ACCEPTANCE ANALYSIS of HEALTH/MEDICAL INFORMATION WEB SITES

ABSTRACT

Various health/medical information web sites are becoming important sources for people to access health related information and services. In order to better serve users, it is meaningful to know what kind of online services/activities on these sites is critical for users to accept and use health/medial information web sites. To this end, this study extends the well-established technology acceptance model (TAM) to study the acceptance of health/medical information web sites by including a new formative construct. This formative construct consists of 10 major health related activities. The empirical study confirms the fitness of TAM in the acceptance study of online health/medical web sites and identifies the significance of included activities to users' final acceptance behavior.

Keywords

Health/medical information Web Sites, technology acceptance, formative measurements.

INTRODUCTION

Internet is now becoming an important source of health and medical information. Globally, more and more people access health and medical information web sites to learn knowledge and share their experiences and opinions. With the development of online information technologies, more and more online functions and tools are integrated into health/medical information web sites to support users' health related activities. The online health/medical information empowers users to make them more knowledgeable (McDaid and Park, 2010), so they are becoming more confident when they visit their doctors. However, many people are still reluctant to make use of and could not benefit from this important information source. In this research, we will analyze the acceptance issues from those who have been using online health/medical information. Hopefully, we can develop some recommendations to help those non-users to benefit from online health/medical information.

This paper first introduces the research background about online health/medical information and studies related to technology acceptance. Then, a research model and hypotheses will be proposed. Based on collected data, the proposed hypotheses will be tested to get meaningful research findings. Finally, this paper will be concluded with discussions and recommendations.

RESEARCH BACKGROUND

Technology acceptance is an important issue in the field of information systems. Since the first introduction of technology acceptance model (TAM) by Davis (1989), numerous research activities have been conducted about the acceptance of information technologies in different areas. Heijden (2003) studied the key factors affecting the usage of World Wide Web by extending Davis' basic model. Naturally, technology acceptance issue related to online health/medical information is gradually attracting people in this field. For example, Kim and Chang (2007) investigated the key functional features in the design of health information web sites.

Different from previous studies about the acceptance issue of health/medical web sites, this paper investigates the acceptance issue of online health/medical web sites from the perspective of applications. Specifically, this study will investigate which application has more significance on users' behaviors of usage. Considering the vast variety of applications used on online health/medical web sites, the study tries to include the important major applications used on health/medical related web sites. According to a research report conducted cross 12 countries about people's online health/medical information seeking behaviors, ten major health related activities of online users are as follows: 1) Information on medicine, 2) Self-diagnosis, 3) Other patients' experiences, 4) Information on hospitals/clinic, 5) Information on doctors, 6) Post a comment/question about a health condition, 7) Social networking sites (e.g.Facebook etc) for healthcare information, 8) Book an appointment with a doctor, 9) Buy prescription medicine, 10) Use Twitter to post/read about a healthcare matter (McDaid and Park, 2010). Based on these ten major activities, this research will investigate the acceptance issue to see the significance of each activity.

RESEARCH METHODOLOGY

Research Model

Different from general purpose web sites, health/medical information web sites are mainly for people to seek health related information and advices. The activities on health/medical web sites are for utilitarian purpose. Therefore, it is reasonable to use Davis' TAM as the base model in this analysis. The purpose of this study is to identify which specific activity/function is more significant than others to a user's final usage intention. In addition to the original constructs of perceived usefulness and

perceived ease of use, this study includes a new formative construct of perceived application usefulness, which consists of the usefulness of aforementioned 10 health-related activities. For convenience, this paper uses application usefulness to represent the perceived application usefulness. Please check appendix A for the proposed research model.

Hypotheses

Aforementioned, the including of 10 formative factors in the model creates a new formative construct. It is named as (perceived) application usefulness. First in this research, we need to make sure that the application usefulness is the source of users' perceived usefulness. This is the foundation of the later analysis. To confirm the 10 activities are the positive sources of perceived usefulness. The first hypothesis is:

H1a: Application usefulness has a significant positive effect on the perceived usefulness of the online health/medical information web sites.

Aligned with the classical definition of TAM, the other thee hypotheses are:

H1b: Perceived usefulness has a significant positive effect on the continued usage intention of the online health/medical information web sites.

