah, J. Wai, and C. Lee, "System Characteristics , Satisfaction And E-Learning Usage: A Structural Equation Model (SEM) 1," vol. 11, no. 2, pp. 26–28, 2012.

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