H2: Perceived ease of use has a significant positive effect on the continued usage intention of the online health/medical information web sites.

H3: Perceived ease of use has a significant positive effect on the perceived usefulness of online health/medical information web sites.

Instrument Development

There are two parts in the questionnaire. See appendix B. The first part collects users' demographic information, including age, gender, and experience of using health/medical information web sites. In the second part, a group of questions are used to collect users' perceived usefulness, perceived ease of use, and continued usage intention. As mentioned above, the perceived usefulness includes 10 items measuring perceived usefulness from specific applications, and 3 items measuring the general perceived usefulness of health/medical information web sites. The items measuring the perceived ease of use and the continued usage intention are adapted from a proved research of Kim, Choi and Han (2009).

Sample

To validate the proposed hypotheses, the survey questionnaire was distributed to campuses through university email/announcement systems. This survey is voluntarily and anonymously. The participants include university faculty, staff and students. Therefore, only those who are interested in this topic filled this online survey. Since the goal of this research is to investigate the continued usage intention, 8 responses from non-experienced users (i.e., those who had never used online health/medical web sites) are excluded in the final data analysis. Two missing values in the responses are replaced with "-1" according to the instruction of smart PLS. Finally, there are 125 valid responses used for analysis. The average age of participants is 43.4 (STDEV=14.1) years old. The participants' ages range between 18-77 years old. Of all respondents, 82 of them (65.6%) are female, and the rest 43 respondents (34.4%) are male. The participants' usage distribution of online health/medical information web sites is: Rarely, 19; Sometimes, 55; Often, 28; and Frequently, 23.

DATA ANALYSIS

SmartPLS 2.0 (M3) Beta (www.smartpls.de) is used in the data analysis. This research uses 10 formative measures in the model. According to Barclay, Thompson, and Higgins (1995), the minimum sample size in PLS is at least 10 times of the number of formative indicators or antecedent constructs (i.e., predictors) of the most complex construct. In the proposed model, the most complex construct is application usefulness, which consists of 10 formative measures. Therefore, the minimum sample size is 100. In this study, 125 valid responses satisfy the sample size requirement of PLS.

Please check the Table 1 for the descriptive statistics of the constructs.

Construct	Number of Items	Mean	Standard Deviation
Application Usefulness	10	5.03	1.08
Perceived Usefulness	3	4.88	1.21
Perceived Ease of Use	4	5.55	1.30

Continued Usage Intention	3	5.30	1.33

Table 1. Descriptive Statistics Of Constructs

Measurement Model Results

In this model, the application usefulness is a formative construct. The first thing needs to do is to verify if this formative construct can cover all the perceptions of perceived usefulness. As suggested by Chin (2010), a redundancy analysis is necessary for this verification. Also, the multicollinearity analysis will be conducted for formative indicators.

- Redundancy Model for Usefulness

As indicated in Figure 1, the path coefficient between application usefulness and perceived usefulness is 0.842** (T = 27.259). The T values were calculated using bootstrapping (Sign Changes = Individual changes**;** cases = 125; sample = 1000). This path coefficient is above the expected value (i.e., 0.8, as suggested by Chin (2010)). This means that there exists a "strong convergence and implies an adequate coverage of the perceptions in the formative set" (Chin, 2010, p683). In other words, the usefulness from these 10 activities covers the major sources of users' perceptions of usefulness. Further, we can see that PAU1, PAU 2, PAU 6 and PAU8 are significant at the significance level of 95% or 99%. This result indicates that these four activities are the most significant applications regarding to the usage of health/medical information web sites. The values near lines from PAU1-PAU10 to application usefulness are component weights for the formative construct. According to the weight values, these four significant activities can be ranked from high to low as: PAU1 (weight: 0.492; T: 4.624), PAU8 (weight: 0.235; T: 2.733), PAU6 (weight: 0.212; T: 2.238) and PAU2 (weight: 0.207; T: 2.157), i.e., Information on medicine, Booking an appointment with a doctor, Posting a comment/question about a health condition, and Self-diagnosis.

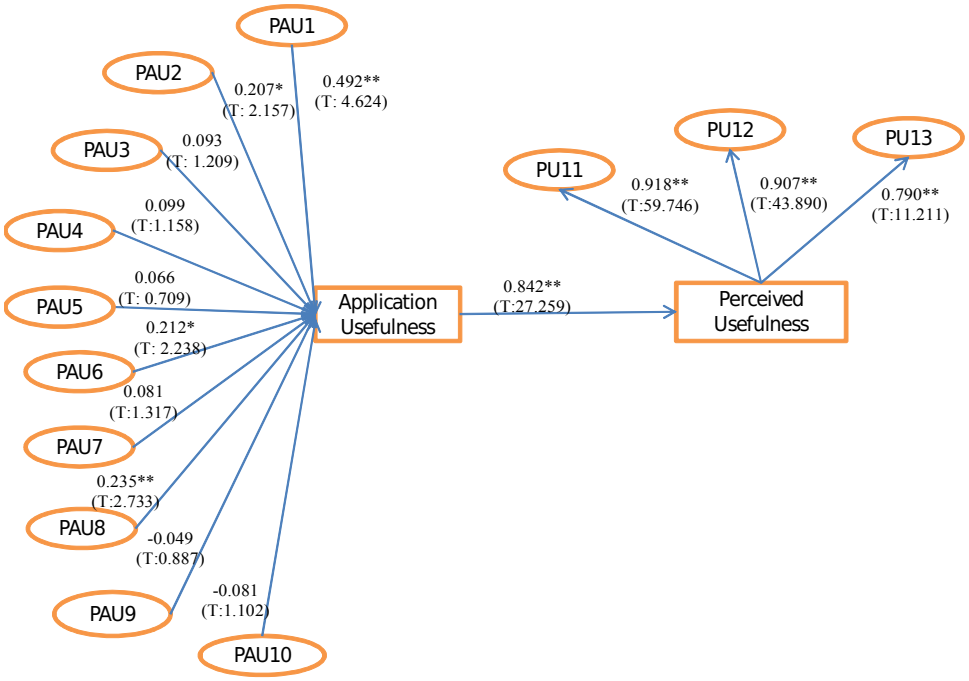

Figure 1. Redundancy model for Usefulness (*p < 0.05; ** p < 0.01)

- Multicollinearity Analysis of Formative Indicators

Multicollinearity analysis is expected for formative constructs. In this study, variance inflation factor (VIF) values are calculated for the 10 formative indictors of application usefulness. As indicated in Table 2, all VIF values are between 1 and 3. As suggested by Hair, Black, Babin, Anderson and Tatham (2006), the commonly acceptable threshold of VIF is 10. Another commonly referred cutoff value of VIF is 3.33 (Diamantopoulos and Siguaw, 2006). Therefore, the VIF values in this study are all acceptable.

Indicators	PU1	PU2	PU3	PU4	PU5	PU6	PU7	PU8	PU9	PU 10
Multicollinearity	2.003	1.647	2.348	2.992	2.535	2.168	1.93	1.791	1.491	1.907

Table 2. Multicollinearity Analysis of Formative Indicators

- Discriminant Validity of Reflective Measures

The discriminant validity of reflective measures is demonstrated in Table 3. As indicated in this table, the AVE (average variance extracted) is at least 0.76, and they are much higher than listed squared correlations. According to Chin (1998), the AVE of each construct should be much larger than the squared correlation of the specific construct with any of the other constructs in the model. Also, the AVE value should be at least .50 (Fornell and Larcker, 1981). Therefore, the constructs in this study are closely related to their own measures, but not other constructs. The composite reliability is a measure of internal consistency of all indicators on one construct. In this study, all composite reliability values are all above 0.9, which is well above the acceptable level of 0.70 (Nunnally, 1978). Therefore, all indicators of constructs are internal consistent.

Composite Reliability	AVE		Continued Use	Perceived Ease of Use	Perceived Usefulness
0.91	0.76	Continued Usage Intention	1		
0.98	0.93	Perceived Ease of Use	0.30	1	
0.91	0.76	Perceived Usefulness	0.56	0.28	1

Table 3. Squared Inter-construct Correlations and Reliability Measures (Reflective measures)

Another way to check the discriminant validity from the indicator level is to see how each measure relates to its own construct (Chin, 2010). As indicated in Table 4, all item loadings are higher than cross loadings, and all item loadings are well greater than the 0.707, which is suggested by Chin (1998). Therefore, the items are more closely related to their own constructs than to other constructs.

	Continued Usage Intention	**Perceived Ease of Use**	**Perceived Usefulness**
CUI1	**0.94892**	0.607732	0.743836
CUI2	**0.795768**	0.326292	0.572084
CUI3	**0.867317**	0.473004	0.631268
PAU11	0.50473	0.305344	**0.787904**
PAU12	0.653675	0.503963	**0.906559**
PAU13	0.768902	0.538044	**0.920156**
PEU1	0.560396	**0.968273**	0.518495
PEU2	0.548508	**0.971464**	0.529427
PEU3	0.473918	**0.935231**	0.468208
PEU4	0.533584	**0.975268**	0.514504

Table 4. Loadings and cross-loadings for the measurement model

(Reflective Measures)

- Outer Model Weights and Loadings

In this study, there are 10 formative measures used for the measurement of (perceived) application usefulness. Researchers need to consider the weighs, not the loadings, for formative measures evaluation. Table 5 summarizes the weights for formative measures and loadings for reflective measures. According to the weight values of 10 formative indicators, the four significant activities can be ranked from high to low as: PAU1, PAU8, PAU2 and PAU6. Here, PAU 2 and PAU 6 are of the same weight. This rank result is different from that in the redundancy analysis. As indicated by Chin (2010), the weights may differ for a given construct when its context changes. Now, the rank from high to low is: Information on medicine, Booking an appointment with a doctor, Self-diagnosis, and Posting a comment/question about a health condition.

	Weight	T Value	Loading	T Value
CUI1			0.95	120.56**
CUI2			0.80	13.98**
CUI3			0.87	24.46**
PAU1	0.49	4.67**		
PAU2	0.21	2.19*		
PAU3	0.09	1.24		
PAU4	0.10	1.16		
PAU5	0.07	0.71		
PAU6	0.21	2.3*		
PAU7	0.08	1.35		
PAU8	0.23	2.84**		
PAU9	-0.05	0.86		
PAU10	-0.08	1.14		
PAU11			0.79	11.31**
PAU12			0.91	41.67**
PAU13			0.92	64.86**
PEU1			0.97	109.2**
PEU2			0.97	147.73**
PEU3			0.94	44.4**
PEU4			0.98	135.28**

Table 5. Outer Model Weights and Loadings (T-Values: *p < 0.05; **p<0.01)

Structural Model Results

Next step is to check whether or not the proposed model is supported in this study. Figure 4 and Table 6 list path coefficients and corresponding T Values. T values were calculated using bootstrapping (Sign Changes=Individual changes**;** cases = 125; sample=1000). The path coefficient between the application usefulness and perceived usefulness is 0.78 (T: 16.72). This result supports the hypothesis H1a. Together with the value of R^2 (0.721) of perceived usefulness, we can conclude that users' overall perception of usefulness is mainly from the perceived usefulness of included major applications on the health/medical information web sites. The coefficient value between perceived usefulness and continued usage intention is 0.64 (T=8.57); the coefficient value between perceived ease of use and continued usage intention is 0.22 (T=2.38); the coefficient value between the perceived ease of use and the perceived usefulness is 0.12 (T=2.18). Therefore, the study results support H1b, H2, and H3.

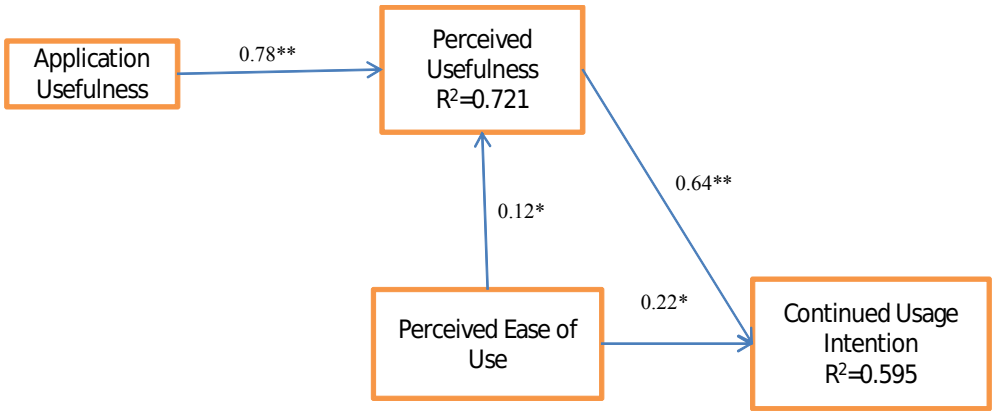

Figure 4. The Structural Model (*p < 0.05; **p<0.01)

	Perceived Usefulness	Continued Use
Application Usefulness	0.78** (T:16.72)	
Perceived Ease of Use	0.12* (T: 2.18)	0.22* (T:2.38)
Perceived Usefulness		0.64** (T:8.57)

Table 6. Path Coefficients (T-Value) (*p < 0.05; **p<0.01)

As indicated at the beginning of this paper, health/medical information sites are for utilitarian applications. The test results of this study re-confirm this affirmation. Based on the path coefficient values, we can clearly realize that the perceived usefulness play about three times more important role than the perceived ease of use in users' continued usage intention. However, the perceived ease of use is still an important factor affecting uses' usage intention of health/medical site. This result is different from the findings from Kim and Chang (2007), which concluded that the perceived ease of use is not significant in affecting a user's continued usage intention towards health/medical web sites. Therefore, a user friendly interface design is still a very important issue in developing health/medical web sites. The findings from this study about the different significance of various activities/functions can help to better design a user interface by arranging applications/functions based on the significance ranking. A friendly interface design can increase users' perceptions of ease of use and finally increases a user's continued usage intention.

The R^2 is an indicator of the model's predictive power. In this study, the R^2 of continued usage intention is 0.595. In a similar research about the acceptance of general information portals, the R^2 value of "intention to use" is 0.447 (van der Heijden, 2003). Therefore, the R^2 value in this study is satisfactory. This R^2 value (0.595) reflects the fact that the continued usage intention of health/medical web sites is mainly determined by the perceived usefulness and the perceived ease of use. This result re-confirms that Davis' TAM is an appropriate base model for the acceptance analysis of health/medical information web sites. Table 6 presents the information of effect sizes on endogenous constructs, which are perceived usefulness and continued usage intention.

The effect size can tell the influence strength of an independent construct on a dependent construct (Chin, 2010). Table 7 includes the corresponding effect sizes on perceived usefulness and continued usage intention from their own independent constructs. According to suggested values: 0.02, small; 0.15, medium; 0.35, large (Chin, 2010; Cohen, 1977), the application usefulness has a large effect on the perceived usefulness, and the perceived ease of use has a small effect on the perceived usefulness at the structural level. The perceived usefulness has a large effect on the continued usage intention, and the perceived ease of use has a small effect on the continued usage intention. This result is consistent with the findings from path

coefficients. The perceived usefulness plays a very important role in determining one user's continued usage intention. The perceived ease of use has a very small impact on a user's continued usage intention compared with the perceived usefulness.

Depedent Varibles		Independent Varibles	
PU	R^2 included =0.721	AU	PEU
	R^2 excluded	0.28	0.71
	f^2	1.58	0.04
	Effect	large	small
CUI	R^2 included =0.595	PU	PEU
	R^2 excluded	0.32	0.56
	f^2	0.69	0.09
	Effect	large	small

Table 7. Effect Sizes on Endogenous Constructs

IMPLICATIONS AND FUTURE RESEARCH

The objective of this research is to analyze the users' acceptance of health/medical information web sites by applying Davis' technology acceptance model. The result can be used in doing comparison analysis with other similar research findings about the acceptance of health/medical information web sites. By introducing formative measurements, this research investigates a meaningful application of formative measurements in the technology acceptance analysis. The findings from this analysis will help practitioners in the health/medical web design by appropriately arranging the significant activities/functions on web pages in order to encourage users' continued usage intention. Also, operators and developers can utilize the research findings in their promotion efforts to attract more users to their web sites. In future research, more investigations will be conducted in other countries/regions to find out the difference in users' usage intention of the health/medical information web sites from the perspective of applications.

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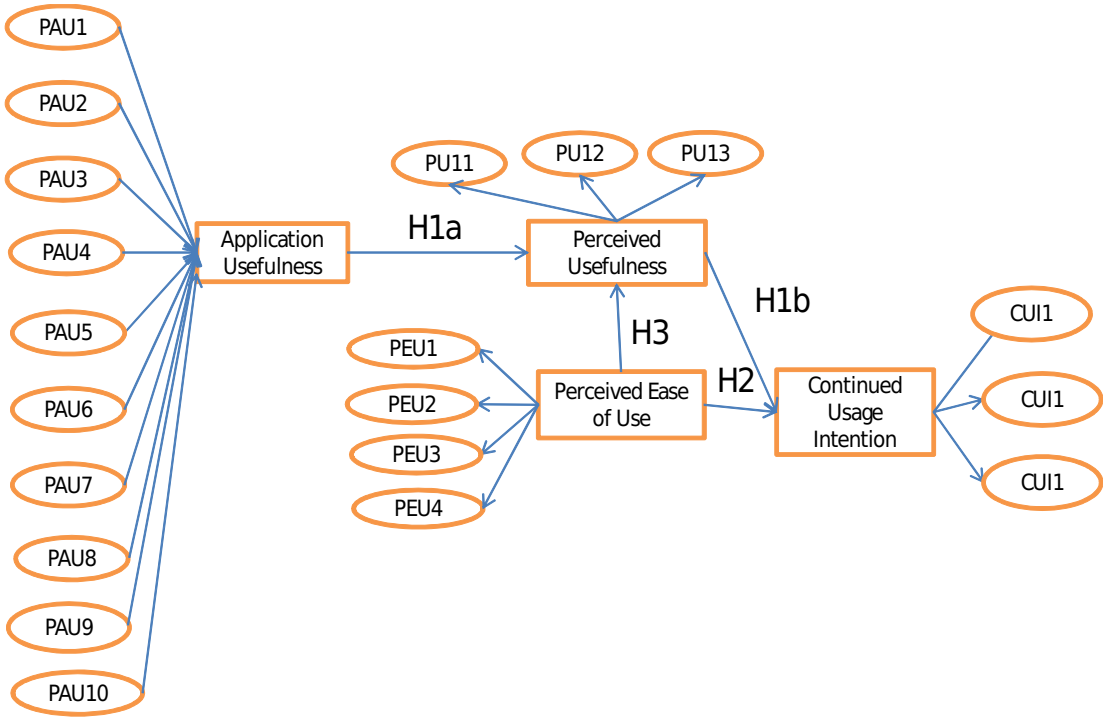
APPENDIX A: Research Model



APPENDIX B: Questionnaire Items

Part A: Demographic Information

Gender: Male Female

Age (>=18): _____

Experience of Using Medical/Health Information Websites:

1	**2**	**3**	**4**	**5**
Never	Rarely	Sometimes	Often	Frequently

Part B: List of model construction and items for users

Perceived usefulness of medical/health information websites to support healthcare

PAU1: Information on medicine on medical/health information websites is useful.

PAU2: Self-diagnosis through medical/health information websites is useful.

PAU3: Other patients' experiences on medical/health information websites are useful.

PAU4: Information on hospitals/clinics from medical/health information websites is useful.

PAU5: Information on doctors from medical/health information websites is useful.

PAU6: Posting a comment/question about a health condition on medical/health information websites is

PAU7: Social networking sites (e.g.Facebook etc) for healthcare information on medical/health information websites are useful.

PAU8: Booking an appointment with a doctor through medical/health information websites is useful.

PAU9: Buying prescription medicine from medical/health information websites is useful.

PAU10: Using Twitter to post/read about a healthcare matter through medical/health information websites is useful.

PAU11: Medical/health information websites offer many useful applications.

PAU12: Medical/health information websites enable me to conduct various medical/health related activities more effectively.

PAU13: Overall, medical/health information websites are useful.

Perceived ease of use of medical/health information websites

PEU1: Learning how to use medical/health information websites is easy for me.

PEU2: It is easy for me to become skillful at using medical/health information websites.

PEU3: My interaction with medical/health information websites is clear.

PEU4: Overall, using medical/health information websites is easy for me.

Continued use intention of medical/health information websites

CUI1: I intend to continue my use of medical/health information websites in the future.

CUI2: I intend to increase my use of medical/health information websites in the future.

CUI3: I would keep using medical/health information websites as regularly as I do now.

Comments about using medical/health information websites:

*** Measured using a 7-point, Likert-type scale, ranging from 1 (strongly disagree) to 7 (strongly agree).**